

**Italy / by K. Mason.**

**Contributors**

Great Britain. Naval Intelligence Division.  
Mason, Kenneth, 1887-

**Publication/Creation**

[Oxford?] : Naval Intelligence Division, 1944-1945.

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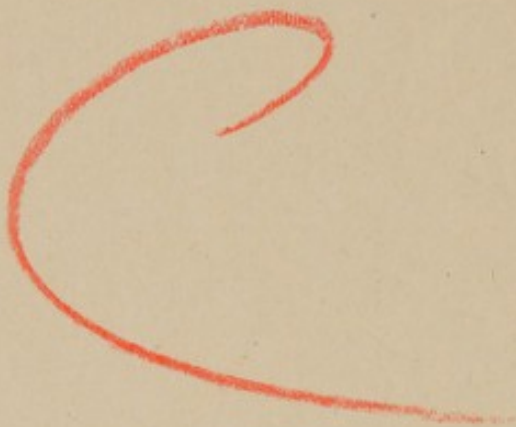
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# ITALY

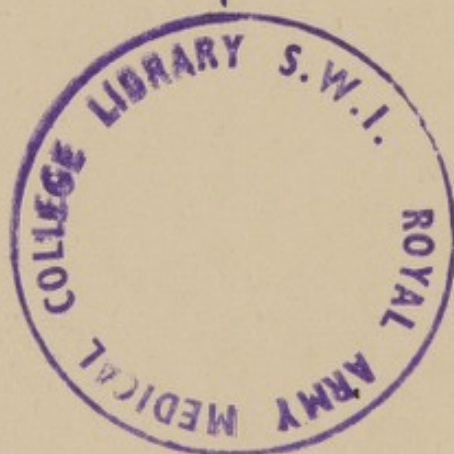
VOLUME I

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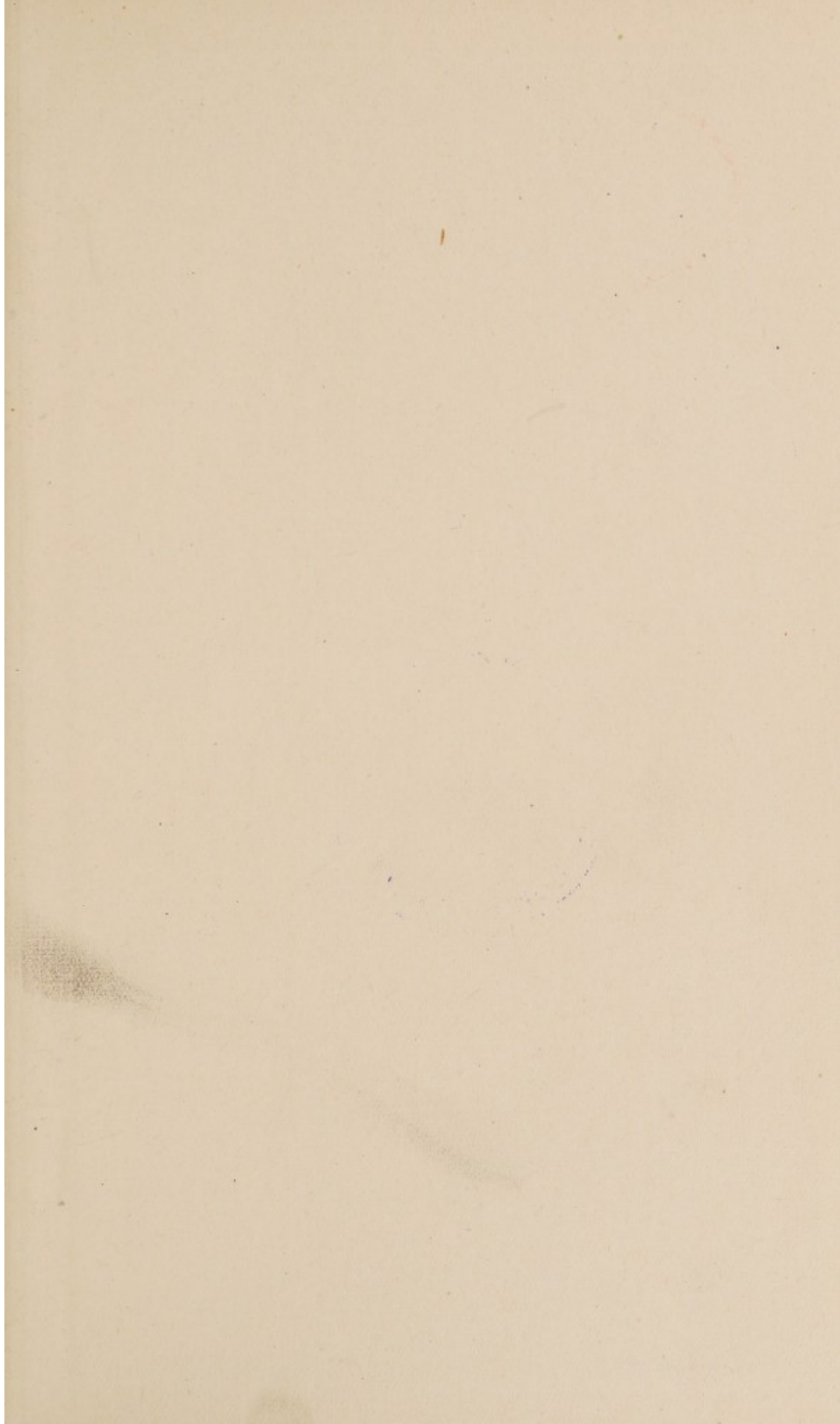


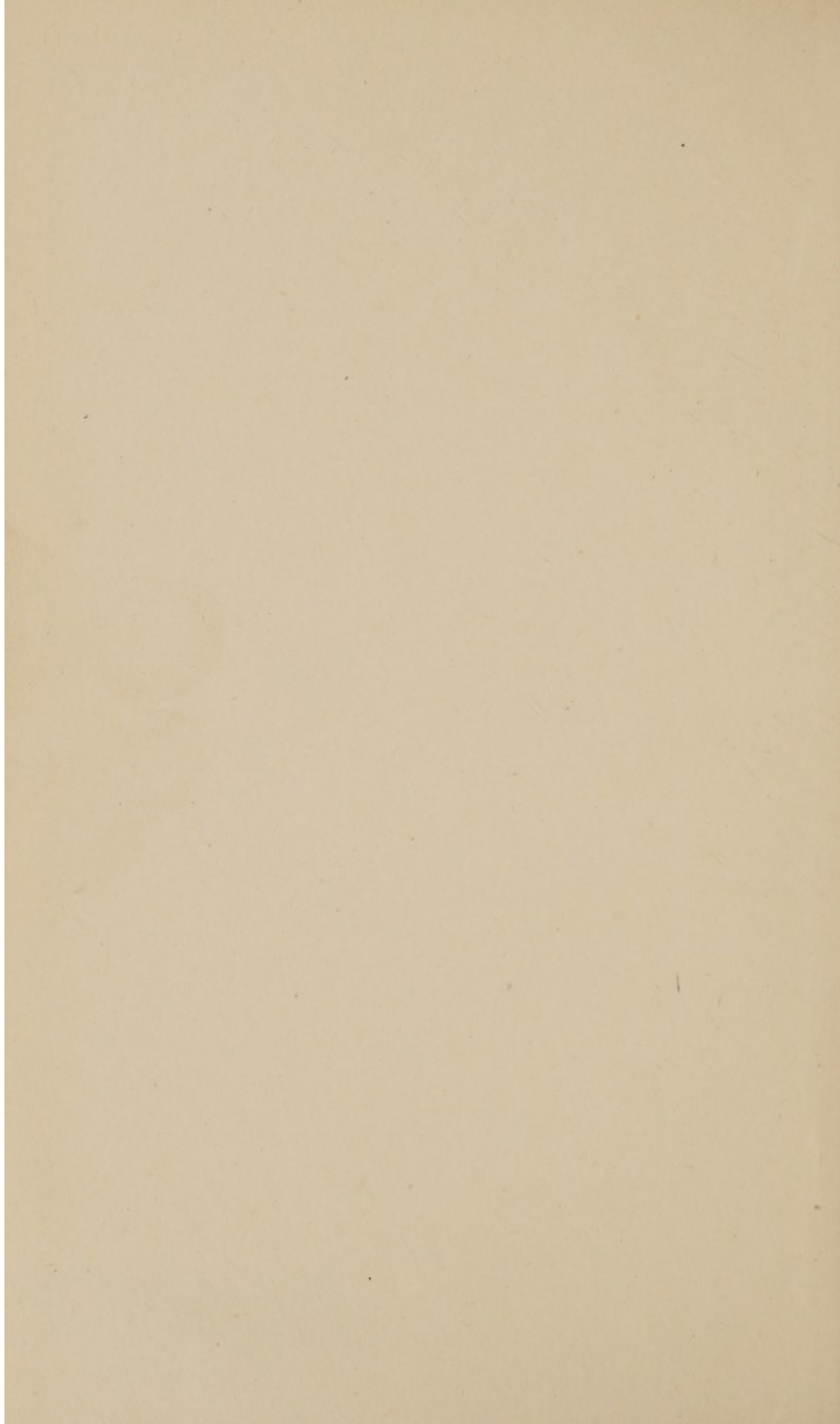


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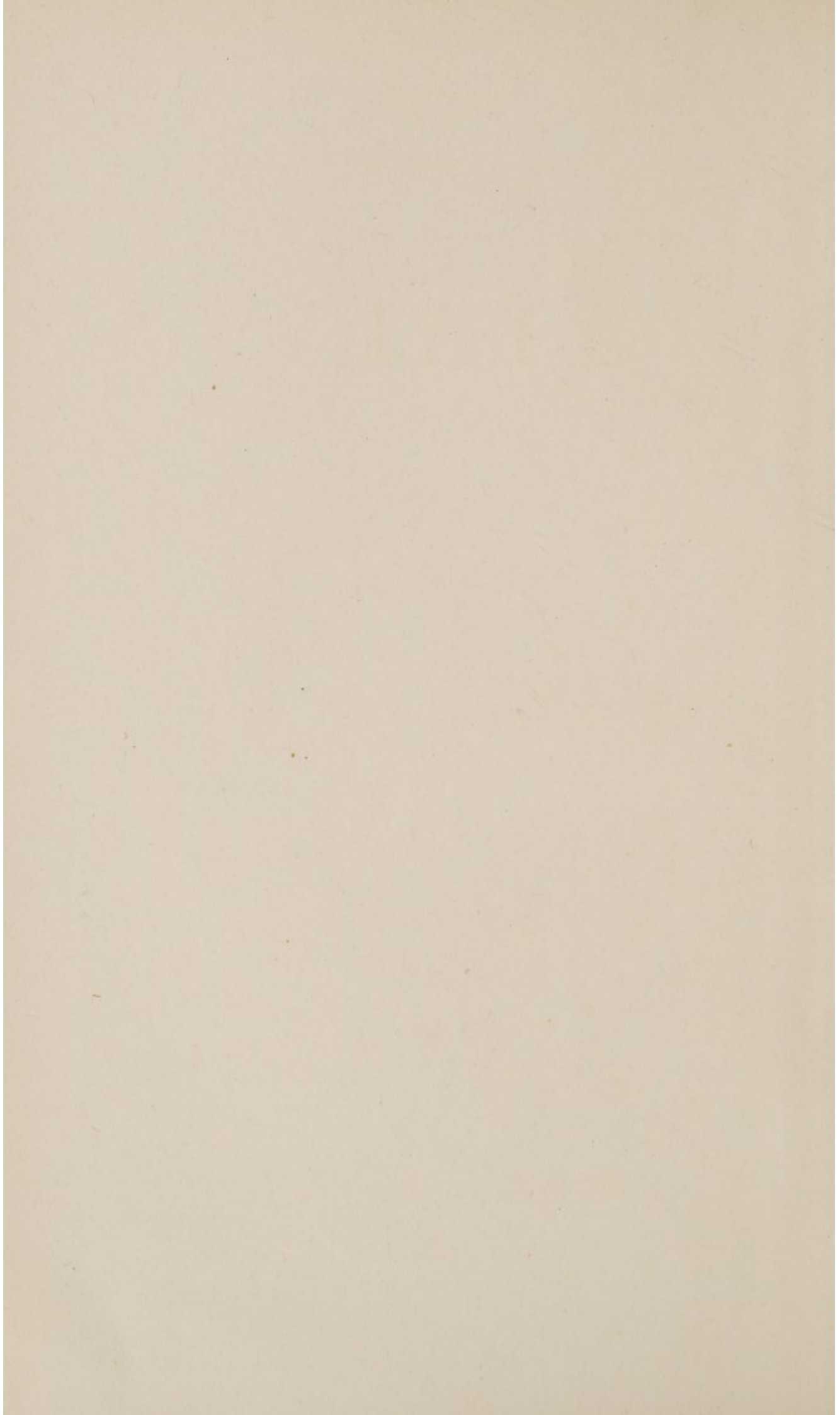


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GEOGRAPHICAL HANDBOOK SERIES

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# ITALY

VOLUME I

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FEBRUARY 1944

NAVAL INTELLIGENCE DIVISION



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## PREFACE

**I**N 1915 a Geographical Section was formed in the Naval Intelligence Division of the Admiralty to write Geographical Handbooks on various parts of the world. The purpose of these handbooks was to supply, by scientific research and skilled arrangement, material for the discussion of naval, military, and political problems, as distinct from the examination of the problems themselves. Many distinguished collaborators assisted in their production, and by the end of 1918 upwards of fifty volumes had been produced in Handbook and Manual form, as well as numerous short-term geographical reports. The demand for these books increased rapidly with each new issue, and they acquired a high reputation for accuracy and impartiality. They are now to be found in Service Establishments and Embassies throughout the world, and in the early years after the last war were much used by the League of Nations.

The old Handbooks have been extensively used in the present war, and experience has disclosed both their value and their limitations. On the one hand they have proved, beyond all question, how greatly the work of the fighting services and of Government Departments is facilitated if countries of strategic or political importance are covered by handbooks which deal, in a convenient and easily digested form, with their geography, ethnology, administration, and resources. On the other hand it has become apparent that something more is required to meet present-day requirements. The old series does not cover many of the countries closely affected by the present war (e.g. Germany, France, Poland, Spain, Portugal, to name only a few); its books are somewhat uneven in quality, and they are inadequately equipped with maps, diagrams, and photographic illustrations.

The present series of Handbooks, while owing its inspiration largely to the former series, is in no sense an attempt to revise or re-edit that series. It is an entirely new set of books, produced in the Naval Intelligence Division by trained geographers drawn largely from the Universities, and working at sub-centres established at Oxford and Cambridge, and is printed by the Oxford and Cambridge University Presses. The books follow, in general, a uniform scheme, though minor modifications will be found in particular cases; and they are illustrated by numerous maps and photographs.



The purpose of the books is primarily naval. They are designed first to provide, for the use of Commanding Officers, information in a comprehensive and convenient form about countries which they may be called upon to visit, not only in war but in peace-time; secondly, to maintain the high standard of education in the Navy and, by supplying officers with material for lectures to naval personnel ashore and afloat, to ensure for all ranks that visits to a new country shall be both interesting and profitable.

Their contents are, however, by no means confined to matters of purely naval interest. For many purposes (e.g. history, administration, resources, communications, &c.) countries must necessarily be treated as a whole, and no attempt is made to limit their treatment exclusively to coastal zones. It is hoped therefore that the Army, the Royal Air Force, and other Government Departments (many of whom have given great assistance in the production of the series) will find these handbooks even more valuable than their predecessors proved to be both during and after the last war.

J. H. GODFREY

*Director of Naval Intelligence*

1942

The foregoing preface has appeared from the beginning of this series of Geographical Handbooks. It describes so effectively their origin and purpose that I have decided to retain it in its original form.

This volume has been prepared by the Oxford sub-centre of the Naval Intelligence Division under the direction of Lieut.-Colonel K. Mason, M.C., M.A., R.E., Professor of Geography in the University of Oxford, and is the work of a number of contributors, whose names are given in Appendix IX, page 561.

E. G. N. RUSHBROOKE

*Director of Naval Intelligence*

FEBRUARY 1944



# CONTENTS

	PAGE
I. INTRODUCTION . . . . .	1
Position and Extent (1)—Sea Frontiers (3)—Land Frontiers (5) —General Features (9)—Regions (11)—Pronunciation of Italian (13)—Place-names (15)—Textual References (19).	
II. GENERAL PHYSICAL AND GEOLOGICAL DESCRIPTION . . . . .	19
GENERAL TOPOGRAPHY (19)—GEOLOGY (23)—LANDFORM TYPES (32)—LAKES (41)—RIVERS (44)—Drainage Pattern (44)—River Regimes (46)—GLACIERS (52).	
III. THE COASTS . . . . .	55
INTRODUCTION (55)—LIGURIA AND THE LIGURIAN COAST (57)— RIVIERA DI PONENTE (57)—French Frontier to Albenga (57)— Albenga to Savona (60)—Savona to Genoa (62)—RIVIERA DI LEVANTE (65)—Genoa to the Mouth of the F. Magra (65)— PRE-APENNINES (73)—The Mouth of the F. Magra to Cosa e Ansedonia (73)—Cosa e Ansedonia to Terracina (77)—CAM- PANIA (85)—Terracina to Torre Gaveta (85)—Torre Gaveta to Castellammare di Stabia (89)—Castellammare di Stabia to Salerno and Agropoli (91)—LUCANIA (97)—Agropoli to Sapri (97)—Sapri to Diamante (101)—WEST COAST OF CALABRIA (103) —Diamante to Cape Suvero (105)—Cape Suvero to Point Pellarò (106)—SOUTH AND SOUTH-EAST COAST OF CALABRIA (112) —Point Pellarò to Cape Colonne (112)—GULF OF TARANTO (119)—Cape Colonne to Taranto (120)—Taranto to Cape S. Maria di Leuca (123)—APULIA (127)—Cape S. Maria di Leuca to Barletta (128)—Barletta to Torre Mileto (131)— ADRIATIC COAST (136)—Torre Mileto to Rimini (136)—THE NORTHERN PLAIN (141)—Rimini to Sbocco del Timavo (141)— ISTRIA (149)—Sbocco del Timavo to Point Salvore (149)—Point Salvore to Cape Promontore (151)—Cape Promontore to Fiume (153)—SICILY: WEST COAST (157)—Cape S. Vito to Cape Granitola (157); SOUTH COAST (159)—Cape Granitola to Licata (161)—Licata to Cape Passero (163); NORTH COAST (168)— Cape S. Vito to Cape Zaffarano (168)—Cape Zaffarano to Cape Peloro (170); EAST COAST (176)—Cape Peloro to Cape Schiso (177)—Cape Schiso to Agnone (178)—Agnone to Cape Passero (180).	
IV. REGIONAL TOPOGRAPHY . . . . .	187
THE ALPS (187)—Structural and Physical Features (187)— Vegetation (188)—Settlements (189)—Communications (191)— THE WESTERN ALPS (193)—Introduction (193)—The Maritime Alps (194)—The Cottian Alps (195)—The Graian Alps (198)— The Pennine Alps (202)—THE CENTRAL ALPS (204)—Introduc- tion (204)—The Lombardy Alps (206)—The Judicarian Alps (211)—The Rhaetian Alps (214)—The High Tirol (216)—The Great Valleys (218)—THE EASTERN ALPS (225)—Introduction (225)—The Venetian Alps (226)—The Cima d'Asta and Bol- zano Plateaux (230)—The Dolomites (232)—The Piave Valley	



(235)—The Carnic Alps (237)—The Julian Alps (239)—ISTRIA (241)—Introduction (241)—Istria Rossa (245)—Istria Grigia (246)—Istria Bianca (247)—The Vipacco-Timavo Depression (248)—The Istrian Alps (249)—THE NORTHERN PLAIN (250)—Introduction (250)—Piedmont (257)—Lombardy (260)—Venetia (262)—Emilia (265)—THE PRE-APENNINES (266)—Introduction (266)—The Apuan Alps (269)—The Lower Arno Region (270)—The Tuscan Upland (274)—The North Latin Hills (277)—The Roman Campagna (278)—The Alban Hills (280)—The Pontine Marshes (281)—The Middle Arno Valley (282)—The Tiber Valley (285)—CAMPANIA (286)—Introduction (286)—The Lepini Mountains (289)—Roccamonfina, M. Maggiore, and M. Massico (290)—The Latin Valley (292)—The Plain of Campania (293)—The Sorrentine Peninsula (298)—The Sele Basin (299)—THE APENNINES (300)—Introduction (300)—THE NORTHERN APENNINES (301)—Introduction (301)—The Ligurian Apennines (304)—The Etruscan Apennines (306)—THE CENTRAL APENNINES (310)—Introduction (310)—The Roman Apennines (314)—Umbria (318)—Sabina and the Aquila Plateau (321)—The Abruzzi Apennines (325)—Meta and Matese (326)—Molise (327)—THE SOUTHERN APENNINES (328)—Introduction (328)—The Avella-Taburno Highlands (332)—The Benevento Basin (333)—The Avellino Basin (334)—The Monti Picentini (334)—The Marzano Plateau (335)—The Cilento (335)—The Vallo di Diano (336)—The North Lucanian Apennines (337)—The Upper Agri Basin (337)—The South Lucanian Apennines (338)—The Neapolitan Apennines (340)—M. Vulture (340)—The East Lucanian Apennines (341)—CALABRIA (342)—Introduction (342)—The Catena Costiera of Paola (347)—The Crati Valley (349)—The Sila (352)—The Catanzaro Trough (353)—The Serre (356)—The Monte Poro Plateau (357)—The Mesima-Gioia Trough (358)—The Aspromonte (359)—The East Coast Tertiary Margin (361)—THE APULIAN REGION (364)—Introduction (364)—The Taranto-Tavoliere Corridor (367)—The Salentine Peninsula (371)—The Murge (374)—The Tavoliere di Puglia (380)—The Gargano Promontory (383)—THE ADRIATIC COASTLAND (385)—SICILY (389)—Introduction (389)—Western Sicily (394)—The Northern Highland (397)—South Central Sicily (399)—South-eastern Sicily (401).

## V. CLIMATE . . . . . 406

GENERAL (406)—Introduction (406)—Pressure (409)—Surface Winds (411)—Upper Winds (416)—Rough Sea and Swell (417)—Temperature (417)—Humidity (422)—Rainfall (423)—Snow (426)—Visibility (430)—Cloud (431)—Thunder and Hail (432)—REGIONAL (432)—Continental Italy (432)—The Peninsula (435)—The Islands (437).

## VI. VEGETATION AND ANIMAL LIFE . . . . . 440

VEGETATION (440)—Flora and Vegetation (440)—Forest Communities (445)—Cultivated Woody Plants (451)—Brushwoods (454)—Heaths (456)—Communities of Herbs and Low Shrubs

(457)—Marshlands and Aquatic Vegetation (458)—Coastal Communities (459)—Introduced Plants (461)—Cover and Penetrability of Chief Woody Communities (462)—Index of Plants (463)—ANIMAL LIFE (467).

## APPENDIXES

I. VOLCANIC ACTIVITY . . . . .	471
II. EARTHQUAKES . . . . .	478
III. 'BADLANDS' . . . . .	489
IV. LANDSLIPS . . . . .	491
V. LAKES . . . . .	496
VI. RIVERS . . . . .	503
VII. CLIMATIC STATISTICS . . . . .	513
Table 1. Frequency of Wind Direction.	
„ 2. Number of Days with Moderate and Rough Sea.	
„ 3. Temperature.	
„ 4. Number of Days with Frost.	
„ 5. Relative Humidity.	
„ 6. Precipitation.	
„ 7. Number of Rain-days.	
„ 8. Number of Days with Snowfall.	
„ 9. Number of Days with Visibility less than $\frac{1}{2}$ mile and 2 nautical miles in each Season.	
„ 10. Number of Days with Fog.	
„ 11. Number of Days with Fog per Season.	
„ 12. Duration of Sunshine.	
„ 13. Cloud Amount.	
„ 14. Number of Days with Thunder.	
„ 15. Number of Days with Hail.	
VIII. CONVERSION TABLES: METRIC AND BRITISH UNITS . . . . .	543
IX. BIBLIOGRAPHY, MAPS, AND AUTHORSHIP . . . . .	558
INDEX . . . . .	562



# LIST OF PLATES

	<i>Facing page</i>
1. Ospedaletti . . . . .	64
2. Hill-slopes east of S. Remo . . . . .	64
3. Alassio . . . . .	65
4. The Via Aurelia at Albisola . . . . .	65
5. Portofino . . . . .	70
6. The Gulf of Rapallo and the Promontorio di Portofino . . . . .	70
7. Levanto . . . . .	71
8. Portovenere . . . . .	71
9. Castiglione: coastal pinewoods . . . . .	74
10. Torre S. Liberata . . . . .	74
11. The Laguna di Orbetello . . . . .	75
12. Lido di Roma . . . . .	75
13. Anzio . . . . .	80
14. The Mussolini Canal . . . . .	80
15. M. Circeo and the Pontine Marshes . . . . .	81
16. Lake Miseno and Porto di Miseno . . . . .	81
17. Cape Miseno . . . . .	84
18. The Island of Nisida . . . . .	84
19. Castellammare di Stabia . . . . .	85
20. Sorrento . . . . .	85
21. The Sorrentine Peninsula near Ravello . . . . .	92
22. Amalfi . . . . .	92
23. Vietri Marina . . . . .	93
24. Isola di Dino . . . . .	93
25. Scilla Castle . . . . .	108
26. Scilla . . . . .	108
27. The coast of Calabria and the Aspromonte . . . . .	109
28. ' Calanchi ' south of Reggio . . . . .	109
29. Brindisi . . . . .	128
30. Manfredonia . . . . .	128
31. Peschici . . . . .	129
32. Litorale di Lido . . . . .	129
33. Laurana . . . . .	162
34. Salt-pans near Marsala . . . . .	162
35. Castello di Falconara . . . . .	163
36. Mondello . . . . .	163
37. Palermo from M. Pellegrino . . . . .	170
38. Cape Zaffarano and intensively cultivated coastal strip . . . . .	170
39. Cefalu and Cape S. Antonio . . . . .	171
40. Cefalu . . . . .	171
41. Cape S. Alessio . . . . .	174

	<i>Facing page</i>
42. Taormina: Isola Bella . . . . .	174
43. Rada di Taormina . . . . .	175
44. Cape Taormina . . . . .	175
45. The Maritime Alps near Finale . . . . .	194
46. The Upper Tanaro valley near Garessio . . . . .	194
47. The Dora Riparia valley at Susa . . . . .	195
48. The Gran Paradiso Massif . . . . .	195
49. Courmayeur and the Mont Blanc chain . . . . .	198
50. The Valle di Gressoney . . . . .	198
51. Mont Blanc: the Giant's Tooth . . . . .	202
52. M. Rosa: Punta Gnifetti and the Macugnaga Glacier . . . . .	202
53. The Upper Val Formazza . . . . .	203
54. M. Cervino (the Matterhorn) . . . . .	203
55. Lake Maggiore: Stresa and the Borromean Islands . . . . .	206
56. Lake Como at Menaggio . . . . .	206
57. The Como arm of Lake Como . . . . .	207
58. Lake Como: the junction of the Como and Lecco arms . . . . .	207
59. The Orobic Ridge from M. Gleno . . . . .	210
60. The Bergamasque Alps: Oltre Il Colle . . . . .	210
61. Lake Idro . . . . .	211
62. Lake Garda: the Gulf of Garda . . . . .	211
63. Lake Garda: the west shore . . . . .	214
64. The Sarca valley below Arco . . . . .	214
65. Pizzo Bernina and the Morteratsch glacier . . . . .	215
66. The Passirio valley: dejection-cone at S. Leonardo . . . . .	218
67. The M. Giovo pass . . . . .	218
68. The middle Liri valley at Campodolcino . . . . .	219
69. The Bormio basin . . . . .	219
70. Near the Stelvio pass . . . . .	222
71. Lake Caldaro and the Adige valley . . . . .	222
72. Merano in the Adige valley . . . . .	223
73. Chiusa in the Isarco valley . . . . .	223
74. The Isarco valley at Bressanone . . . . .	226
75. Vipiteno in the Isarco valley . . . . .	226
76. The Asiago plateau and the gorge of the Assa . . . . .	227
77. The Upper Avisio valley and the Gran Vernel . . . . .	227
78. The Val di Fassa at Canazei . . . . .	231
79. Ortisei in the Valle di Gardena . . . . .	231
80. Corvara in Val Badia . . . . .	234
81. The Cristallo group . . . . .	234
82. The Pordoi pass . . . . .	235
83. Dobbiaco . . . . .	235
84. M. Rombon and the Plezzo basin . . . . .	238
85. The Isonzo valley and M. Nero . . . . .	238



	<i>Facing page</i>
86. The slopes of M. Maggiore . . . . .	239
87. Istria Grigia near Capodistria . . . . .	239
88. The Recina gorge and the Castua plateau . . . . .	246
89. The Carso Tergestino . . . . .	246
90. Postumia . . . . .	247
91. Reclamation by warping in the flood plain of the river Po . . . . .	247
92. The Adda at Trezzo . . . . .	260
93. The Apuan Alps and the coastal plain of Viareggio . . . . .	260
94. Carrara: marble quarries in the Apuan Alps . . . . .	261
95. The plain of Pisa at S. Rossore . . . . .	261
96. The Arno at Signa . . . . .	268
97. Fiesole at the edge of the basin of Florence . . . . .	268
98. Reclaimed land near Grosseto . . . . .	269
99. M. Oliveto near Siena: 'calanchi' and ridge road . . . . .	269
100. 'Calanchi' near Siena . . . . .	276
101. Dissected plateau near Siena . . . . .	276
102. 'Balza' at Volterra . . . . .	277
103. Chianti: vineyards . . . . .	284
104. Castel del Piano at the foot of M. Amiata . . . . .	284
105. The Roman Campagna and the Alban Hills . . . . .	285
106. Castel Gandolfo and Lake Albano . . . . .	285
107. The Valdarno near Incisa . . . . .	294
108. The Terra di Lavoro: intensive cultivation . . . . .	294
109. The Campi Flegrei: crater of Agnano . . . . .	295
110. Naples and Vesuvius . . . . .	295
111. The crater of Vesuvius . . . . .	298
112. The plain of Paestum from Capaccio Vecchio . . . . .	298
113. The Langhe near Bossolasco . . . . .	299
114. Tavernelle and the Lagastrello pass . . . . .	299
115. The Lima valley at Bagni di Lucca . . . . .	306
116. La Verna in the Alpe di Catenaia . . . . .	306
117. Lake Scaffaiolo in the Cimone chain . . . . .	307
118. The high Pratomagno . . . . .	307
119. The Mandrioli pass . . . . .	318
120. The Futa pass through the Etruscan Apennines . . . . .	318
121. The Foligno basin and the Martano ridge . . . . .	319
122. The limestone gorge of the Candigliano . . . . .	319
123. Tivoli: the falls and travertine outcrops . . . . .	336
124. Lake Matese and M. Miletto . . . . .	336
125. Muro Lucano . . . . .	337
126. The Cilento mountains from Paestum . . . . .	337
127. The basin of Lauria . . . . .	340
128. The basin of Morano Calabro and M. Caramolo . . . . .	340
129. The Sinni valley near Episcopia . . . . .	341



	<i>Facing page</i>
130. Irrigated bed of the T. Turbido . . . . .	341
131. Spezzano Albanese station . . . . .	352
132. The T. delle Monache from Amantea . . . . .	352
133. Catanzaro and the gorge of the Fiumarella . . . . .	353
134. The Arvo reservoir and the Botte Donato ridge . . . . .	353
135. The 'gravina' at Castellaneta . . . . .	370
136. The Mesima valley . . . . .	370
137. Barren limestone outcrops with poor olives, near Otranto . . . . .	371
138. 'Trulli' on the Murge near Alberobello . . . . .	371
139. M. Titano (San Marino) . . . . .	386
140. Claylands near Urbino . . . . .	386
141. The Tronto valley . . . . .	387
142. The Conca d'Oro . . . . .	387
143. The Temple of Segesta and M. Barbaro . . . . .	398
144. The Rocca dei Maschi from Corleone . . . . .	398
145. The Madonie: the Piano degli Zucchi and Pizzo Antenna Piccola . . . . .	399
146. M. Polizzo and claylands near Calatafimi . . . . .	399
147. Sutera . . . . .	402
148. A fumara near Messina . . . . .	402
149. The Monti Rossi . . . . .	403
150. Etna from Taormina . . . . .	403
151. Olive tree . . . . .	450
152. Stone pines . . . . .	450
153. Messina earthquake . . . . .	451
154. Messina earthquake . . . . .	451

## LIST OF FIGURES

1.	The northern Frontier . . . . .	<i>p.</i>	4
2.	The Compartments (Compartimenti) . . . . .	<i>p.</i>	12
3.	Topographical Regions . . . . .	<i>p.</i>	18
4.	Rock Types. . . . .	<i>facing p.</i>	23
5	A. River Regimes and Regions of Underground Drainage . . . . .	<i>p.</i>	48
5	B. Types of River Regime . . . . .	<i>p.</i>	49
6.	Key map of the Coasts . . . . .	<i>p.</i>	54
7.	The Coast: French frontier to Albenga . . . . .	<i>p.</i>	58
8.	„ Albenga to Savona . . . . .	<i>p.</i>	61
9.	„ Savona to Genoa . . . . .	<i>p.</i>	63
10.	„ Genoa to Moneglia . . . . .	<i>p.</i>	66
11.	„ Sestri Levante to the mouth of the F. Magra . . . . .	<i>p.</i>	68
12.	„ the mouth of the F. Magra to Piombino . . . . .	<i>p.</i>	72
13.	„ Piombino to Torre di Monalto . . . . .	<i>p.</i>	76
14.	„ Torre di Monalto to Anzio . . . . .	<i>p.</i>	78
15.	„ Anzio to the Bay of Formia . . . . .	<i>p.</i>	80
16.	„ Gaeta to Agropoli . . . . .	<i>p.</i>	86
17.	„ the Gulf of Naples and the Sorrentine Peninsula . . . . .	<i>p.</i>	88
18.	„ Agropoli to the Gulf of Policastro . . . . .	<i>p.</i>	98
19.	„ the Gulf of Policastro to Cape Suvero . . . . .	<i>p.</i>	100
20.	„ Cape Suvero to Siderno Marina . . . . .	<i>p.</i>	104
21.	„ Siderno Marina to Crotone . . . . .	<i>p.</i>	114
22.	„ Crotone to Taranto . . . . .	<i>p.</i>	118
23.	„ the Salentine Peninsula . . . . .	<i>p.</i>	124
24.	„ Torre Canne to Rodi . . . . .	<i>p.</i>	130
25.	„ Rodi to Pescara . . . . .	<i>p.</i>	132
26.	„ Pescara to Ancona . . . . .	<i>p.</i>	138
27.	„ Ancona to Ravenna . . . . .	<i>p.</i>	139
28.	„ Ravenna to Chioggia . . . . .	<i>p.</i>	142
29.	„ Chioggia to the F. Tagliamento . . . . .	<i>p.</i>	144
30.	„ the F. Tagliamento to Point Salvore . . . . .	<i>p.</i>	146
31.	„ Istria . . . . .	<i>p.</i>	150
32.	„ Western and North-western Sicily . . . . .	<i>p.</i>	156
33.	„ Cape Granitola to Licata . . . . .	<i>p.</i>	160
34.	„ South-eastern Sicily . . . . .	<i>p.</i>	164
35.	„ Cefalu to the Straits of Messina . . . . .	<i>p.</i>	172
36.	„ North-eastern Sicily . . . . .	<i>p.</i>	181
37.	The structure of the Alps . . . . .	<i>p.</i>	186
38.	Landform types: Northern Italy . . . . .	<i>facing p.</i>	189
39.	The subdivisions of the Alps . . . . .	<i>p.</i>	190



## LIST OF FIGURES

xiii

40. The Western Alps . . . . .	<i>facing p.</i>	193
41. The Vegetation of the middle Dora Baltea Basin . . . . .	<i>p.</i>	200
42. The Central Alps . . . . .	<i>facing p.</i>	205
43. The Eastern Alps . . . . .	„	225
44. Istria . . . . .	„	241
45. Istria: vegetation . . . . .	<i>p.</i>	242
46. The Northern Plain . . . . .	<i>facing p.</i>	251
47. The Pre-Apennines . . . . .	„	267
48. The Lower Arno Basin . . . . .	<i>p.</i>	272
49. Landform types: Central Italy . . . . .	<i>facing p.</i>	275
50. Campania . . . . .	„	287
51. The Northern Apennines . . . . .	„	301
52. The Central Apennines . . . . .	„	311
53. The Southern Apennines . . . . .	„	329
54. Landform types: Southern Italy . . . . .	„	333
55. Calabria . . . . .	„	343
56. Calabria: vegetation . . . . .	<i>p.</i>	344
57. Calabria: vegetation . . . . .	<i>p.</i>	345
58. Calabria: snowfall . . . . .	<i>p.</i>	354
59. The Apulian Region . . . . .	<i>facing p.</i>	365
60. The Geology of the Salentine Peninsula . . . . .	<i>p.</i>	372
61. The Murge: major scarps . . . . .	<i>p.</i>	376
62. The Murge: land utilization . . . . .	<i>p.</i>	378
63. The Adriatic Coastland . . . . .	<i>facing p.</i>	385
64. Sicily . . . . .	„	389
65. Landform types: Sicily . . . . .	<i>p.</i>	392
66. The plain of Catania: vegetation . . . . .	<i>p.</i>	403
67. Meteorological Stations . . . . .	<i>p.</i>	408
68. Mean pressure over Southern Europe . . . . .	<i>p.</i>	410
69. Surface winds: Spring and Summer . . . . .	<i>p.</i>	412
70. Surface winds: Autumn and Winter . . . . .	<i>p.</i>	413
71. Mean temperature: January . . . . .	<i>p.</i>	418
72. Mean temperature: July . . . . .	<i>p.</i>	419
73. Days with frost . . . . .	<i>p.</i>	421
74. Mean annual rainfall . . . . .	<i>facing p.</i>	423
75. Season of rainfall . . . . .	<i>p.</i>	425
76. Number of rain-days . . . . .	<i>p.</i>	427
77. Number of days with snowfall . . . . .	<i>p.</i>	429
78. Cloud . . . . .	<i>p.</i>	431
79. Types of vegetation . . . . .	<i>p.</i>	442
80. Forests and rough grazing . . . . .	<i>p.</i>	444
81. Distribution of fruit trees . . . . .	<i>p.</i>	452
82. Intensity and distribution of earthquakes . . . . .	<i>p.</i>	486
83. Landslips . . . . .	<i>p.</i>	492
84. Winds at 1,650 feet: Spring and Summer . . . . .	<i>p.</i>	519

85. Winds at 1,650 feet: Autumn and Winter	.	.	.	p. 520
86. Winds at 3,300 feet: Spring and Summer	.	.	.	p. 521
87. Winds at 3,300 feet: Autumn and Winter	.	.	.	p. 522
88. Winds at 6,600 feet: Spring and Summer	.	.	.	p. 523
89. Winds at 6,600 feet: Autumn and Winter	.	.	.	p. 524
Map of Italy	.	.	.	<i>In pocket at end</i>



## CHAPTER I

### INTRODUCTION

ITALY is the central of the three great peninsulas of Europe which protrude southwards into the Mediterranean Sea. Although Italy is in many ways similar to the other two, it is far less massive than the Iberian and far less irregular than the Balkan Peninsula. No part of the country is more than 150 miles from the coast. The name Italy has not always been used to designate the whole of the land now so called, but gradually spread from the extreme south to the north. At the time of the Roman Republic Italy did not extend beyond the rivers Magra, near Spezia, on the west, and Rubicon, near Rimini, on the east. By the time of Augustus the name Italy was applied in the modern sense to the whole region south of the Alps, and this is the area so denoted ever since, although for long periods there has been no corresponding political unit or federation.

#### *Position and Extent*

The kingdom of Italy at the beginning of 1939 included not only the Italian Peninsula but also the large islands of Sicily and Sardinia, Elba, about seventy minor islands, and the small enclave of Zara on the Dalmatian coast, together with an overseas empire. This included the small island of Saseno (1920) in the mouth of the bay of Valona (Albania); Libya (Tripolitania and Cyrenaica), acquired after the Italo-Turkish war in 1912; Italian East Africa, constituted in 1937 from the old colonies of Eritrea (1885) on the Red Sea coast, and Italian Somaliland (1891), together with Abyssinia, conquered in 1936; Rhodes and the Dodecanese Islands off the Asia Minor coast (1912); and a concession at Tientsin (1902). In the spring of 1939 Albania, a country in which Italy had been recognized as having special interests, was occupied by Italian forces and the crown assumed by the King of Italy. In 1941 a large area around Ljubljana and parts of the Dalmatian coast were handed over to Italy.

It is only since the middle of the last century that political and geographical Italy have coincided. Under the Roman Empire Italy was the centre of an empire extending far beyond its boundaries into Europe, Africa, and Asia, and since the decline of Rome there has never until recently been a political unit taking in the whole, or nearly the whole, of the country. Innumerable changes of boundary



and allegiance have occurred, but persisting through most of them has been a distinction between northern Italy, including Rome, and southern Italy. Sicily has at all times, since the Norman kingdom of Sicily spread to the mainland in the twelfth century, been politically connected with Naples; Sardinia also has throughout modern history been subordinate to one of the states of the Italian mainland. The present kingdom of Italy came into being, during the course of the second half of the nineteenth century, by accretion to the principality of Piedmont, or kingdom of Sardinia. The struggle for the unification of Italy, known as the *Risorgimento*, gave Italy its 1914 boundaries, excluding the districts of the Trentino and upper Adige and Istria, which have been added since 1918. At the present day the country of Italy still includes two small areas which are independent of the kingdom of Italy. The one, the small republic of San Marino (23 sq. miles, population 14,500) near Ancona, claims to be the oldest state in Europe. The other, the Vatican State (109 acres and 13 buildings in Rome outside its borders; population about 1,000), is of recent creation (1929), but represents a resuscitation of the States of the Church, which for many centuries until the mid-nineteenth century stretched across central Italy.

Within its present limits Italy extends in the north from Vetta d'Italia, in a latitude ( $47^{\circ} 5' N.$ ) similar to that of Budapest, Nantes, or Quebec, to Melito di Porto Salvo ( $37^{\circ} 56' N.$ ) on the south coast of Calabria. Sicily extends farther south to the Isola delle Correnti ( $36^{\circ} 39' N.$ ) near Cape Passero and in a similar latitude to Algiers and Tunis. The country thus lies within temperate latitudes. The most westerly point is M. Tabor in the Graian Alps ( $6^{\circ} 33' E.$ ) and the most easterly, Cape Otranto in the 'heel' ( $18^{\circ} 32' E.$ ). From Vetta d'Italia to Cape Passero is 730 miles (cf. 800 miles from the Shetlands to the Isles of Scilly). The difference in longitude is not nearly so great and corresponds to a difference in time of only 48 minutes.<sup>1</sup> Although the width of the country is nowhere, except in the north, above 150 miles, the Peninsula is arranged diagonally so that, for example, practically the whole of Sicily is to the east of Rome and Venice to the west. The total area of the kingdom is estimated at 119,813 square miles, of which the mainland accounts for 100,537,

<sup>1</sup> Italy uses Central European Time (or *Ora dell'Etna*), which is one hour in advance of Greenwich Mean Time or the same as British Summer Time. Italy does not employ summer time. The Italians also use their own prime meridian, that of Monte Mario observatory at Rome, which is  $12^{\circ} 27' 8'' E.$  of Greenwich. This prime meridian is used on most modern Italian maps and on reproductions of them.



Sicily for 9,938, and Sardinia for 9,301. The total area compares very closely with that of the whole British Isles (121,463 sq. miles), and is much less than that of the Italian Empire (1,345,619 sq. miles), which, however, includes large areas of desert.

The population of Italy according to the 1936 census was about 43 millions (British Isles, 49 millions), of which Sicily accounted for 4 millions and Sardinia for over 1 million. These figures gave an average density of 359 to the square mile (Great Britain 468; England alone 766). The population of the Italian Empire is small (1936 estimate, 8,586,000) with an average density of about  $2\frac{1}{2}$  persons per square mile.

### *Sea Frontiers*

The peninsula of Italy and its accompanying islands are situated almost midway along the Mediterranean Sea, and, together with the north-easterly projection of Tunisia, serve to divide the western basin from the eastern basin, which lies considerably farther south. Portions of this sea bathe the shores of the Peninsula: on the west the Tyrrhenian Sea and on the north-west the gulf of Genoa or Ligurian Sea, on the south-east the Ionian Sea including the gulf of Taranto, and on the east the Adriatic Sea. Sardinia divides the Tyrrhenian Sea on the east from the Balearic or Sardinian Sea on the west. To the north of Sardinia, the Tyrrhenian Sea is restricted by the large French island of Corsica and separated from the Ligurian Sea by the Italian Tuscan archipelago. Between Sardinia and Sicily is an opening of 170 miles, and between Sardinia and Tunisia one of only 115 miles. Sicily forms the southern shore of the Tyrrhenian Sea, and is separated from Africa on the south by the Sicilian Strait (min. width 90 miles) or African Sea.

The main groups of minor islands are the Tuscan archipelago including Elba, the Ponza and Ventotene islands together with Capri, Procida, and Ischia off the Campanian coast, the Lipari (or Aeolian) islands and Ustica off the north coast of Sicily, the Egadi Islands off the west of Sicily, Pantelleria, Linosa, and Lampedusa in the Sicilian Strait, a number of islands, including Lagosta, between the Gargano promontory and the Dalmatian coast, and Cherso, Lussino, and other islands of the north Dalmatian coast.

The total length of the coast of the mainland is approximately 2,450 miles, of Sicily 680 miles, of Sardinia 830 miles, and of the smaller islands 970 miles; about 5,250 miles in all.



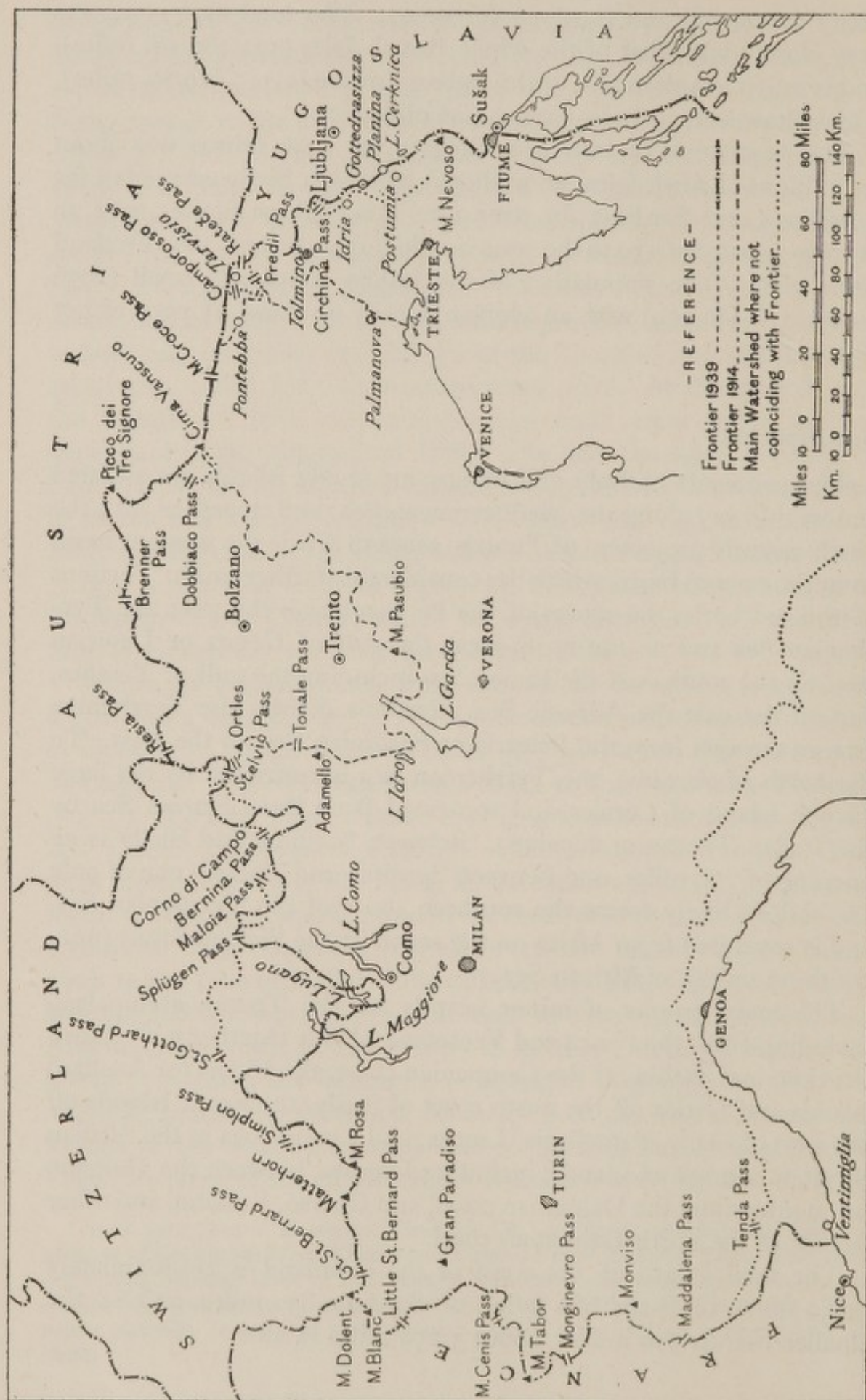


FIG. 1. The Northern Frontier



*Land Frontiers*

On the landward, northern side Italy has frontiers with France (303 miles) in the west, Switzerland (450 miles), Austria (262 miles), and finally Yugoslavia (152 miles) in the east, altogether 1,167 miles. This land frontier is wholly situated among the Alps or their continuation in the mountains of Istria. Moreover, for the greater part of its course the frontier follows the main watershed between streams draining west, north, and east, to the Rhône, Rhine, and Danube on the one hand, and those draining in a general southward direction to the Po and the Adriatic on the other. This correspondence with the watershed is not, however, exact. There are two major departures in the Maritime Alps and in the upper Ticino valley. In the Maritime Alps the main watershed continues east from the Alps into the Apennines and along the Peninsula, so that the frontier has necessarily to leave it and strike south towards the coast. The second main departure represents a transgression of the watershed by Switzerland in the Ticino (Tessin) canton. This is the principal surviving example in the Alps of the persistence of small, mountain states straddling a mountain range, a phenomenon formerly far more common not only in the Alps but also in the Pyrenees and other large ranges. The duchy of Savoy, before the present French department was ceded in 1860, and the old duchy of Tirol are other examples. Such states were made possible by, and derived their importance from, the passes through the mountains which formed their territories. It not infrequently happened that communication over some of the Alpine passes between the higher parts of the valleys on either side was easier than communication down the valleys themselves, or from tributary valleys into the main valley. Gorges and waterfalls downstream proved more effective obstacles than any presented upstream, so that the upper valleys on either side of the passes tended to form a political unit. This fact may also explain the many smaller inconsistencies still persisting between the watershed and the frontier, and also the spread of French and German speech from the north beyond the watershed and the modern frontier. There are some small portions of southward-draining valleys that are in Switzerland, e.g. the Val di Poschiavo which communicates over the Bernina pass with the Engadine, but is cut off from the Valtellina near Tirano by a gorge; similarly some small portions of northward-draining valleys are politically Italian, e.g. the Spöl valley. Similarly there are areas, for example in the upper Dora Baltea valley (Val d'Aosta), where



French speech is predominant, and in the upper Adige where German, and in Istria and the westward-draining valleys of the Julian Alps where Slovene and Serbo-Croat are the chief languages.

The *French frontier* starts from the Ligurian coast at Balzi Rossi, about  $1\frac{1}{2}$  miles east of Mentone, and 3 miles west of Ventimiglia at the mouth of the F. Roia. The frontier extends in a roughly northerly direction to M. Dolent in the Mont Blanc group. At first it bears no relation to either watershed or valley routes and is at comparatively low altitudes. It starts on the west side of the Roia, runs north for about 9 miles, and then crosses to the east side of the river, thus bringing into French territory part of the important road and railway from Cuneo through the Tenda pass to Ventimiglia. The boundary proceeds north-eastwards nearly to the summit of M. Pietravecchia, where its direction changes to west-north-west. The line crosses back to the west side of the Roia and proceeds through Cima del Diavolo for about 30 miles parallel with, but about 5 miles south of, the Adriatic-Ligurian watershed, and so just cuts off the head-waters of the streams rushing south to join the Var. At Cima di Collalunga the frontier joins the main Alpine watershed and follows it through many irregularities, but with a general northerly direction to the Mont Blanc massif. Roughly speaking, this portion of the boundary is in the form of two zigzags, the two eastward points of which are in Monviso and Gran Paradiso, the two most entirely Italian, because most easterly, mountain blocks. The two westward points are where the two greatest rivers, the Dora Riparia and Dora Baltea, have cut their valleys farthest back into the range. M. Tabor, the most westerly point in Italy, rises above the head of the Dora Riparia valley. This section of the frontier is all among high mountains (many over 10,000 ft.), between which there are a number of high passes, but only four crossed by roads.

The *Swiss frontier*, which has a general east to west direction from M. Dolent to Piz Lat, close to the Resia pass, is less faithful to the watershed, which it follows only as far as Pizzo d'Andolla, 12 miles west of Domodossola. This part of the frontier, apart from the neighbourhood of the Great Saint Bernard pass, immediately east of Mont Blanc, follows a continuous line of ice-clad crests, including the Matterhorn and M. Rosa, across which there are no passes. From Pizzo d'Andolla the direction is south-west to north-east. The important Simplon pass is entirely in Switzerland, and the frontier cuts off the head-waters of the T. Diveria before rejoining the watershed at M. Leone and following it to Punta di Valrossa,



about 10 miles short of the Saint Gotthard pass. Between this and the Splügen pass, 45 miles farther east, the frontier describes a great southward-pointing V, which brings Switzerland south to the very threshold of the Northern Plain. In this section the boundary bears no constant relation even to minor watersheds and has great irregularities, especially round Lake Lugano. Switzerland includes practically the whole of the basins of the rivers emptying into the northern end of Lake Maggiore and the bulk of the central part of the basin of Lake Lugano. The western arm of the V roughly divides the basins of the Toce in Italy and the Maggia in Switzerland, cuts off the head of Lake Maggiore, and follows the western arm of Lake Lugano. From this arm the frontier continues south-east to within less than 3 miles of the centre of the town of Como before bending sharply north, cutting off the eastern extremity of Lake Lugano again, and passing north-north-east along the Como-Mesolcina watershed to Pizzo Tambo near the Splügen pass. There is a tiny enclave of Italian territory around Campione on the south-east shore of Lake Lugano. From the Splügen the frontier passes south to the west end of the Bernina Alps, and includes in Italy one of the headstreams of the Hinter Rhein, but excludes the upper Maloja valley, which is in Switzerland. From the eastern end of the Bernina ridge the frontier loops south to near Tirano, and then north again to Corno di Campo to include the whole of the Bernina pass and its southern approach through the Val di Poschiavo in Switzerland. North-east of the Corno di Campo the Livigno basin, or upper Spöl valley, which drains through gorges to the Inn, is Italian, but the Münster basin, or upper Bam valley, which drains east to the Adige at Glorenza, is Swiss. From Münster the main watershed is followed northwards to the Resia pass. The Swiss frontier has many easy crossings, especially near the lakes, but through passage is limited by the passes on the watershed.

The *Austrian frontier* from the Resia pass to M. Forno, just east of Tarvisio, continues the general east to west direction of the Swiss frontier, but is less irregular and keeps practically the whole way to the main Danube-Adriatic watershed. It is in two west to east sections connected by a short north to south leg. The first west to east section, along the snow-capped crest of the Venoste (Ötztal) and Stubai Alps to the Brenner and thence along the straight wall of the Aurine (Zillertal) Alps to the Hohe Tauern, covers a distance of about 85 miles over high mountains, interrupted only by the broad saddle round the Brenner pass. From the Picco dei Tre Signori the Pusteria Alps, which form the north to south leg, extend to the



ridge of the Carnic Alps. The upper Drava cuts through the line of the main ridge, which is followed by the frontier, and collects the waters of the Val di Sesto. The upper Drava basin and the Dobbiaco pass are, therefore, in Italy. At Cima Vanscuro the watershed rejoins the frontier, which passes almost due east for about 60 miles along the wall-like, north-facing barrier of the Carnic Alps. These mountains, although steep and difficult to cross except for the M. Croce pass, are much lower than those farther west. At their eastern end the F. Silizza, a tributary of the Gail and Drava, crosses the frontier ridge. The frontier transgresses the watershed at M. Osternig to include in Italy the important Tarvisio area with the three passes of Camporosso, Predil, and Radeče.

The *Yugoslav frontier* from M. Forno to the Adriatic at Fiume extends nearly north and south. At M. Mangart the watershed regains the frontier crest and the two run together for about 30 miles almost to the Circhina pass. Thence to the sea the frontier follows no leading feature and is at relatively low altitudes. The watershed in the regions of underground drainage is often indiscernible, but even where it is clear Italian territory transgresses it. As far as Gotte-drasizza the frontier follows a line just east of the watershed and includes in Italy the uppermost valleys of the Poljanske Sora and its tributaries. From this point to near M. Nevoso it continues along the west side of the great through trough which stretches from Idria to Planina, Cerknica, and beyond. The F. Piuca disappears underground near Postumia, but certainly drains east towards the Save, from which it is cut off by this line. From the northern slopes of M. Nevoso the frontier heads south-west for the northern corner of the gulf of Fiume, but less than a mile from the coast turns sharply south-east parallel with the shore as far as Fiume. The whole of the town and northern suburbs are included in Italy, but as the frontier follows the Recina river, the suburb and smaller port of Sušak are in Yugoslavia.

*Frontier Changes after 1918.* The western part of the frontier, French and Swiss, is of fairly long standing, although Savoy and Nice were only ceded to France in 1860. The eastern frontier, which now delimits Austria and Yugoslavia, is very different since the transfer to Italy of two large areas after the war of 1914-1918. These areas are the Trentino and Alto Adige, which include the whole basin of the upper Adige and upper Brenta, and the region known as Venezia Giulia, which comprises Istria and the Isonzo basin. The claim to these almost entirely mountainous areas was based partly on ethnic,



but partly also on strategic grounds. Their acquisition had the effect of bringing Italy up to the main Alpine watershed throughout long stretches of frontier, whereas formerly she had only extended to the outer slopes of the Alps. The territory added to Italy by these changes now forms the two compartments of Venezia Tridentina and Venezia Giulia, which have a combined area of about 8,650 square miles, with a population at present of about  $1\frac{1}{2}$  millions.

The 1914 boundary, which had lasted since 1866 when Venetia was ceded to Italy after the Austro-Prussian War, was shaped like a large S lying on its side. The northern loop along the Carnic Alps from Cima Vanscuro to near Pontebba was the same as the present frontier. The southern loop was formed by a great southward swing to the head of Lake Garda. From the Stelvio pass the line ran south through the Ortles and Adamello groups to Lake Idro, thence generally east across Lake Garda, through M. Baldo and M. Maggiore to the Mi. Lessini. From the Mi. Lessini the general direction was north-east through Pala di S. Martino, Marmolada, Punta Sorapis, and M. Cristallo, to the eastern end of the Carnic Alps. Most of the Dolomites were thus in Austria, but the upper Piave basin or Cadore in Italy.

The final southward bend of the S in Friuli was a line almost parallel with the Isonzo throughout its course, but about 3-8 miles to its west. This line crossed the Julian High Alps, followed the crest of the Julian Sub-Alps towards Tolmino and then the river Iudrio to its point of disappearance. Finally the frontier continued past Palmanova across the plain to the coast at Porto Buso.

### *General Features*

Italy is a mountainous country, with one extensive lowland in the north and small areas of plain elsewhere. The climate of the greater part of the country, although warm, has a very marked seasonal drought, normally in summer, and is not entirely favourable to the growth of crops.

The occupations and distribution of the people are to a large extent determined by the natural conditions. Agriculture of a very specialized type, different from that of England but similar to that of other Mediterranean countries, plays the most important part and employs 45 per cent. of the occupied population. The industrial tradition is, however, very old in Italy, and the great industrial and commercial cities of former times were the homes of a great flowering of the arts during the Renaissance. Medieval industry depended largely on the



great acquired skill of the workmen, and this tradition still persists, supplemented in more recent years by the impetus derived from the utilization of Italy's water-power resources. Now 30 per cent. of the occupied population is employed in industry, of which the light industries, such as textiles, are of most importance. The heavy industries, although they have been deliberately encouraged, are relatively smaller on account of Italy's lack of minerals, especially fuel and iron. With an area and a population both roughly comparable with those of the British Isles, Italy, with less economic resources both in agriculture because of the mountainous land and inadequate rainfall, and in industry because of insufficient mineral reserves, is much the poorer country. Not unconnected with this relative poverty of the country is the high rate of emigration during the last quarter of the nineteenth century and the first quarter of the twentieth. Italians went, especially from north Italy, to neighbouring European countries, and, particularly from south Italy, to the United States, Brazil, Uruguay, and Argentina.

Italians are a town-loving people. Scattered and isolated dwellings and hamlets are the exception, especially in the south. The towns and villages, often in picturesque, prominent positions, are markedly concentrated in the valleys and basins and on the lower slopes of the mountains, and along the edges of the plains. Large mountainous and hilly areas and many of the low-lying parts of the plains are very thinly populated. Other regions such as the district round Naples and parts of the plain of northern Italy have extremely high average densities of population.

In most cultural aspects of the country there is a clear break between the north and the south together with Sicily. Central Italy forms a transitional zone, but reflects many of the tendencies of the south. The break is mainly due to the history of the country. The north has been influenced, often as a result of conquest, by the north-west European countries, whereas the south has been affected by the Saracens from Africa, Normans, and Spaniards. The Renaissance flowered in the northern and central city-states. After the period of stagnation which followed the Renaissance it was in the Northern Plain that industrial initiative re-awoke.

The south, however, has remained essentially agricultural and backward. As a result, people in the industrial north are less bound by the ties of tradition, and women are more emancipated; in the south, tradition, customs, and superstitions are still binding. Women, especially in Sicily, are guarded almost as carefully as in Moslem



countries and are not, for example, permitted to work in factories. Care must be taken in the south not to give offence through lack of knowledge of local customs, whereas the northerners are more like inhabitants of other north-west European countries, and can be treated as such.

Few descendants of the North African and Spanish invaders have remained in the south. In the north, on the other hand, there are groups of non-Italians, particularly near the French and the old Austro-Hungarian frontiers. After the war of 1914-1918 this foreign population was greatly increased and has given rise to minority problems. These have never been very evident amongst the French in Piedmont, but the German-speaking Austrians in the High Tirol (Venezia Tridentina) and the Yugoslavs in Venezia Giulia have presented more serious difficulties. These people have suffered summary treatment from the Fascist Government, who, admitting no minority problem, maintain that all inhabitants of Italy are Italians and should therefore speak the language.

The large proportion of mountainous area and the seasonal nature of the rainfall make transport in Italy difficult. The effect of the physical features on roads and railways varies in different parts of the country, but, except in the plain of northern Italy, communications are confined by nature to the coastal routes and to a few valley or ridge-lines. Centuries of practice in coping with the precipitous slopes, steep-sided valleys, torrential streams, and recurrent landslips of their native land may in part explain the reputation that Italians have acquired as civil engineers.

### *Regions*

The highly distinctive relief of Italy makes it possible to divide the country into a number of regions for the purposes of topographical description. These regions (Fig. 3) are as follows: (1) the Italian Alps, subdivided into the Western Alps, the Central Alps, and the Eastern Alps; (2) Istria; (3) the Northern Plain. These three regions together make up Continental Italy. Peninsular Italy is composed of (4) the Liguria or Riviera, (5) the Pre-Apennines and (6) Campania along the west coast; (7) the Apennines, subdivided into the Northern Apennines, the Central Apennines, and the Southern Apennines, in the centre; (8) Calabria in the southern 'toe' of the country; (9) the Apulian Region, and (10) the Adriatic Coastland along the east coast. (11) Sicily forms a final region, and Sardinia is described in a separate volume.



FIG. 2. *The Compartments (Compartimenti)*



For administrative purposes the country is divided into ninety-four provinces, but the units usually employed for official statistics are the compartments (*compartimenti, regioni*) into which these provinces are grouped. Of these there are eighteen (Fig. 2), many roughly corresponding with historical and natural units such as Tuscany and Calabria. They are not themselves administrative areas.

### *Pronunciation of Italian*

Italian is the nearest of the principal Romance languages to the original Latin. The following changes are among the most helpful to remember: final consonants are dropped, and accented *ě* and *ŏ* split into *ie* and *uo* (*věnit* = *viene*, *ovum* = *uovo*); *l* becomes *i* after an initial consonant (*florem* = *fiore*, *plenum* = *pieno*); *au* becomes *o* (*aurum* = *oro*); *c* and *b* tend to become *v* and *g* respectively between vowels (*habere* = *avere*, *lacus* = *lago*), but this is by no means invariable.

The Italian alphabet has twenty-one letters (*j* obsolete, replaced by *i*; *k*, *w*, and *y* only in foreign words; *x* only in the Latin preposition *ex*, as *ex-Duce*). *h* is very seldom used except after *c* and *g*, and is not pronounced.

Italian uses three accents (grave, acute, circumflex), but there are no rigid rules for the first two, and accents will often be found used indiscriminately. The circumflex always denotes a contraction (*occhio*, *occhî*, for *ii*); the other two are used (i) to call attention to words with stress on the last syllable (*città*, *perché*); (ii) to distinguish monosyllables which would otherwise be confused (*e* = and; *è* = is). The best usage keeps ` for open vowels (*avrò*, *avrà*; *è*) and ' for closed ones (*perché*, *finì*, *giù*).

The normal Italian word is stressed on the last syllable but one: *Róma*, *piàno*, *andiamo*, &c. Where the stress falls on the final syllable this is always marked by an accent (see above). Words stressed on the last syllable but two are common, and are not usually marked with an accent, so that they are easy to mistake (*Nàpoli*, *Tràpani*, *tàvola*, *lèttera*).

*Vowels.* The five vowels represent seven sounds, as follows:

<i>a</i>	as <i>a</i> in 'art'
<i>e</i> (close)	as <i>a</i> in 'late' ( <i>vede</i> , <i>che</i> )
<i>e</i> (open)	as <i>e</i> in 'met' ( <i>viene</i> , <i>sedia</i> )
<i>i</i>	as <i>i</i> in 'machine'
<i>o</i> (close)	as <i>o</i> in 'rope' ( <i>sole</i> , <i>coda</i> )
<i>o</i> (open)	as <i>o</i> in 'rot' ( <i>nuovo</i> , <i>volta</i> )
<i>u</i>	as <i>oo</i> in 'moon'



The correct use of open and close *e* and *o* is difficult, and these vowels are not always uniformly used by Italians of different regions. It may be remembered that *ie* and *uo* are always open.

Where two vowels come together they may either be pronounced separately (*Gàeta* Ga-e-ta, *Europa* E-oor-o-pa, *Paola* Pa-o-la), or the first may become a consonant (*bianco*, where *i* = *y* of 'you'; *buono*, where *u* = *w*).

**Consonants.** *b, d, f, l, m, n, p, q, t,* and *v* are pronounced approximately as in English (*n* before *c, g, q* slightly nasalized as in English 'bank'; *bianco, lungo*).

*c* and *g* are soft before *e* or *i*, like *ch* in 'church', or *g* in 'gentle' (*vicino, gentile*), hard in all other cases, i.e. like 'cat', 'got' (*Como, grosso*).

*h* is always silent (see above).

*r* is trilled (i.e. with vibration of tongue against upper teeth).

*s* has two sounds: *s* before *c, f, p, t* has the sound of *s* in 'seat' (*bosco, Sforza, Spoleto*); *s* before *b, d, q, l, m, n, r, v* has the sound of *s* in 'rose' (*sbocco*); *s* before a vowel, when initial or preceded by a consonant has the sound of *s* in 'seat' (*Siena, corso*); *s* between vowels generally, but with exceptions, has the sound of *s* in 'rose'.

*z* is generally pronounced as *ts* in 'bits' (*Spezia*) but often as *dz* especially after *n* (*Firenze*). The many exceptions can only be learnt by experience.

Double consonants are frequent in Italian and represent a single, energetic, prolonged sound.

**Combined Letters.** The following combinations represent single sounds.

*ch* and *gh*, used only before *e* and *i*, when the *c* and *g* are hard (i.e. as *car* and *goat*): *chiave, S. Margherita*.

*ci* and *gi* before *a, o,* and *u* are soft and equivalent to *ch* in 'church' or *g* in 'gentle' (*provincia, giallo*); the *i* is not pronounced.

*gli*, representing the same liquid *l* as in Spanish *ll* (*ly* as one sound): *figlio, paglia*. The *i* is not pronounced when followed by another vowel.

*gn*, representing the same sound as Spanish *ñ* (similar to *ni* of 'onion'): *bagno, Bologna*.

*qu*, always pronounced as *kɥ* (*Squillace*).

*sc*, pronounced as *sh* before *e* or *i* (*Brescia*); otherwise as *sk* (*Ascoli*). The *i* in *sci* is not pronounced if followed by another vowel (*Sciacca*).

**Plurals and Diminutives.** Plurals usually terminate in *i*, but the



most common exception is that feminines ending in *a* change this to *e* in the plural.

Endings such as *-ino*, *-etto*, *-ello*, and their corresponding feminine forms are diminutive endings.

### *Place-names*

In general the spelling of place-names is phonetic and presents no difficulty, although, especially in southern Italy, there are frequently alternative forms, which are only slightly different (e.g. Porto Cesaro, Cesareo, or Cesarea). As a rule the spelling used on the Italian 1:100,000 maps has been used, except for coastal names, which have been spelt as in the *Mediterranean Pilot*. The anglicized forms of certain well-known towns and districts have been used, e.g.:

Apulia	<i>Puglia</i>	Rome	<i>Roma</i>
Florence	<i>Firenze</i>	Sardinia	<i>Sardegna</i>
Genoa	<i>Genova</i>	Sicily	<i>Sicilia</i>
Latium	<i>Lazio</i>	Syracuse	<i>Siracusa</i>
Leghorn	<i>Livorno</i>	Tiber	<i>Tevere</i>
Mantua	<i>Mantova</i>	Turin	<i>Torino</i>
Naples	<i>Napoli</i>	Tuscany	<i>Toscana</i>
Padua	<i>Padova</i>	Venice	<i>Venezia</i>

In the northern frontier region there are many place-names which have alternative forms, Italian and French in the west, Italian and German in the centre, and Italian, Slav, and also German in the east. Often the alternatives are recognizable forms of the same name (e.g. Bressanone, Brixen; Monte Bianco, Mont Blanc; Erpelle, Herpelje), sometimes they are translations (Picco dei Tre Signori, Dreiherrnspitze), but often the names are completely different in the two languages. This is particularly true of the Italian and German forms. The German forms can usually be located only by using the old Austrian maps (Ortisei, St. Ulrich; Postumia, Adelsberg; Colle Isarco, Gossensass; Monte Cervino, Matterhorn).

The following words (with plurals shown, e.g. bagno: *i*) frequently occur in place-names and on maps:

abbazia: <i>ie</i>	monastery, abbey	basso, <i>a: i, e</i>	low
albergo: <i>hi</i>	hotel	bianco, <i>a: hi, he</i>	white
alpe: <i>i</i>	high mountain, summer pasture	bivio	road junction
altipiano: <i>i</i>	plateau	bocca, bocchetta	pass, volcanic vent
alto, <i>a: i, e</i>	high	bonifica	reclamation, reclaimed land
bagno: <i>i</i>	bath	borgo: <i>hi</i>	village, small town
baia: <i>e</i>	bay	bosco: <i>hi</i>	wood
balza: <i>e</i>	cliff (p. 493)	cala	creek, cove



calanchi	badlands (p. 489)	foglio	sheet of paper or map
camino	way	fontana: <i>e</i>	fountain, spring
campagna	open country	fontanile: <i>i</i>	spring (Northern Plain)
campanile	church tower	forca	fork, pass
campo: <i>i</i>	field	fornace	furnace, kiln
camposanto	graveyard	fossa: <i>e</i>	ditch, watercourse
canale: <i>i</i>	canal, channel	frana: <i>e</i>	landslide
cantoniera	road-mender's hut	freddo, <i>a: i, e</i>	cold
capo (C.)	headland, cape	galleria: <i>e</i>	tunnel
capoluogo: <i>hi</i>	chief town of a district	ghiacciaio	glacier
cappella: <i>e</i>	chapel	ghiaia: <i>e</i>	gravel
casa: <i>e</i>	house	giogo	yoke, ridge, pass
casale	hamlet	gravina: <i>e</i>	gully, watercourse,
cascata	waterfall	(Apulia)	canyon
cascina: <i>e</i>	farm building	greco	north-east, north-east wind
castello	castle, fortified village	grosso, <i>a: i, e</i>	large
catena	chain	guado: <i>i</i>	ford
cava: <i>e</i>	quarry, valley	inferiore	lower
chiesa: <i>e</i>	church	isola: <i>e</i>	island
chiusa: <i>e</i>	barrier, enclosure	lago: <i>hi</i>	lake
cima: <i>e</i>	summit	laguna: <i>e</i>	lagoon
cimitero	cemetery	lazzaretto	quarantine station, isolation hospital
circondario	administrative district	legno	wood, timber
colla (Liguria)	pass	levante	east, east wind
colle: <i>i</i> , or col (local)	hill	libeccio	south-west, south-west wind
compartimento: <i>i</i>	division, group of provinces	lido	shore
comune: <i>i</i>	commune (municipality)	macchia	scrub, undergrowth
contrada	district	maestrale	north-west, north-west wind
corno: <i>i</i>	horn, peak	maggiore	greater
corso	boulevard	mar, mare	sea
costa: <i>e</i>	slope, sea coast	maremma	swampy district (Tuscany)
cresta	crest, ridge	marina	sea-coast, coastal suburb of an inland village
croce: <i>i</i>	cross	masseria: <i>e</i>	large farm-house
del, or dello, della; dei or degli, delle (d.)	of the	meridionale	southern
destro, <i>a: i, e</i>	right	mezzogiorno	midday, south
dogano	customs house	miniera: <i>e</i>	mine
dolina: <i>e</i>	doline (p. 38)	minore	lesser
duomo	cathedral	molino: <i>i</i>	mill
est (E.)	east	montagna	mountain
faro	lighthouse	monte (M., Mi.)	mountain
fermata	halt (on railway)	motoscafo: <i>i</i>	motor-boat
ferrovia: <i>e</i>	railway	murgia: <i>e</i>	hilly or barren district
fiatile: <i>i</i>	barn, hay-loft, farm	(Apulia)	navigable canal
fiumara (Fra.): <i>e</i>	torrent, bed of torrent	naviglio	black
fiume (F.): <i>i</i>	river	nero, <i>a: i, e</i>	north
foce	river mouth, valley opening, pass	nord (N.)	new
		nuovo, <i>a: i, e</i>	



orto: <i>i</i>	vegetable garden	salina: <i>e</i>	salt pan, salt-works
ospedale: <i>i</i>	hospital	San or santo, <i>a</i> (S.)	saint, holy
ovest (O.)	west	sasso: <i>i</i>	stone, crag
padule: <i>i</i> }	swamp, marsh	sbocco: <i>i</i>	outlet, river-mouth
palude: <i>i</i> }		scoglio: <i>i</i>	rock, islet, reef
pantano: <i>i</i> }		scolo: <i>i</i>	drain
passo	pass, passage, strait	scuola: <i>e</i>	school
passeggiata: <i>e</i>	promenade	selva: <i>e</i>	wood
pendenza: <i>e</i>	gradient	seno	small bay, cove
penisola: <i>e</i>	peninsula	sentiero: <i>i</i>	path
pescaia }	fishing pond, fishing-hatchery	serra: <i>e</i>	ravine, cross-range of mountains, height
peschiera }		settentrionale: <i>i</i>	northern
piana: <i>e</i> }	plain, plateau	sinistro, <i>a: i, e</i>	left
piano: <i>i</i> }		sopra	above
pianalto: <i>i</i>	high plain	sorgente: <i>i</i>	source, spring
pianura: <i>e</i>	large plain	sotto	below
picco	peak	spiaggia	beach, sea-shore
piccolo, <i>a: i, e</i>	small	stabilimento	establishment, works
piroscafo: <i>i</i>	steamer	stagno: <i>i</i>	pond, lagoon
piz (Central Alps) }	tip, peak	stavolo: <i>i</i>	mountain pasture with huts, tempo- rary Alpine dwell- ing
pizzo }		stazione	station
podere: <i>i</i>	peasant farm or hold- ing	strada: <i>e</i>	road
poggio: <i>i</i>	height, hill	sud (S.)	south
ponente	west, west wind	sul, sullo, sulla,	on the
ponte: <i>i</i>	bridge	sugli, sulle	
porta, portella	gate, pass	superiore: <i>i</i>	upper
porto: <i>i</i>	port, harbour	testa: <i>e</i>	headland, bluff
pozzo: <i>i</i>	well	tonnara: <i>e</i>	tunny-fishing station
prato: <i>i</i>	meadow	torre (Tre.)	tower, summit
punta: <i>e</i> (P.)	point, cape, headland, peak (Alps)	torrente (T.)	mountain torrent
rada	roadstead	tramontana	north, north wind
reale: <i>i</i> }	royal	tratturo: <i>i</i>	sheep-track
regio, <i>a: i, e</i> }		tumoleti	sand-dunes, hum- mocks
regione: <i>i</i>	region, compartment	valico: <i>hi</i>	pass
rialto	embankment, knoll	val, valle: <i>i</i> (V.)	valley
rio (R.)	stream	valle: <i>i</i>	lagoon
ripa }	bank, shore	vallone: <i>i</i>	large valley, arm of sea
riva }		vecchio, <i>a: i, e</i>	old
ripiano	plateau	via: <i>e</i>	road, street
riviera	strip of land between hills and sea, river	vigneta: <i>e</i>	vineyard
rocca: <i>he</i>	castle	villa: <i>e</i>	house with garden
roccia: <i>e</i>	rock	zolfara, zolfatara,	sulphur mine
rosso, <i>a: i, e</i>	red	or zolfiera	
rovina: <i>e</i>	ruin		
ruineri	ruins		
sabbia: <i>e</i>	sand		

### Textual References

Cross-references to Plates, Figures, and other pages are given in brackets. Road numbers in brackets are the official numbers of the State roads (*Strade Statali*).



FIG. 3. *Topographical Regions*



## CHAPTER II

# GENERAL PHYSICAL AND GEOLOGICAL DESCRIPTION

## GENERAL TOPOGRAPHY

THE form of Italy is that of a peninsula broadly rooted along its northern frontier in the continent from which it springs. A convenient distinction is therefore drawn between the continental and the peninsular parts of the country: a distinction which is invaluable in dealing with most aspects of the country's geography and also of its climate (pp. 406 ff.). A third part is formed by the islands.

The mainland consists essentially of the two mountain ranges, the Alps and the Apennines, which are separated by the Northern Plain, and of the smaller lowlands and subsidiary hill masses on either side of the Apennines. Continental Italy embraces the southern slopes of the Alps, the northern slopes of the Apennines, and the plains of the river Po and of Venetia lying between them. The Peninsula includes the Apennines and accompanying coastal belts on either side. Insular Italy includes Sicily and Sardinia and many small islands mainly in the Tyrrhenian Sea.

The Alps are much higher than the Apennines; there are over 100 peaks exceeding 10,000 feet in the Italian Alps alone, whereas in the Apennines few are higher than 8,000 feet. The Alps sweep right across the north of the country from Dalmatia in the east, and, curving ever more sharply, swing right round south and finally eastward in Piedmont and Liguria. The broad Northern Plain lies at their foot. The Apennines, continuous with the Alps, stretch from end to end of the Peninsula, broadening out in the centre and trending in such a way that they lie close to the Adriatic coast in the north, but close to the Tyrrhenian coast in the south. This arrangement leaves room for a wide area of confused hill ranges, plateaux, and small river plains in the northern part of the west side, and a similar area of somewhat simpler elements in the southern part of the east side. Sicily forms a westward continuation of the Apennines with a narrow, steep northern flank and a broad southern slope. Sardinia is quite unlike the mainland and consists of old, plateau-like mountains of hard crystalline rocks.



### *Topographical Regions*

The major divisions of continental and peninsular Italy can be subdivided into regions. *Continental Italy* divides into the Alps, including Istria, and the Northern Plain.

The *Alps*, a continuous and high mountain range of varied rocks of all ages and kinds, which have been highly folded, displaced and distorted, line the northern frontier from the Riviera coast to Istria, where they connect with the similar mountains of Dalmatia. The division between the Alps and the Apennines behind Savona is arbitrary and is marked by no break in the range. Farther north the Alps and their foothills rise sharply from the Northern Plain. The main belts of different kinds of rock (p. 28) and the trends of the subordinate ridges are approximately parallel to the range as a whole. A few valleys follow this same direction, but the only large longitudinal valley in Italy is the Valtellina (F. Adda). Most of the rivers have cut transversely across the main ranges, dividing them into separate massifs. Two of these valleys, those of the Ticino and Adige, can be used to make three major subdivisions. The *Western Alps*, from the Cadibona pass to Lake Maggiore include two mountains over 15,000 feet, Mont Blanc (M. Bianco, 15,782 ft.), and Monte Rosa (15,217 ft.), in addition to other lofty mountains such as M. Cervino (Matterhorn), Gran Paradiso, and Monviso, and altogether about fifty peaks over 10,000 feet. The *Central Alps* from Lake Maggiore to the Dobbiaco pass and the Adige valley are wider but not so lofty. Pizzo Bernina, M. Cevedale, and Ortles exceed 12,000 feet, and again there are some fifty summits which exceed 10,000 feet, many of them on the northern frontier of the Trentino (Southern Tirol). The *Eastern Alps* from Dobbiaco to Istria are characterized by an abundance of limestones and are generally lower than the other subdivisions. They include the picturesque Dolomites, which, in spite of their impressiveness, have only eighteen peaks over 10,000 feet (Marmolada, 10,972 ft.). Farther east the peaks are all below 10,000 feet. *Istria*, although a structural continuation of the Alps, forms a distinct subdivision, where a series of limestone plateaux extends, without any intervening plain, south-westward to the sea.

Communications through the Alps necessarily follow the valleys, and the great transverse streams are nearly all followed by good routes. Many of the valleys, however, have gorge sections, which are difficult to traverse (e.g. F. Adige below Trento), and the absence



of longitudinal streams makes communication from valley to valley difficult. The transverse routes are in many cases international and their relative importance depends on the nature and ease of the passes to which they lead.

The absence of longitudinal routes in the Alps is partly counter-balanced by the ease of communication along their foot in the *Northern Plain*. This, the most extensive plain in Italy (over 200 miles long and about 50 broad), is bounded on the west and north by the Alps and Alpine foothills, and on the south by the Apennines, which rise abruptly along a remarkably straight line. In the south-east the plain reaches the sea between Rimini and Monfalcone in a low-lying lagoon and delta coast of very irregular outline. The general flatness of the plain is broken by Monferrato, a northerly extension of the Apennines between Turin and Alessandria, and by the Mi. Berici and the Euganean hills, which rise like islands to the west of Padua. The general surface slopes gently towards the river Po and the sea. Along the Alpine margin the plain rises to 300–600 feet in the east and to 1,000–1,700 feet in the west.

The relief of the *Peninsula* is arranged in three parallel, longitudinal strips, dominated by the curved course of the Apennines which keeps close to the Tyrrhenian Sea in the north and south and to the Adriatic in the centre. On the outer, eastern side their limit is comparatively clear cut. The inner, Tyrrhenian side of the range is confused, both geologically and topographically, by the presence of interior lowland basins among the mountains, and of semi-isolated offshoots of the mountains in the lower country. The effect of all this on the subdivision of the Peninsula is notable. A central ridge of highland traverses its whole length, and occupies most of the 'toe'. The coastal belts sometimes are merely the lower maritime slopes of these mountains, as in Liguria or along the Adriatic coastland, but sometimes are composed of distinct physical regions, as in the Apulian Region, the Pre-Apennines and parts of Campania. These rather heterogeneous units are bound together, by their common maritime nature and importance as routeways, into two coastal belts, the west side and the east side of the Peninsula.

The *West Side of the Peninsula* includes a large number of independent units (plains, hill masses, &c.) which are roughly grouped into three sections, each with some characteristics in common. *Liguria* in the north is merely the lower slopes of the Maritime Alps and Ligurian Apennines where these come close to the sea. South of the river Magra, the *Pre-Apennine* region embraces a number of



distinct types of landscape. Its main distinguishing characteristic is a division into small physiographic units, the product of faulting and volcanic activity. Two major rivers, the Arno and the Tiber, are the main unifying influences. South of the Pontine Marshes, *Campania* is characterized by small alluvial plains and still active volcanoes, which, ensconced among limestone offshoots of the Apennines, hamper and canalize communications. Beyond the southernmost alluvial plain, that of the river Sele, the west coastal strip becomes extremely narrow, and widens only into much smaller river plains, which are included in Calabria. In Liguria and Calabria the mountains reach the west coast, which is steep. In the intervening Pre-Apennine and Campanian regions the fragmentation of the country is reflected in the alternation of hilly promontories and small plains with low-lying, straight shores.

The *Apennines* form the backbone of the Peninsula and are remarkably continuous both in themselves and with the Alps. From the Cadibona pass and Turin they trend south-east to the river Esino behind Ancona, south-south-east to the M. Maiella and the river Sangro, south-east again as far as the river Crati in north Calabria, thence south, and finally westwards into Sicily. Differences of rock type are more powerful differentiating factors than marked breaks in relief, of which there are only two, at Benevento and Catanzaro. In the north and south-east limestones are rare, in the centre and south-west they are common and give a distinctive character (p. 37) to the mountains. The *Northern Apennines* from the Maritime Alps to the river Metauro consist mostly of sandstones and clays. They do not generally rise above 6,000 feet, and are a comparatively simple, narrow chain. The *Central Apennines*, the highest and widest part of the range, have their main heights formed of limestone. This is particularly widespread in the Abruzzi, where are the highest peaks (Gran Sasso, 9,560 ft.). The *Southern or Campanian and Lucanian Apennines* are separated from the Central by the gap at Benevento and are, on the whole, considerably lower. Clays and sandstones form a larger proportion of the surface, but in the west and south there are limestones which rise in the Pollino massif to over 7,000 feet (Serra Dolcedorme, 7,451 ft.).

The *East Side of the Peninsula* is simpler than the west side. The *Adriatic Coastland*, including the lower Apennine slopes between Rimini and the river Fortore, is formed of Tertiary sands and clays, eroded into narrow ridges by short, straight streams flowing eastwards. The upper limit, as in Liguria, is somewhat arbitrary, but





Figure 1. The Indian subcontinent and the surrounding waters. The map shows the Indian Ocean to the south, the Arabian Sea to the west, and the Bay of Bengal to the east. The map also shows the major rivers of the region, including the Ganges, Brahmaputra, and Irrawaddy.



FIG. 4. Rock types



the region is much broader owing to the gentler slope of the mountains. Except at Ancona, the coast is straight and harbourless, and the coastal plain is nowhere wide. South of the mouth of the river Fortore, the *Apulian Region* is formed by two limestone plateaux with intervening plains of soft alluvial rocks. The two major promontories of Gargano and eastern Apulia correspond with the two limestone massifs, and the gulfs of Taranto and Manfredonia have at their heads plains which are connected with each other by the Taranto-Tavoliere corridor, and also with the coast near Termoli by a lowland to the west of M. Gargano.

*Calabria*, which is nearly separated from the rest of the Apennines by the wide, alluvial valley of the Crati, is distinguished by old, hard, crystalline massifs (6,000 ft.) with rounded landforms. These massifs rise above a setting of high platforms formed of younger and softer rocks which extend through the gap at Catanzaro and along the flanks of the mountains. The coast consists mainly of high promontories and long sections where the mountains fall directly to the sea, with small intervening lowlands. In the Marchesato, which includes both sides of the Crotona headland, the coast is comparatively low.

*Sicily*, the largest island in the Mediterranean, is physiographically similar to the Peninsula, from which it is separated by the narrow (2 miles) Straits of Messina. In the north the mountains form a continuation of the Apennines, crystalline like Calabria in the east, clay and sandstone like the Northern Apennines in the centre, and limestone like the Central Apennines in the west. The southern part is mainly a much dissected plateau (p. 37) of clays and sandstones sloping gradually towards the south. The east is complicated by the presence of the lava- and limestone-capped tableland of the Hyblaean hills (Mi. Iblei), the alluvial plain of Catania, and the volcano Etna. The coast from Termini east to Taormina is high and, but for the Milazzo peninsula, regular. The south-east and the west are marked by headlands and small bays, some with plains at their heads. The south coast is straight and difficult of access.

## GEOLOGY

THE geological evolution of Italy will be considered in five stages, which, it must be emphasized, are of unequal length; the first two stages represent enormous periods of time, and the last three relatively short periods. Nevertheless, Italy is geologically a new country and owes its present shape and structure mainly to the last three



## GEOLOGICAL TABLE

<i>Era</i>	<i>System</i>		<i>Rock types</i>	<i>Stage</i>
	Recent and Pleistocene		Modern beaches, sand-dunes, and landslips. River gravels, peat. Raised beaches. Glacial moraines and gravels of the Ice Age. Volcanic lava and tuff.	Fifth
	Pliocene		Marine sand and clay. Lake sand and clay.	Fourth
Tertiary	Main mountain-building period of the Alps and Apennines, and alteration of the earlier rocks, particularly in the Alps.			Third
	Miocene		Sand and marl with some limestone (partly earlier and partly later than the main mountain-building process).	
	Oligocene		Sand with some limestone. Lava-flows (Mi. Berici and Euganean hills).	
	Eocene		Altered gabbro and diorite, 'pietre verdi' (age uncertain). Granite intrusions of M. Adamello, &c. (age uncertain). Nummulitic limestone.	
Secondary	Cretaceous		Non-marine layers with bauxite. Marl, sand, and clay. Neocomian limestone.	Second
	Jurassic		Tithonian limestone. Bathonian limestone. Lias clay and limestone. Rhaetic marine band.	
	Trias	Upper	Principal dolomite (Eastern Alps). Carrara marble (Apuan Alps). Sandstone and marl (Western Alps).	
		Middle	Limestone and dolomite.	
		Lower	Sandy beds with some limestone.	
Primary	Permian		Mainly red sandstone and conglomerates. Porphyritic lava-flows (Dolomites).	First
	Carbo-Permian mountain-building (especially Carnic Alps).			
	Carboniferous		Fusulina limestone (Carnic Alps). Sandstone and anthracite (Western Alps). Marine limestone (Western Alps).	
	Devonian		Marine limestone.	
	Silurian		Graptolite shales.	
	Ordovician		Marine shales.	
	Cambrian		Slate with subordinate limestones.	
	Pre-Cambrian		Ultra-basic igneous rocks with diorite. Granite. Schist and gneiss.	

} age uncertain.



periods. The stratigraphical table will help to clarify the relationship of the periods. The distribution of different kinds of rock is shown on Fig. 4.

*First Stage.* The most ancient rocks known in Italy now outcrop in scattered areas and lie hidden beneath more recent material. These rocks represent mainly the worn-down stumps of an ancient mountain chain of Carbo-Permian age, but also incorporate fragments of yet older chains. All these rocks are more or less metamorphosed,<sup>1</sup> mostly crystalline, and often accompanied by ancient volcanic material, e.g. the lava-flows of the Trentino. Some of the present areas of these outcrops represent the faulted<sup>2</sup> fragments of former land masses, but others have been involved in later mountain-building movements, to which they owe their present position. Of the first type are (1) the granites, schists, &c., of Calabria, north-east Sicily, and Sardinia; (2) the Cambrian slates of Sardinia with which are associated the ore deposits of the Iglesias, and (3) the Permian sandstones of Sicily and Sardinia. Of the second type are (1) the Silurian and Devonian limestones of the Apuan Alps (in the Pre-Apenines, north of Lucca) and the Carnic Alps; (2) the Carboniferous limestones, with unimportant coal seams, found in the Carnic Alps, and, in the same area, the Carboniferous slates containing mercury obtained from the famous Idria mines; and (3) the Permian sandstones of Tuscany and many parts of the Alps. Italy's lack of coal is due largely to the formation of limestones instead of coal-bearing beds in Carboniferous times, and to the alteration by later mountain-building processes of such coal as was formed. For instance, in the Western Alps the coals have been altered into anthracites, or in some cases into rocks containing graphite.

This first stage was brought to a close by the folding of these rocks to form the Carbo-Permian mountain chains, already mentioned.

*Second Stage.* During this stage the materials worn from the Carbo-Permian mountains were laid down, together with other deposits, in a narrow sea which covered the position of Italy for almost the whole stage and may be regarded as the predecessor of the present Mediterranean. Conditions during this long period favoured the formation of limestones, which are abundant throughout the

<sup>1</sup> Metamorphic rocks are very rough and often massive, and consist of granite, sandstone, or almost any common type of rock, the structure or composition of which have been changed by heat or pressure. They are usually crystalline.

<sup>2</sup> Faults are fractures with the rocks on one side moved in relation to those on the other. The differential movement is often nearly vertical, and can range in different examples from 1 or 2 feet to many thousands of feet.



Mediterranean region. Limestone and dolomite (a rock much like limestone) of Triassic age occur in Italy in the Dolomites and many other parts of the Alps, in the famous Carrara marble of the Apuan Alps, and scattered throughout the Pre-Apennine region, the Southern Apennines, and western Sicily. In the Alpine foothills of Lombardy and Venetia these rocks contain some zinc and lead. Limestones formed during the succeeding Jurassic, Cretaceous, and Eocene periods are abundant in the Alps, and form the younger limestones of the Central and Southern Apennines, M. Gargano, eastern Apulia, and Istria and the Dalmatian islands. In the Northern Apennines, the Maritime Alps and Monferrato, clay and sand, particularly of Eocene age, take the place of limestone. Even in those parts of Italy where limestone predominates, deposition was not continuous, and periods of emergence of the land above the sea are marked by irregular layers of bauxite (aluminium ore), which are most common in the Cretaceous rocks of Istria, the Abruzzi, and eastern Apulia. Towards the end of this second stage, in Eocene and Oligocene times, the seas in which the limestones were formed became less extensive, and, as the land rose above the sea, lake-basins appeared. These basins were generally filled with deposits of sand and gravel, as in Sicily and the Southern Apennines, but sometimes they were floored with dead vegetation, which eventually became lignite, especially in Sardinia. In addition, volcanoes were active to the north-west of Padua, where their lavas form part of the Mi. Lessini, Mi. Berici, and Euganean hills.

*Third Stage.* During lower and middle Miocene times the seas of the preceding period were finally reduced to comparatively narrow areas and straits, separating land-masses the nuclei of which were the ancient blocks of the first stage, such as those of Sardinia, Sicily, and Calabria. In the seas round these and in lakes and lagoons deposition continued. The deposits laid down consisted mostly of sand and clay, together with some limestone, itself often sandy and clayey. The sand and clay occur in the Langhe and the Apennines from eastern Emilia to Umbria. A well-known example of this limestone is at San Marino, but others are found throughout the Apennines, particularly in the north, the Abruzzi, and Sicily. There are also detached outcrops in Apulia near Lecce, and in Sardinia. In the lake-basins lignite and gypsum were also formed, the latter particularly in Tuscany and in numerous localities along the eastern side of the Central Apennines. In many places the gypsum has been changed into sulphur by chemical action. Most of the sulphur deposits are



in central and southern Sicily, but they also occur on the eastern side of the Apennines, in the provinces of Pesaro, Ancona, and Forli, and near Catanzaro in Calabria.

The whole area was now caught up in the mountain-building movements, mainly of Miocene times, which produced the Alps and Apennines, together with other mountain chains, and caused the central Mediterranean to assume more nearly its present aspect. The building of these mountains consisted essentially of the folding or arching up of the rocks formed during the earlier stages, and of the thrusting or pushing of the lower rocks over the higher. At the same time the altitude of the mountains thus formed was increased by uplift only to be reduced by erosion (p. 33). The folding and thrusting took place along great arcuate lines, so that the Alps form a great curve from the Ligurian coast to the north and north-east, and the Apennines trend south-east from the Ligurian coast along the length of peninsular Italy, and finally west through Sicily. The same period saw, in addition, the construction of the mountains trending south-east through Istria to Dalmatia, and the more broken chain, which is still traceable from north to south through Corsica and Sardinia. The trend of the fold lines was much affected by the distribution of the ancient resistant blocks which remained after the disintegration of the earlier land masses. Troughs were also formed by subsidence between the main ranges; the Adriatic trough on the east and the Tyrrhenian trough on the west (p. 282).

Among the most notable secondary results of these mountain-building movements were (1) the alteration of some of the simple deposits of limestone, sandstone, &c., of the first two stages into metamorphic rocks (p. 25 footnote), and the changing of coal seams into anthracite and rocks containing graphite; (2) the formation of new rocks, e.g. some of the granite of Elba and Tuscany, the intrusion of which was accompanied by the formation of iron-ore, the granite-like rocks of M. Adamello, and the band of nickel-bearing rocks which runs north-east from Ivrea to Lake Maggiore; (3) widespread faulting, and (4) vulcanicity.

The arrangement of the rocks due to these movements was not identical in the Alps and in the Apennines. In the Alps the folding and thrusting were far more violent and the rocks exposed at the surface include those of both the first and second stages, whereas in the Apennines they belong mostly to the second.

In the *Alps* folding was very intense and much thrusting, with large-scale displacement of rock masses, occurred. There is now,



therefore, little direct correspondence between structure and relief. In spite, however, of the great diversity of rocks exposed as a result of this violent movement, it is possible to recognize, running nearly parallel to the direction of the range as a whole, three belts within which certain types of rock predominate. (1) The most westerly belt, consisting of mixed shales, slates, sandstones, and limestones, mostly of the second stage, occupies the Maritime Alps and the frontier region as far north as M. Blanc. It includes the detached granite and metamorphic masses of Mercantour (P. Argentera) and M. Blanc. (2) The second belt includes the bulk of the Italian Alps west of the Brenner. Here the rocks belong to the first two stages and are overwhelmingly metamorphic and crystalline. They include several masses of igneous rock, among which the granite masses of M. Cervino (Matterhorn), M. Rosa, Pizzo Bernina, and M. Adamello stand out. This belt includes most of the highest mountains east of M. Blanc. On the south it abuts directly on the Northern Plain between the Maritime Alps and Lake Maggiore, but thence eastward foothills of younger rocks intervene, and, widening eastward, form the beginning of the third belt. (3) This is relatively narrow between Lake Maggiore and the neighbourhood of Lake Garda, but widens out east of the latter to include the Dolomites, before passing right round the north and east of the plains of Venetia to merge into the south-east-trending Dinaric Alps. The rocks (Trias to Eocene), in contrast to those of the rest of the Italian Alps are mainly limestones. Some older rocks outcrop in the Carnic Alps, along the northern border, and near Idria in the east. The only granite masses are small (e.g. Cima d'Asta), but in the west this belt includes the great porphyry mass of the Trentino.

The first of these three belts swings round eastward in the Maritime Alps as far as the Ligurian coast near Savona. The hills between Turin and Genoa, accordingly, mark the north-western extremity of the Apennines.

The *Apennines*, unlike the Alps, have a fairly simple, folded structure, since thrusting and displacement were on a small scale. There is a certain correspondence between upfold and mountain ridge, downfold and longitudinal valley. The folding of the main range (2, below) was accompanied by the faulting and fragmentation of the country inside the bend of the arc, in the Pre-Apennine region (1, below). In the Apennines, as in the Alps, longitudinal belts can be distinguished. (1) The most westerly belt follows the west coast of Italy discontinuously, and consists of ancient metamorphic rocks and



granite in Calabria and in the Mi. Peloritani of Sicily. It also includes more recent limestones and sandstones (Permian and Triassic) which are found in Calabria, northern and western Sicily, and in the Pre-Apennine region, e.g. in the Apuan Alps, and in the hills west of Siena, known, on account of their iron and other ores, as the *Catena Metallifera*. Geologists are not agreed whether the rocks of Corsica, Sardinia, and Elba belong to this same belt or form the remains of an independent mountain chain. For present purposes, however, they can be regarded as part of this belt, since they include much ancient granite and folded rocks (Cambrian to Permian). To the east there is (2) a wider belt which occupies the main part of the Apennines. The mountains trend south-east from Turin to the river Metauro, whence they bend south to Terni and Rieti, and then resume the south-easterly direction from the Abruzzi to Lucania. The older rocks in this belt are mainly limestones (Jurassic, Cretaceous, and Eocene), which are most conspicuous in eastern Umbria and the Abruzzi. The Northern Apennines, however, are made up of coarse gravel, sandstone and shales (Cretaceous and Eocene). (3) The isolated limestone masses (Jurassic and Cretaceous) of Gargano and eastern Apulia are less disturbed than the rocks of the main Apennines, from which they are separated by a broad trough filled with later (Pliocene and Pleistocene) deposits.

The *Adriatic and Tyrrhenian Troughs* were formed, or at least greatly modified, by areas of subsidence partly bounded by faults, which left only the present ancient blocks above sea-level. Although much of the movement along these faults took place during this third stage, some movement continued during Pliocene and Pleistocene times and still persists, being one of the causes of earthquakes (p. 478).

The area of Adriatic subsidence includes the Northern Plain, filled with later deposits swept down from the mountains. No system of faults has been found round the plains of Lombardy and Piedmont, but in the mountains bordering the Venetian plains a great fault system, which has been aptly described as the 'frame of Adriatic subsidence', has been traced. The more important of these faults are the Judicarian Fault, extending north-north-east from Lake Idro to Merano (80 miles), the Schio Fault, from Schio to a point south-west of Padua (40 miles), several faults running almost east and west from near Trento by Belluno to Caporetto (combined distance 115 miles), and faults trending south-east from Caporetto and Gorizia, which continue down the Dalmatian coast. The main trend of the



Adriatic coast may also be governed by faults, and the protuberances of M. Conero near Ancona, Gargano, and Apulia may be blocks left standing above sea-level. The structure of these blocks is certainly more like that of Dalmatia than that of the Apennines.

Subsidence along the Tyrrhenian coast of Italy was local and irregular, being confined to relatively small, semicircular areas, entirely different from the long rectangular troughs of the Adriatic. This difference goes far to explain the contrast between the Adriatic coast with its long, straight lines and few islands, and the Tyrrhenian coast with its numerous bays and islands. The great number of volcanoes on the west side of Italy, in comparison with the few on the east may also be traced to the same cause.

*Fourth Stage.* During this stage, which includes Pliocene times, the main violence of the mountain-building processes of the previous stage had died down and more normal sedimentation was resumed in the sea, which extended on to the lower slopes of the present Alps and Apennines. Deposits were laid down in horizontal sheets, the lower consisting of clay, the middle of sand, the uppermost often of gravel. The flat tops of these sheets to-day form plateaux, usually up to heights of 1,300–1,500 feet above sea-level, which extend discontinuously round the Apennines and Sicilian mountains.

These plateaux are found in the hills between the river Arno, Volterra, and the south-west flank of the Chianti hills. They continue through the Siena trough, broaden out to occupy most of the country between M. Amiata and Lake Trasimeno, and can be traced south-eastward as far as Rome. Pliocene clays underlie the later volcanic formations near Rome and Naples, and the clays and sands pass through the Benevento gap, which separates the Southern from the Central Apennines. In Calabria the mountain ranges were large islands during the Pliocene stage, and are now separated by plateaux at 1,300 feet. In Sicily the clays, sands, and gravels outcrop at intervals all round the coast, and also occupy a broad band running south-west from Taormina and Catania to Agrigento and Cape Scalambri. In Apulia the Pliocene plateaux fill the ancient straits (Taranto–Tavoliere corridor) which formerly connected the gulfs of Taranto and Manfredonia. Deposits of this stage can also be traced up the Adriatic coast from San Severo to Ancona, and onwards in a narrow strip along the northern flank of the Apennines to Piacenza and Asti. The clays so often found near the bases of the plateaux, especially in the Peninsula, hold up valuable water-supplies in the sands above, but, at the same time, by lubricating the junction



between the sands and the clays, may also lead to disastrous landslides (p. 491).

While these deposits were being laid down in the sea, lakes were formed in basins among the Apennines, and many of their sites are now represented by wide, alluvial plains in the valleys, floored with Pliocene sands. The most noteworthy of these are situated in the Arno and Tiber basins and among the Lucanian Apennines. There are also smaller basins throughout the Central and Southern Apennines.

*Fifth Stage.* In Pleistocene times more clay, sand, and gravel deposits were laid down. As, however, the sea-level had fallen far below the high level of the Pliocene, the Pleistocene deposits form lower plains, which are coastal except in the Northern Plain, where, far inland, enormous spreads of gravel were swept down from the neighbouring mountains, especially from the Alps.

Pleistocene coastal plains are arranged, like the Pliocene plateaux, with a clay base, capped by sand and gravel, or occasionally by a limestone (*tufa*) layer. The flat, gravel capping tends to reach four definite levels, corresponding with the changing sea-levels of this period, namely about 300, 100, 50, and 15 feet. They are found here and there down the Tyrrhenian coast, mainly around the small plains, and fairly continuously from M. Argentario to M. Circeo. They are best developed, however, along the Ionian shore from the neighbourhood of Catanzaro to Taranto, along the whole Adriatic coast, and along the north, west, and south coasts of Sicily.

The climate during part of this stage deteriorated to the arctic conditions of the Ice Age. Alpine glaciers came down as far as the plain, the lowest points reached being marked by extensive morainic amphitheatres (p. 39) at the mouths of the main valleys, e.g. round Ivrea and south of Lake Garda. The Apennines also had small glaciers, distributed in three groups: one in the Apuan Alps (above 4,500 ft.), and on M. Cimone and M. Cusna (above 5,000 ft.); a second and larger group in the Abruzzi, Maiella, M. Velino, M. Viglio, the Meta, and Matese (above 5,500 ft.); and a third small group north-east of the gulf of Policastro, particularly on M. Pollino (above 6,000 ft.).

Volcanoes were also active during Pleistocene times and produced extensive deposits of tuff (in Latium), cones of mixed lava and ash (Naples), and lava-flows (west Sardinia). The distribution of the Pleistocene volcanoes shows that most of them, with the notable exceptions of M. Vulture and Etna, were connected with the



subsidence of the Tyrrhenian Sea (p. 27). For instance, the island of Capraia consists of lava-flows, and on the mainland there is to the north-west of Rome an important group of extinct volcanoes including M. Amiata, Mi. della Tolfa, Mi. Volsini, Mi. Cimini, and Mi. Sabatini, and, to the south-east, the Alban hills (mainly basaltic tuff). Most of these still retain the external shape of a volcano and some have crater lakes (p. 42). The Neapolitan group has the extinct Roccamonfina and the Ponza and Ventotene islands, and the active volcanoes of Ischia, the Campi Flegrei, and Vesuvius (lavas and tuff), which had become active in prehistoric times. Farther south the volcanoes were more scattered; e.g. Etna, which has a geological history similar to that of Vesuvius, the extinct volcanoes round Lentini south of Catania (basalt), and many of the islands round Sicily, including the Lipari islands, Ustica, Linosa, and Pantelleria. Finally there is an important group of extinct volcanoes on the west coast of Sardinia (basalts and trachytic lavas), and M. Vulture (a little lava, but mostly tuff) is isolated on the eastern side of the Apennines.

A few of these Pleistocene volcanoes are, as already noted, still active. These are restricted to the south of the Peninsula and to the adjacent islands, and consist of four principal groups: (1) round the bay of Naples, (2) the Lipari islands, (3) Etna, and (4) Pantelleria.<sup>1</sup>

The eruptions of the active volcanoes are accompanied by local changes of level. Still more serious, however, are the movements of rocks in the folded and faulted regions of the Apennines and Alps. Both of these types of disturbance give rise to earthquakes (*see* Appendix II). More all-pervading, however, than these earth-movements in the current modelling of Italy are the less spectacular geological processes of denudation and river deposition.

## LANDFORM TYPES

THE major divisions of the country, already outlined, are described in Chapters III and IV, where only the principal relief features can be outlined. It is, however, possible to distinguish certain broad types of country, many of which recur in several of the regions. With each of these types, the distribution of which is shown on Figs. 38, 47, 53, 65, are normally associated characteristic minor relief features.

<sup>1</sup> For further information about the type, frequency, and prediction of eruptions, see Appendix I.



No simple method of classification can be used for the landform types, since the form of the land is everywhere affected, either on a large scale or in detail, by at least three variable factors. The first of these is the nature of the rock, which may be hard or soft, porous or impermeable, soluble or insoluble. The second includes natural agencies modifying the landscape, and the period during which they have been active. The rock at the surface is continuously attacked by weathering and eroding agents, and the eroded material transported in glaciers and rivers until deposited farther downstream. Distinctive landforms are dependent on the prevalence of either erosion or deposition: erosion is dominant in mountainous and hilly country and deposition in plains, wide valleys, and under the sea. Earth movements (sometimes accompanied by volcanicity), which fold, uplift, and depress the outer crust of the earth, provide the third factor. The distinction between folded and unfolded rocks is not made on Figs. 38, 47, 53, 65, but in practice all rocks are more or less folded except for alluvium, Pliocene and volcanic rocks, and the limestones of Apulia. All the rocks of the Alps and Apennines, the north of Sicily and most of Sardinia, and the pre-Apennine region are highly folded. All three factors have helped to produce the present-day landscape, but usually one or two of the three are of preponderant importance.

If the maps do not make the most obvious of distinctions, namely that between mountains and plains, this is because such major contrasts are adequately depicted on topographical maps; the main concern of the landform maps is with the more detailed features of the landscape. Nevertheless, it is vital, when interpreting them, to bear in mind the broad distribution of the main mountain ranges (p. 20). This is facilitated by the fact that certain landforms are almost entirely confined to plains and others to mountainous and hilly districts. Littoral sands, the lagoon-delta zone, alluvial plains, alluvial and gravel terraces, and plains of volcanic material are all found in the plains, whilst the remaining classes are for the most part hilly or mountainous.

The following section distinguishes and describes the landform types shown on Figs. 38, 47, 53, 65, the key to which is here explained.

1. *Littoral Sands* or *Shingle* fringe the seaward edge of most of the plains. On those stretches of coast where loose sand is widespread, dunes tend to form. The most seaward of these are normally in gradual motion inland under the force of the wind, while the inner ones are usually fixed by a specialized vegetation cover or by pine



forests (p. 450). Occasionally the sands are lithified or cemented together by the percolation of lime-bearing waters (Plate 11).

2. *The Lagoon and Delta Zone.* This occurs particularly near the mouth of the river Po and along the northern shore of the Adriatic. Most Italian rivers build deltas out into the sea, owing to the weakness of tidal currents in the Mediterranean. This landform type occupies much the same general situation as the littoral sands, and in fact, within this zone, except in the actual deltas, littoral sands continue to form the seaward margin. The sands are succeeded inland by a series of shallow lagoons, either still connected with the open sea (*laguna viva*) or enclosed (*laguna morta*). Separating the lagoons, and to landward of them, there extend low, amphibious areas of silt, the scene of land reclamation activities which have been proceeding for centuries. Such areas are cut by many watercourses, either natural and tortuous, or artificial and straight. Much of the reclaimed land may be below the level of the sea and of the rivers.

3. *Alluvial Plains* are low, almost featureless stretches of alluvium, drained by sluggish, meandering rivers. Alluvium is a recent deposit of soft clay, sand, or gravel, not consolidated or lithified, and almost always more or less horizontal, as when laid down. The plains themselves are normally composed of fine silt, but on the margins of higher land coarser material occurs, merging into dejection-cones (p. 35). The alluvium is spread far and wide by floods and by the shifting of the river-course over the plain, which may be but little above or even below the level of the water in the rivers. Thus in the immediate flood plain there may be marshy depressions and ponds marking former river-courses. The chief example is the lower valley of the river Po, which flows between embankments for nearly 250 miles (Plate 15).

4. *Alluvial and Gravel Terraces* are a result of a lowering of base-level,<sup>1</sup> whether due to local uplift or to a fall of sea-level. The former flood plains and the coarser sand and gravel deposits found along their margins are then dissected into shallow and discontinuous terraces by the larger streams. These terraces tend to be arranged around the circumference of and above the present alluvial plains, but they may also be coastal. They slope gently upwards from the river, and their edges, not usually more than 30-40 feet in height, are sometimes fairly abrupt. Such terraces may be arranged in series one above the other, corresponding to periods of standstill during

<sup>1</sup> Base-level is the lowest possible level, down to which all rivers are attempting to erode their beds.



the lowering of base-level. Each tends to maintain a fairly uniform height above the river. Also included in this class, but of coarser material, are the terraces which line the larger valleys among the mountains, and the dejection-cones, or fan-shaped spreads of debris (e.g. that of the Stura di Lanzo, west of Turin), whether terraced or not. Dejection-cones are due to the fact that where a river leaves its mountain course and debouches on to flatter ground its speed is suddenly decreased, and it is not strong enough to carry all the material held in suspension. Much of the coarser debris is, therefore, dropped close to the mountain edge and the finer and softer material deposited farther downstream. The material of which all these landforms are made up is much the same as that of the alluvial plains, but on the whole coarser and more permeable. Although consisting of easily eroded material, terraces often preserve their original form in spite of later erosion owing to their low relative height and their porosity.

In the Northern Plain (p. 252) it is useful to distinguish the oldest and highest of the terraces, which, for the most part, take the form of terraced dejection-cones and outwash plains,<sup>1</sup> lying outside or between terminal moraines (p. 39). They consist of coarser material, mainly fluvio-glacial, i.e. coarse and angular debris provided in abundance by glaciers, and re-sorted into grades of fineness by running water (Plates 66, 84, 92).

5. *Marine Terraces* resemble the group of terraces already described, but, being formed as a result of falls in sea-level, are found at comparatively uniform levels. They are of two main types. The lower and younger (Pleistocene, p. 31) are generally found with their inner edges at about 300, 100, 40-50, or 10-15 feet, with a gradual slope towards the sea. Their seaward edge not uncommonly consists of a shingle bank, which makes a distinct 'step' (of about 100 ft. at most) up to the level of the terrace. They are an important and easily recognizable feature of the south of Italy (Plate 39). The higher and older terraces are generally less well preserved and consist of the remains of platforms cut by the waves in pre-existing rocks and later uplifted. These are common up to great heights in Calabria (p. 343).

6. *Conglomerates, Sandstones, and Clays*<sup>2</sup> give rise for the most part to hilly or mountainous landforms. These rocks occur in intermingled and varied beds and are of differing degrees of compactness, mainly,

<sup>1</sup> Outwash plains are formed by the conjunction of neighbouring dejection-cones.

<sup>2</sup> Some comparatively thin limestones are also present, but are too insignificant to give rise to a distinctive landscape.



but by no means entirely, according to their age. They are all comparatively recent (mainly Tertiary), but the most recent (Pliocene), owing to their peculiar characteristics, have been placed in a different category (cf. 7). The pre-Pliocene rocks are in general, with the exception of some of the sandstone beds, soft and easily eroded. Their porosity varies greatly, but owing to the alternation of beds of clay and sand no massive porous beds occur. Such rocks when raised above sea-level are quickly dissected by the formation of valleys. On the whole, in this type of landform, valleys with steep and sometimes unstable slopes abound. In certain areas of soft and incoherent clay, especially the laminated clays (*argile scagliose*), where erosion is vigorous, a common form is that known as *calanchi*<sup>1</sup> corresponding to the *badlands* of America (Plate 99). In such areas erosion is continuous and so rapid that the formation of true soil and the establishment of any protective cover of vegetation are both impossible. The rock is continually being eaten away to form a wilderness of little gulleys and ridges, useless for agriculture and practically useless for pasture. In similar areas and especially where, in interbedded clays and sands, the dip of the strata is in the same direction as, but less than, the slope of the land, landslips (*frane*)<sup>2</sup> may occur. When the removal of the underlying clay causes the downfall of the more resistant sand or limestone, a fairly steep and rapidly eroded clay slope, crowned by a sand or limestone escarpment (*balza*), is formed (Plate 102). Calanchi and landslips are a great handicap to communications, since it is difficult, if not impossible, to find a stable road bed, not menaced either with undermining or with blockage from above. In country liable to either danger, lines of communication normally follow the ridges. These forms of instability are, however, confined to the softest rocks and to regions where the streams have an exceptionally steep fall. Elsewhere more indeterminate and modulated topography (Plate 140) prevails, though sometimes there are fairly narrow, V-shaped valleys. Beds of harder rocks stand out, but the landscape is more permanent. In such country, roads follow the valleys (Plate 119).

7. *Pliocene Plateaux and Basins*. Plateaux are level surfaces raised upward *en bloc*. They may be in varying states of preservation according to their age, their height, and the resistance of the rock of which they are formed. The original surface, known as a peneplain, is sometimes only recognizable by the roughly uniform height and flattened summits of the hills into which the plateau has been

<sup>1</sup> See Appendix III.

<sup>2</sup> See Appendix IV.



dissected. Basins result from the local depression of the earth's crust by faulting and sometimes introduce areas of lowland into abnormal inland intermontane positions. This group of landforms must be distinguished because of the great importance of the platforms built in sands and clays of Pliocene age around much of the coast of Italy, and because similar rocks floor many of the interior basins of the Apennines. These deposits resemble the others of Tertiary age, but are on the whole looser and more easily eroded, contain fewer beds of consolidated sandstone, and are horizontal or slightly tilted, but not folded. The distinction between Pliocene and other rocks is thus hardly anything more than one of age, nor do the Pliocene rocks everywhere constitute either plateaux or basins (Plate 131).

In the west and south-east of Sicily and in the north of Sardinia, Pliocene and late Miocene rocks, protected by a resistant calcareous layer, form noticeable and well-preserved plateaux.

8. *Crystalline Rocks* are confined to the older geological formations in the Alps, Calabria, and Sardinia, and are usually hard and impermeable, nearly always highly folded and often metamorphosed (p. 25). They are thus capable of preserving their original surface-form better than soft rocks, but are usually much dissected, e.g. in Calabria. The resulting forms are similar to those evolved in softer rocks except that the landscape is usually more stable and bold. Abrupt scarps due to undermining are absent, but steep-sided valleys and gorges are formed where the rock is sufficiently resistant, and where the process of dissection is not far advanced, e.g. the granite plateau of the Sila in Calabria. Some softer crystalline rocks (schists and phyllites) occur, together with their typical more rounded landforms, especially in Calabria and north-east Sicily.

9. *Limestone* is usually hard and resistant to the normal forces of erosion, but, being subject to chemical action both at the surface and underground, is highly porous and soluble in rain-water. The consequent landforms, however, vary according to the purity of the limestone and to the degree of interbedding with other, impermeable rocks. Where massive limestone beds have been uplifted bodily to form plateaux, these are often in a very perfect state of preservation owing to the porosity of the rock, which does not permit the appearance of running water on the surface at all. It is in this type of landscape that the peculiar features of land sculpture in limestone rocks are shown in extreme form. In such excellent examples as the plateaux of the Apulian Murge (Plate 138) and the Carso of Istria (Plate 89) surface water is entirely absent. This development



of underground drainage by solution of the rock leads to other peculiarities, such as enclosed depressions, both small (Ital. *foiba*, *buso*, Slav. *dolina*) and large (Slav. *uvala*, *polja*), pot-holes (Slav. *ponor*), blind valleys, dry valleys, copious springs at the edge of the limestone, the disappearance of rivers, and the presence of bare rock or only a thin covering of soil. Such plateaux are by no means always flat. They may be crowned by a series of gentle ridges (Mi. della Vena) and, even if originally flat, they are probably pitted with small depressions, and may be crossed by deep canyons (Plate 88), which are either dry or followed by streams usually originating outside the limestone area.

In the intensely folded regions of the limestone Apennines and south-eastern Alps the frequent outcrop of other rocks hinders the development to the full of all the most distinctive limestone characteristics just described. The limestone masses, however, stand out as rugged highland, the shape of which often depends on the dip and original form of the rock, preserved by its porosity (Plate 144). The isolated hills of western Sicily are good examples of this.

10. *Glaciated Highlands* are limited to areas which have been subjected to the special form of erosion associated with ice. This, though very restricted at the present day, was in the recent geological past (Pleistocene) active in the Alps and higher Apennines, with the result that the topographical features produced by the action of mountain glaciers are still dominant in the landscape of these areas. Such features are remarkably similar in all parts of the world and in very diverse types of rock. For instance, the Italian glaciated mountains, although on a larger scale, are somewhat similar to those of the Lake District, North Wales, and the Scottish Highlands, in Great Britain. Characteristic of the higher parts of these districts is the cirque or corrie (*circo*), a steep-sided, armchair-shaped hollow, filled sometimes by a small glacier, sometimes by a tarn, or sometimes dissected and drained. The conjunction of two or more of these corries in a mountain-mass produces the typical Alpine form of a quasi-pyramidal peak, surrounded by a series of arêtes or ridges (*creste*) between neighbouring corries.<sup>1</sup> The principal valleys are made up of long, straight stretches along which an uninterrupted view can be obtained. Their longitudinal sections normally resemble a series of steps, the lower part of the flat portion being sometimes

<sup>1</sup> The Matterhorn (M. Cervino) is a very perfect example of this form and Striding Edge with its two corries in the side of Helvellyn is a typical English example of the arête. Plates 47 to 85 illustrate glacial forms.



occupied by a long, narrow lake, usually deep, and the steep portion by a gorge or waterfall. Their cross-sections are typically U- rather than V-shaped. The tributary valleys may 'hang' above the main valley, descending to it with a marked drop, so that access from the main to a tributary valley is often difficult. These peculiarities of glaciated valleys are of the utmost importance in affecting communications, and in creating a hydrography and relief almost perfect for the establishment of hydro-electric plants. The kind of rock makes comparatively little difference to this type of landform. In the relatively soft conglomerates, sands, and clays, however, glacial forms are less well preserved, as subsequent river erosion has gone far to obliterate them. They are found high up among the older and more consolidated rocks of the Northern Apennines and Maritime Alps. In crystalline and limestone rocks, glacial forms are well preserved. Some peculiar features are associated with the limestone Alps. Precipitous and rocky slopes are here rather more common at lower altitudes than elsewhere in the Alps, and among the Dolomites there are many high, flat-topped, almost pillar-shaped mountains.

11. *Terminal Moraines* are a direct result of the Pleistocene glacial period and are practically confined to the mouths of the main glaciated valleys along the Alpine margin of the Northern Plain. They consist of a series of mounds, composed of debris of all sizes, from large boulders to the finest clay, mixed indiscriminately together and deposited by a glacier at its terminus. These mounds are arranged to form 'morainic amphitheatres', rings of confused hillocks, rising sometimes to a relative height of as much as 1,000 feet, but usually much less. They are often wooded, and interspersed with depressions, sometimes marshy or lake-filled. Normally below the line of the terminal moraines, both on the margin of the Northern Plain and up glaciated valleys, there are fluvio-glacial terraces and dejection-cones along the sites of former ice-margins (p. 251).

12. *Volcanic Forms* depend largely on the character of the rock concerned and the form and place of eruption. Volcanic rocks are of two types. Lavas are hard and resistant, whilst tuffs consist of ash and scoriae, together with a certain amount of lava and other debris, arranged generally with the coarser material nearest the source of activity. All these are more or less compacted together, and vary in hardness and porosity according to the fineness of the material and the compactness of the rock.

(a) Volcanic cones are familiar features to most people from pictures of Vesuvius and Etna (Plates 110, 150). There are, however,



many different types. The simple, active cone, made up of ash with interspersed lava-flows, has an even slope on all sides, increasing from a low angle (less than  $10^\circ$ ) near the base, to a steep slope composed of loose fragments near the crater (more than  $25^\circ$ ).<sup>1</sup> The upper slopes of the active volcano are usually waterless owing to the porosity of the ash, but springs break out lower down. Most volcanoes have smaller subsidiary craters which spoil their symmetry; Etna is remarkable for the number of these. The Campi Flegrei, on the other hand, show a multiplicity of small independent cones and shallow craters, and have no principal cone (Plate 109).

Extinct volcanic cones are more or less destroyed by subsequent erosion. The loose material tends to be removed, so that the harder lava stands out. The crater may be occupied by a lake or broken up into several peaks forming a rough circle (M. Ferru, Alban Hills). Valleys run radially down the slopes and leave long, narrow ridges between.

(b) Lava plateaux are composed of great sheets of lava, with little admixture of ash, which have flowed over wide areas. Numerous tablelands at different levels are formed by the bedding planes of the lava-flows, with steep, abrupt edges coinciding with the vertical joints. This type of landscape is found only in Sardinia. Plateaux may also be formed in tuffs, as around the series of old volcanoes north and south of Rome. Here the original lower and very gentle slopes of the cones have been cut by radially draining streams. The term plateau is misleading in so far as it implies that the surface is horizontal, but justifiable to the extent that patches of the original smooth surface are preserved between the valleys. The degree of this preservation varies according to the composition and arrangement of the rocks. Where formed by a layer of hard lava the original surface remains intact and the valleys are steep-sided gorges. Beds of travertine and lithified debris have somewhat the same effect. Where, however, the tuff is softer and more homogeneous, the surface has been carved into comparatively rounded valleys and ridges.

(c) Plains of volcanic material may be formed in tuffs at low levels (e.g. the Terra di Lavoro behind Naples), and differ little in appearance from alluvial plains.

	Mean slopes				
	0-660 ft.	660-1,600	1,600-3,000	Above 3,000	Above 3,400 in 1906
Vesuvius	$4^\circ 54'$	$13^\circ 26'$	$15^\circ 36'$	$24^\circ 52'$	$30^\circ 22'$
	2,600-5,900	5,900-9,350 (SE.)	5,900-9,850 (NE.)	Above 9,850	Above 10,200
Etna	$10^\circ 46'$	$18^\circ 21'$	$23^\circ 44'$	$19^\circ 30'$	$26^\circ 48'$



## LAKES

THERE are in Italy (excluding Sardinia) about 365 lakes<sup>1</sup> of natural origin, as well as about 132 artificial reservoirs (in 1926). The natural lakes vary greatly in size and shape, according to their origin, but may be classified in five groups: (1) glacial lakes, (2) lakes of limestone districts, (3) volcanic crater lakes, (4) lakes dammed back by landslides or alluvium, and (5) coastal lagoons. All classes except the last are found mainly among the mountains.

*Glacial Lakes.* These occupy rock basins hollowed out by glaciers which have since disappeared (p. 31), and may be further subdivided into (a) small, high mountain lakes or tarns, and (b) large valley lakes.

(a) Lakes belonging to the first variety are small, usually with an area of less than 100 acres, fairly round in shape, and often deep for their size. Over half the Italian lakes belong to this type, which is common in the Alps above about 6,000 feet and also high up in the Apennines. A notable example is Lake Moncenisio, west of Turin.

(b) The large lakes in the lower parts of the Alpine glaciated valleys also occupy deep rock basins, though their position and existence may be due in addition to the ponding back of water by the morainic barriers at their lower ends. The lakes are of great depth, long and narrow, and often with islands. With the exception of Lake Orta, which has a northern outlet, they are drained southwards by rivers which cut through the morainic barriers to the Northern Plain. Mountains usually rise steeply on either side of these lakes.

Lake Orta, the westernmost of this class, is small and almost entirely surrounded by mountains. Maggiore, in the valley of the Ticino, is the second largest. It is longer, narrower, and slightly deeper than Garda, and has a lateral bay between Stresa and Pallanza. The upper end near Locarno is in Switzerland. Lake Lugano, farther east, has an irregular outline with three long, narrow arms, two of them fairly straight, and the third curved. The greater part is in Switzerland. Como, the deepest of these lakes, ranks as the third largest. It lies in the valley of the river Adda and has three long, narrow arms, the south-eastern being known as Lake Lecco. Between Como and Garda are two smaller lakes. Iseo, in the valley of the Oglio, east of Bergamo, is almost S-shaped with a large island

<sup>1</sup> A list of the more important lakes is found in Appendix V.



near the centre. Idro is the smallest and shallowest of the lakes in this group, and is also the highest above sea-level. It lies in the valley of the Chiese and is entirely surrounded by mountains, except for the morainic ridge at its southern end. Garda, the last and largest of these lakes, is the lowest in altitude. The narrow upper stretches are surrounded by mountains, but in the south it expands to greater width among the morainic hills (p. 39). Most of these lakes completely fill the bottoms of the valleys in which they lie, leaving very little space along their sides for road or railway. This is particularly noticeable in the middle reaches of Lake Garda.

*Lakes of Limestone Districts.* These lakes are usually small, and occupy irregular hollows of widely varying depth in the limestone surface. Their natural drainage is often by underground channels instead of by surface streams. The water-level is inclined to vary, in some by a few feet only, but in extreme cases the lakes periodically disappear altogether. Sometimes the variation is seasonal, depending on the rainfall, but in other cases (Lake Canterno, east of Rome) the lake is liable to disappear at quite irregular intervals, depending probably on the amount of blockage in the underground channels by which it is drained.

Some lakes of this type are found in the Venetian Alps; of these Lake Morto is a good example. Others occur in the Apennines, e.g. Lake Matese, which is situated on a high limestone plateau, and, although covering a considerable area, had a maximum depth of only about ten feet before it was artificially enlarged. Lake Scanno also belongs primarily to this type, but was probably enlarged when the surface outlet was blocked by a landslide.

*Crater Lakes.* These occur in the craters of extinct or dormant volcanoes, mostly near Rome and west of Naples. They vary considerably in size, are roughly circular in shape, usually deep, and, as they occur near mountain-tops, do not have large inflowing streams. Some have a natural surface outflow, others have none, or are artificially drained. The chief examples are lakes Bolsena, Vico, and Bracciano north-west of Rome, Albano and Nemi south-east of Rome, and Averno in the Campi Flegrei west of Naples. Lake Agnano, a second crater lake in this vicinity, has been drained in recent times, and is now an alluvial flat (Plate 109).

*Lakes dammed back by Landslides or Alluvium.* The lakes of this group are usually small, with the notable exception of Lake Trasimeno, shallow, and irregular in shape.

Many small lakes are held among the morainic hills at the mouths



of the Alpine valleys, especially near lakes Como and Maggiore. The largest of these is Varese; others, such as Viverone (near Ivrea), Monate and Comabbio (near Varese), and Pusiano and Annone (near Como), are only 1 or 2 miles long. These tend to be deeper than the true alluvial lakes, but resemble them in having an irregular outline.

The best-known example of an alluvial lake is Trasimeno. It is near the south-east end of the alluvial basin of the Val di Chiana, and is perhaps a remnant of a larger, ancient lake. In spite of its large area it is nowhere more than about 20 feet deep. The small Lake Gurrida, north-west of Etna, disappears altogether in the summer. Some of the small valley lakes, such as Lake Alleghe in the valley of the Cordevole, are due to landslides damming back rivers. Lake Scanno in the Abruzzi, though a 'limestone' lake, is considered to have been enlarged by a landslide.

*Coastal Lagoons.* These are mostly shallow sheets of water only a few feet above the sea, or at sea-level. They are separated from the sea by beaches or sand-dunes, and are usually bounded on their landward side by alluvium. Sometimes small streams flow into them, but there is often no direct outlet to the sea.

Lagoons are distributed at intervals round the coast, but those on the Adriatic coast tend to be larger than those on the Tyrrhenian. Among the latter the chief examples are Lake Massaciuccoli and the lagoons at Orbetello in Tuscany, lakes Fogliano and Paola bordering the Pontine Marshes, Lake Fondi farther east on the same coast, and Patria and Fusano west of the Campi Flegrei. On the Adriatic coast the large lagoons of Varano and Lesina are grouped round the Gargano peninsula. The lower parts of the Po delta are permanently flooded and form large, intricate sheets of water. The biggest of these, the Valli di Comacchio, are south of the river. Finally there is the almost continuous series of lagoons from Venice to the mouth of the Isonzo, but most of these are open, tidal lagoons.

*Drained Lakes.* Several former lakes have been artificially drained, yielding valuable areas of agricultural land. The largest of these was Lake Fucino, in the Abruzzi, finally reclaimed between 1854 and 1876. Several rivers, including the Foce and Giovenco, flow into this area, which is drained by a tunnel through the mountains to the river Liri at Capistrello. The areas of coastal lagoons round many parts of the coast have been much reduced.



## RIVERS

## DRAINAGE PATTERN

THE watershed between the Tyrrhenian and the Adriatic and Ionian drainage systems is formed by the Apennines. The contributions made to the total by these systems have been estimated as:

To the Adriatic . . . .	69 per cent.
To the Tyrrhenian . . . .	21 „
To the Ionian . . . .	4 „
Sicily and Sardinia . . . .	6 „

The high percentage of water flowing into the Adriatic is due to the size of the catchment area of the river Po (27,367 sq. miles), which, it has been estimated, carries 38 per cent. of the total volume of water flowing in Italian rivers. The next largest catchment areas are those of the Tiber (6,382), Adige (4,531), and Arno (3,173).<sup>1</sup>

*The Rivers of Continental Italy*

These flow either into the river Po or independently across Venetia to the Adriatic. The Alps form the main watershed to the west and north. The Apennines, which cut off continental from peninsular Italy, form the watershed of the Po basin on the south.

*The Po Drainage.* The river Po (navigable to Casale Monferrato) is the longest river in Italy (407 miles), and drains the whole of the Italian Alps between the river Tanaro and Lake Garda, the northern Apennines as far east as Modena, and the bulk of the Northern Plain. It rises in some small lakes on the northern slopes of Monviso, and flows as a mountain stream for 20 miles before turning northward to Turin. Thence it rounds the north side of Monferrato and meanders some 300 miles to the delta.

The main left-bank tributaries are mountain streams, flowing for various distances across the plains from the Alps. The chief are the Dora Riparia (68 miles) from the Mont Cenis, Dora Baltea (150 miles) from the Aosta valley, Sesia (80 miles) through Vercelli, Ticino (136 miles) through Lake Maggiore, Adda (174 miles) through Lake Como, Oglio (155 miles) through Lake Iseo, and Mincio (124 miles) through Lake Garda.

On the right bank the drainage from the Maritime Alps and Ligurian Apennines is collected by the Tanaro (105 miles), which

<sup>1</sup> The catchment area of the Thames above Teddington lock has been estimated at 3,800 square miles, with a length of 150 miles. For detailed data on Italian rivers see Appendix VI.



flows south of Monferrato through Asti and Alessandria. The main Apennine tributaries are the Trebbia (72 miles), Taro (93 miles), Enza (57 miles), Secchia (98 miles), and Panaro (103 miles). The Reno formerly joined a branch of the Po but now has an independent outlet south of the delta.

*The Venetian Rivers.* The most important is the Adige (*Ger.* Etsch), which has a length of 255 miles and a catchment area of 4,531 square miles. It rises in a chain of lakes below the Resia pass, flows through the Alps for more than half its course, and emerges on to the plain above Verona. The two main tributaries are the Isarco (*Ger.* Eisack) and Rienza (*Ger.* Rienz), which join 24 miles south of the Brenner pass and meet the Adige at Bolzano.

Four other important Alpine rivers, the Brenta (108 miles), Piave (137 miles), Tagliamento (106 miles), and Isonzo (85 miles), flow to the head of the Adriatic Sea.

### *The Rivers of Peninsular Italy and Sicily*

The watershed follows the trend of the Apennines (p. 300). In the north it is so near to the Ligurian coast that some of the tributaries of the river Po rise within a few miles of the gulf of Genoa. In the Central Apennines the watershed is close to the east coast, but in Campania, Lucania, and Calabria it again approaches the west. In general, the rivers flowing south-west into the Pre-Apennine region change direction frequently, owing to the north-west to south-east ridges, and have many tributaries; those flowing to the north-east, except the Pescara, have short, straight, and simple valleys and few important tributaries.

*The Western Apennine Rivers.* North of the Arno basin the only rivers of any size are the Magra (40 miles) and its tributary the Vara, and the Serchio (64 miles). The Arno (150 miles, 3,173 sq. miles) is much the same size as the Thames (p. 44, footnote). It rises in the Apennines only 20 miles east of Florence, and follows a most circuitous course to Pontassieve, whence it flows westward to Pisa and the sea. These deviations are due to the grain of the country and to the presence of former lake basins (p. 37), notably those of the Casentino, Valdarno, and Florence, which now form alluvial areas connected by sections of narrow valley. The Ombrone (100 miles) drains much of the country between the Arno and the Tiber.

The Tiber (*Ital.* Tevere), like the Arno, connects a number of lake basins including the Val Tiberina and the basin of Spoleto, but has a more direct course (250 miles, 6,382 sq. miles). From Todi



to Orvieto there is a transverse, gorge-like section. Below this the river separates the Apennines from the volcanic hills of Latium, through which it flows to Rome and the delta. The chief tributaries are: on the left bank, the Nera, which drains the alluvial basins of Terni and Rieti; on the right bank, the drainage from Lake Trasimeno and the river Paglia.

The chief rivers of Campania are the Liri (77 miles; Garigliano in its lower course), Volturno (115 miles), and Sele (46 miles). All these have large tributaries and courses made tortuous by the north-west to south-east grain of the mountains.

*The Eastern Apennine Rivers.* The rivers flowing into the gulf of Taranto include the Crati (50 miles), draining an interior basin in northern Calabria, and the Sinni (58 miles), Agri (69 miles), Basento (93 miles), and Bradano (73 miles). Except for small streams near Taranto and Otranto, there are no rivers in Apulia between the Bradano and the Ofanto.

The chief rivers of the Adriatic coast (from south to north) are the Ofanto (83 miles), Fortore (53 miles), Biferno (52 miles), Trigno (52 miles), Sangro (73 miles), Pescara (90 miles), draining the Sulmona basin and the longitudinal trough of the Aterno, Tronto (58 miles), Metauro (68 miles), Savio (62 miles), Montone (56 miles), Lamone (62 miles), and Reno (137 miles). The courses of these rivers are remarkably straight and their main direction is north-east.

*The Rivers of Sicily.* The main watershed of Sicily follows the mountains close to the north coast as far west as the river Torto. The principal rivers are (1) the Salso (c. 80 miles, 818 sq. miles), which drains to the south-west coast; (2) the Simeto (71 miles, 707 square miles), draining the plain of Catania to the east coast; and (3) the Platani, also draining to the south-west coast.

#### RIVER REGIMES

All Italian rivers are subject to great variation of flow at different times of the year, some of them even drying up altogether during summer. This feature, which is usually much more marked than, for instance, in England, is characteristic, though to a varying degree, of the whole Mediterranean region.

The rivers of northern Italy, including the river Po, vary less than those of southern Italy. The Adige, a typical example of a northern river, has a flow at Verona of 1,760 cubic feet per second at low water and 64,000 in flood. In the south most rivers, except the largest, dry up altogether during drought. The Simeto, for example,



has about 35 cubic feet per second at low water and 38,200 during flood. Throughout the Peninsula all small streams become dry in summer, with a few exceptions in limestone districts. The length of the period during which streams are dry varies from north to south of the Peninsula; in Liguria it is only a few months, whereas in Calabria it is as long as six months or more. The *fumara* of Calabria and Sicily is an exceptionally variable type of torrent (p. 343).

The chief factors affecting river regime, i.e. volume and seasonal distribution of flow, are (a) the rainfall regime in the catchment area, (b) the melting of winter snow and of glaciers, (c) the presence or absence of lakes, (d) the permeability of the rock, and (e) the vegetation cover. Not all these factors affect the different aspects of river regime to the same extent.

The seasonal distribution of rainfall (p. 424) is shown on Fig. 75. North of a line which follows approximately the rivers Tanaro and Po there is a winter minimum, and south of it a summer minimum of rainfall, but over most of the country there are two rainy seasons and two relatively dry intervening periods. The seasons of low water in the rivers agree well with the rainfall minima. Rivers north of the Tanaro and Po reach their lowest level in winter, when freezing helps to reduce the flow of the Alpine streams; rivers south of this line have low water in summer. Floods, on the other hand, are not so exactly synchronized with periods of maximum rainfall; they occur in summer in the extreme north of Italy, in winter in the south, and in a large intermediate area, in spring and autumn.

The time of the thaw and quantity of melting snow affect both season and volume of high water. Melt-water is most abundant in the Alps (Fig. 5 B), where the thaw takes place slightly later than in the Apennines. Its main effect is to extend the duration and the height of the spring flood, rather than to cause an independent flood. Glaciers, which appreciably influence only the Dora Baltea, Adda, and Adige, melt later in the year than snow, and contribute most in July and August. Their effect is, however, much less important on the Italian rivers than on the glacier-fed rivers of Switzerland and the French Alps.

Lakes exert a powerful influence on the regime of rivers. Without affecting their total volume of flow they considerably reduce their range of variation and slightly retard the date of high and low water. This effect is only appreciable in rivers draining large lakes or a large number of smaller lakes, and its extent depends roughly upon the ratio between the total catchment area drained by the river in



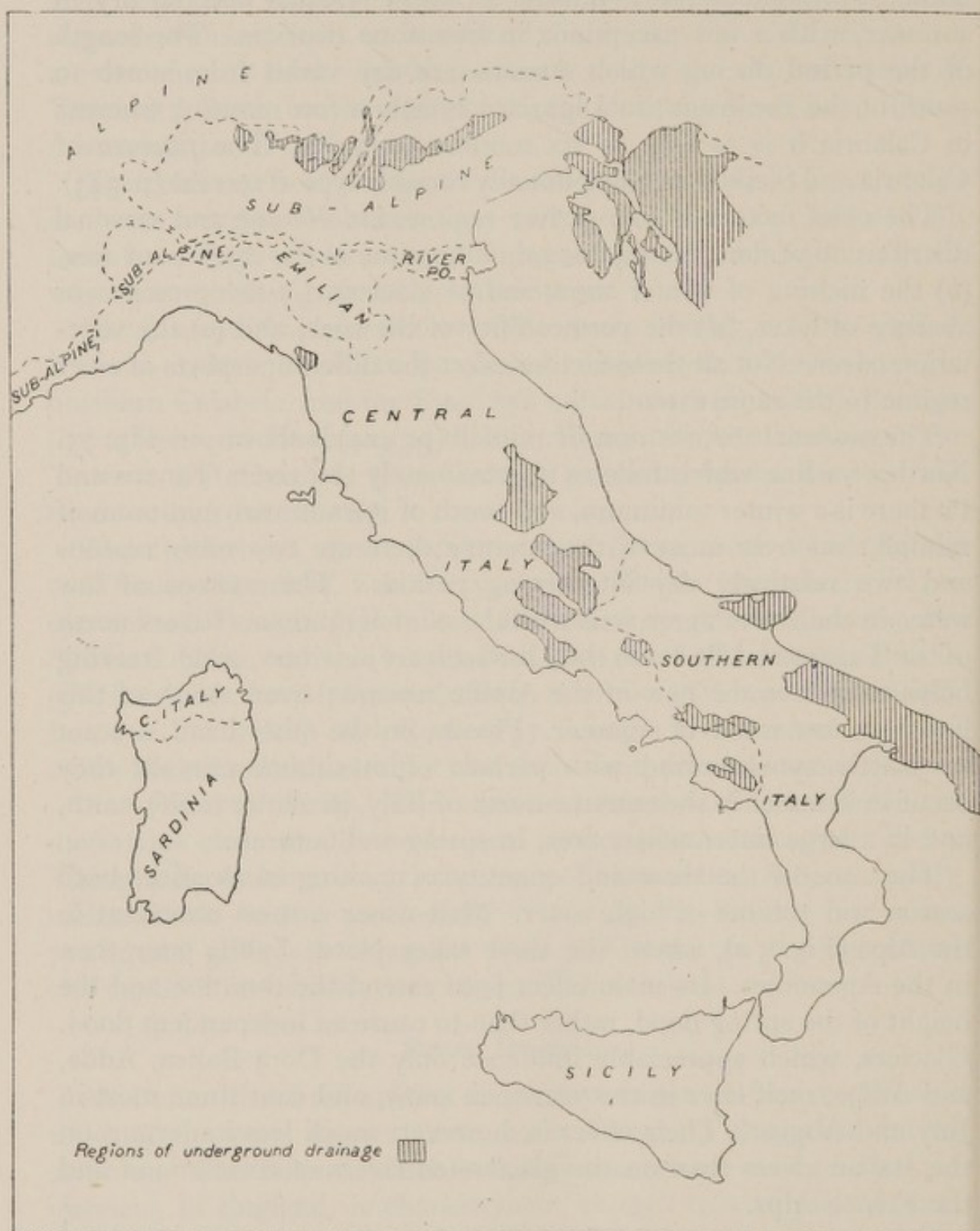
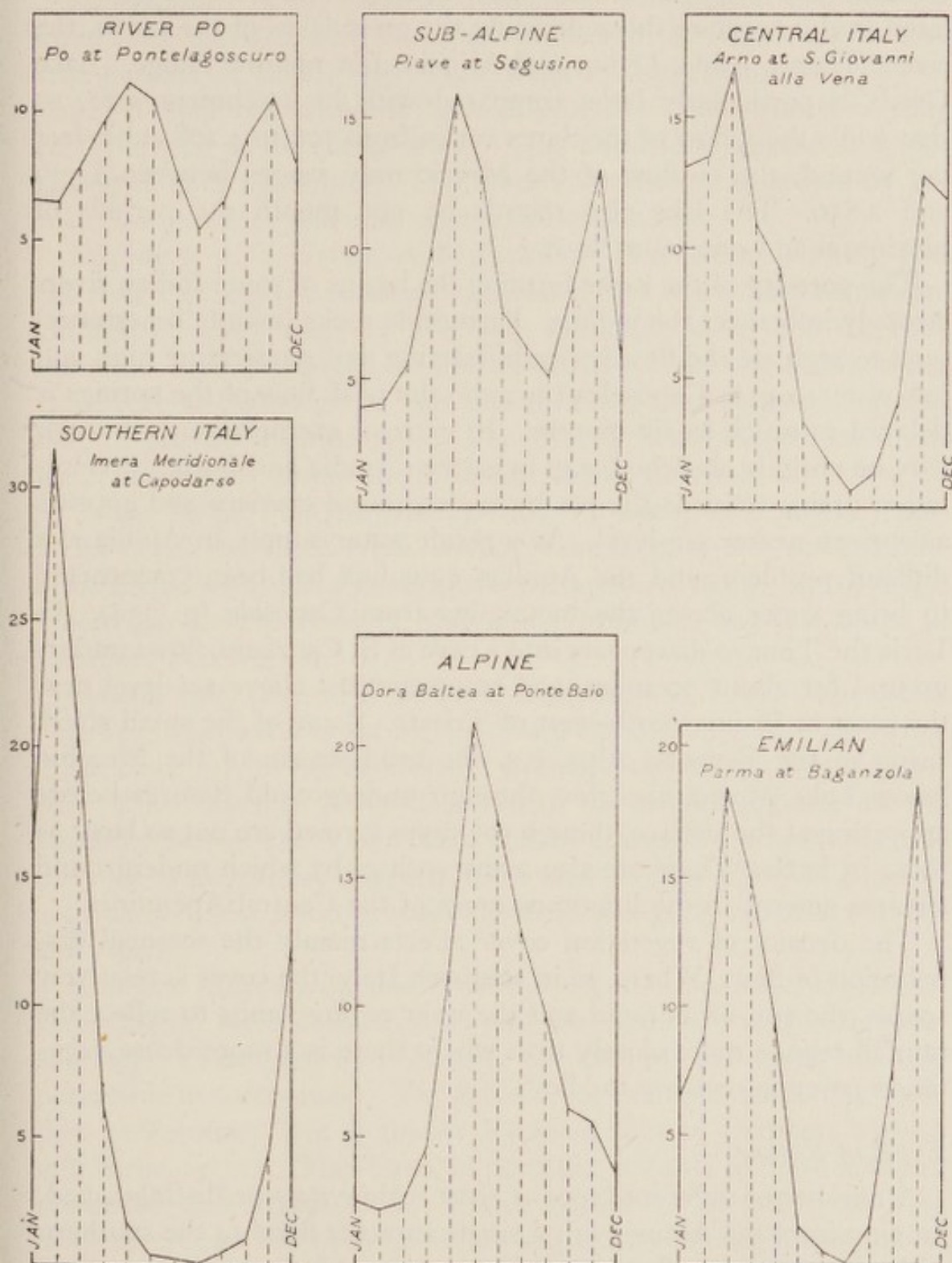


FIG. 5 A. *River Regimes and Regions of Underground Drainage*



FIG. 5 B. *Types of River Regime*



question and the total area of lake surface. The chief rivers regulated in this way are those draining the great lakes of the north, the rivers Ticino, Adda, Oglio, and Mincio, but not the Adige. Lake Garda is particularly large compared with its catchment area, so that while the inflow of the Sarca varies from 706 to 4,208 cubic feet per second, the outflow of the Mincio only ranges between 1,736 and 2,849. The lake also retards by one month the periods of maximum and minimum flow.

The porosity of the rocks forming the basins of some Italian rivers strongly influences the regime. Permeable rocks (mainly limestones) tend to regulate the flow by both delaying and moderating high and low water; e.g. at Caposele (Lucania) the peak flow of the springs is delayed as much as six months. In extreme examples surface water may be entirely absorbed, e.g. in eastern Apulia and Istria. Precipitation drains towards the sea by underground crevices and appears as springs nearer sea-level. As a result water-supply in Apulia is a difficult problem, and the Apulian aqueduct has been constructed to bring water across the mountains from Caposele (p. 334). In Istria the Timavo disappears into a cave at S. Canziano, flows underground for about 30 miles, and reappears just above sea-level near the coast at Duino, north-west of Trieste. Some of the small rivers rising in the Venetian Alps, e.g. the head-stream of the Meschio below Lake Morto, also flow through underground fissures before appearing at the surface, though the caves formed are not so large as those in Istria. There are also many springs by which underground streams emerge in the limestone areas of the Central Apennines.

The density of vegetation cover affects mainly the seasonal distribution of flow. Where, as in southern Italy, the cover is relatively sparse, the run-off is rapid and the river regime tends to reflect the rainfall regime more closely than where there is a more dense vegetation cover to regulate the flow.

### *Types of Regime*

A number of different types of river regime may be distinguished, ranging from the Alpine with a single summer flood to the southern with a single winter flood.

*Alpine* (e.g. F. Dora Baltea at Ponte Baio). Rivers with a regime of this type are influenced primarily by the melting snow and glaciers, but the peak period of melt-water partly coincides with the spring (April, May, June) rainfall maximum. Such rivers are therefore in flood in early summer (June or July).



*Sub-Alpine* (e.g. F. Piave at Segusino). The shorter rivers of the outer Alps together with the lower courses of the Alpine rivers have two periods of flood. One high water in early summer (May or June) corresponds with the main Alpine flood, but occurs slightly earlier owing to an earlier thaw. This flood is accentuated by the spring rainfall maximum. The other (November) is caused by the main late summer and autumn rainfall maximum.

*Emilian* (e.g. T. Parma at Baganzola). The streams flowing into the river Po from the south are controlled by a more 'Mediterranean' climate (p. 406), and are relatively less affected by snow. They therefore have two floods, in March and November, with low water from July to September. The autumn flood thus corresponds with that of the Sub-Alpine type. The March flood and summer low water are a reflection of the different rainfall distribution.

*River Po* (at Pontelagoscuro). The Po itself, since it has tributaries of all the three types already described, shows some of the same features but has a more moderate regime than any one of them. There are flood periods in May and November, and low water in February and August.

*Central Italy* (e.g. F. Arno at S. Giovanni alla Vena). The rivers here have high water in spring (February and March), followed by low water from July to September and a second, minor, flood in November. This coincides fairly closely with the rainfall regime. In the southern half of the Tiber basin and in Campania, where much of the rock is limestone, the range of volume is (e.g. Tiber at Ripetta) considerably less, and the season of flood is slightly retarded (March and April).

*Southern Italy, Sicily, and Sardinia* (e.g. F. Imera Meridionale at Capodarso). Here both drought and low water are very marked in summer. Floods are in February, the autumn rise being scarcely noticeable in comparison. The Simeto, for example, has a maximum flow in February, but is almost dry from May to October, when a minor rise occurs. The Tirso, in Sardinia, is liable to flood between December and March, but is almost dry for six months from May to October, and has been known to remain dry for eight months on end. In Lucania the regime is slightly different (e.g. F. Bradano at S. Giuliano). The flood occurs later (April), as does low water.

The times of flood and low water are not exactly constant every year. Throughout northern Italy, exceptional conditions are possible at most times of the year, but southwards the times of flood become more regular.



## GLACIERS

ALL the existing Italian glaciers are, with one exception, in the Alps. Altogether 711 have been catalogued, which are distributed as follows:

<i>Western Alps</i>	
Maritime . . . . .	11
Cottian . . . . .	10
Graian . . . . .	123
Mont Blanc range . . . . .	26
Pennine . . . . .	102
	<hr/> 272
<i>Central Alps</i> . . . . .	349
<i>Eastern Alps</i>	
East of the Brenner . . . . .	44
Dolomites and Cadore . . . . .	41
Carnic and Julian . . . . .	4
	<hr/> 89
<i>Apennines</i>	
Gran Sasso . . . . .	1
	<hr/> 711

Out of the total number, 621 glaciers are west of the Brenner pass and only 89 to the east; they are thus mostly grouped in the higher parts of the mountain range.

The glaciers tend to be larger on the northern than on the southern side of each massif; consequently those which are grouped on the frontier, as many of them are, tend to be smaller on the Italian than on the French or Swiss sides. The most important Italian glaciers are found in the Gran Paradiso and on the French frontier to the west; at the foot of Mont Blanc where the Miage and Brenva glaciers feed the headwaters of the river Dora Baltea, from the M. Cervino to M. Rosa; on the Bernina massif, above the Adda valley; near the Ortles and M. Cevedale, and on the isolated Adamello and Presanella groups; and on the mountains immediately west and east of the Brenner pass. The chief rivers to be fed by glaciers are the Dora Baltea, the Adda, and the Adige (p. 50).

Although the snowfall on the Apennines is considerable, especially in the Abruzzi and in Calabria, only one small glacier is known, viz. the Calderone, near the highest part of the Gran Sasso.

In common with those of the rest of Europe, the Italian glaciers are known to have been more extensive during the period 1610 to 1860 than



they are to-day. Since about 1860 the glaciers have been retreating, with two minor subsidiary advances, one about 1895 and the other between 1920 and 1930. Some of the glaciers are also subject to small though rapid fluctuation, e.g. the Brenva, which is near the source of the river Dora Baltea.



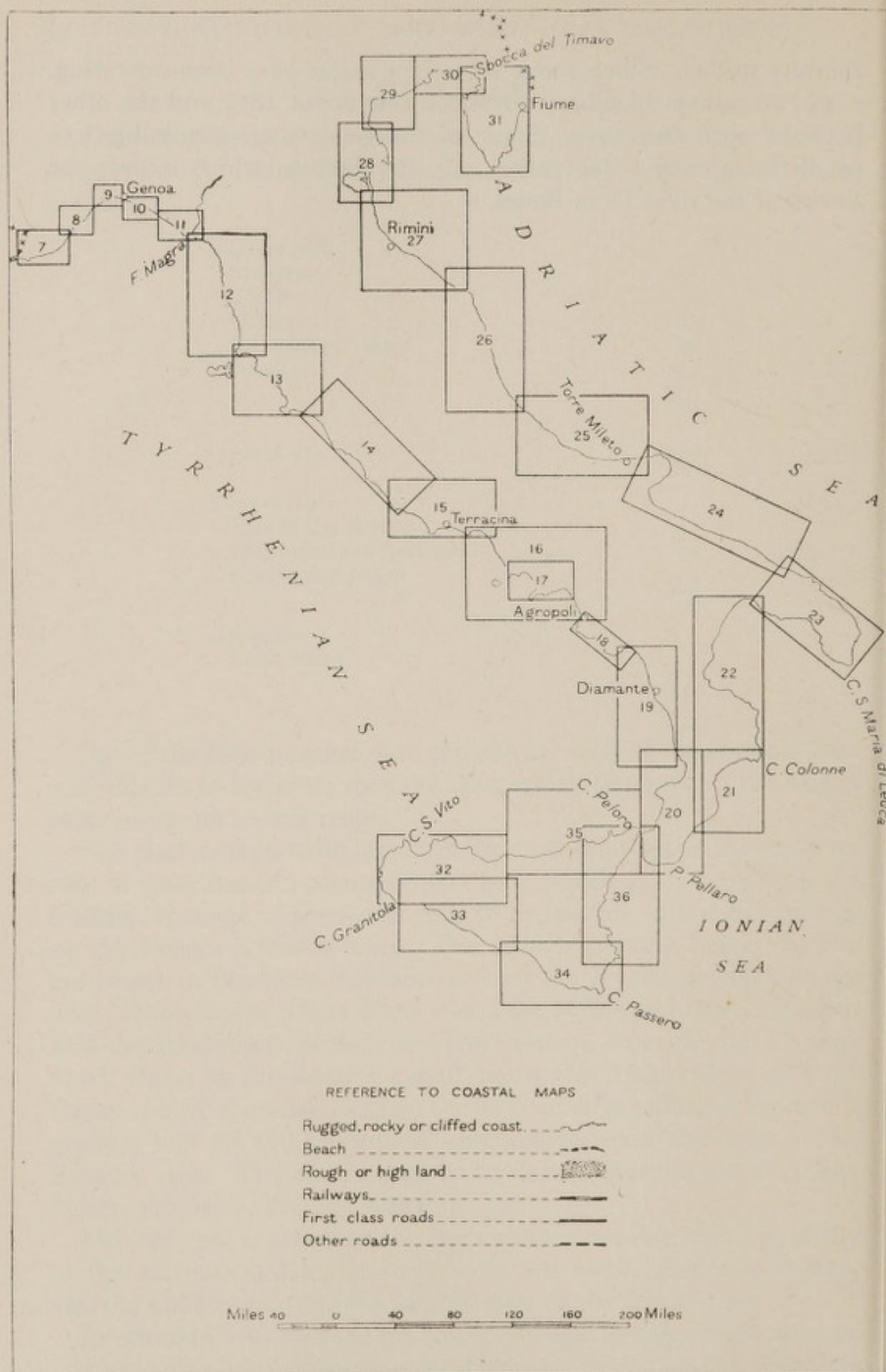


FIG. 6. Key Map of the Coasts



## CHAPTER III

### THE COASTS

#### INTRODUCTION

THE coasts of the mainland of Italy and of the islands have a total length of about 5,000 miles. The mainland, which has a coast 2,457 miles long, is washed on the west by the Tyrrhenian Sea, on the south by the Ionian Sea, and on the east by the Adriatic Sea. The coast of Liguria from the French frontier almost to Spezia consists of the seaward spurs of the Ligurian Alps and Apennines and, for the most part, has beaches only at the mouths of the numerous torrents which cut through the hills. The west shore of peninsular Italy, from near Spezia to the plain south of Salerno, consists of a series of long beaches in front of curving bays or gulfs, and backed by plains which are separated from each other by the mountain spurs of the Pre-Apennines and the Apennines. The gulfs of Follonica, Terracina, Gaeta, Naples, and Salerno are the most notable of the indentations. From Agropoli to the southernmost point of Calabria the coast is immediately backed by steep, high mountains, except at the heads of the beach-fringed gulfs of Policastro, S. Eufemia, and Gioia. The east coast of Calabria and the gulf of Taranto are, for the most part, beach-fringed and backed by lower hills. The gulf of Taranto forms the instep of the foot of Italy between Cape Colonne and Cape S. Maria di Leuca. The 'heel' is formed by the low, limestone Salentine peninsula, which is generally fringed by low cliffs, here and there interrupted by beaches. The Adriatic coast trends north-west from Cape S. Maria di Leuca to the delta of the Po and has no major indentations except for the mountainous Gargano peninsula, the 'spur' of Italy. A sandy beach fringes the coast north-west of the Gargano peninsula. Between the mouth of the F. Biferno and Rimini it is backed by low steep-sided hills which rise in shallow steps to the rugged Apennines. At Rimini, however, the Apennines retreat inland, and the coast, now fringed with deltas and lagoons and bordered by low, flat country, curves gently north-east to form the gulf of Venice. The coast is again rugged, from Monfalcone to Fiume, and is especially steep along the east side of the triangular Istrian peninsula.

The island of Sicily, which lies 2 miles to the west of the toe of Italy, has a coastline about 680 miles long and is washed on the north



by the Tyrrhenian Sea, on the south by the Sicilian straits or the African Sea, and on the east by the Ionian Sea and the straits of Messina. The south coast is, for the most part, beach-fringed, but is frequently backed by a steep rise inland, though the hills may be comparatively low. The west coast generally is low and sandy, whilst the country inland is gently undulating. North of Trapani, however, the whole nature of the topography changes. This stretch of coast and the north coast eastwards to Cefalu is steep and rugged and cut into by gulfs and bays with undulating plains at their heads. The gulfs of Palermo and Castellammare are the most notable. From Cefalu to Cape Peloro steep mountains back the coast, although there are some narrow, beach-fringed coastal strips. The east coast between Cape Peloro and Catania, though often edged by beaches, is backed by steep mountains, including Etna. From Catania to Syracuse the coast is broken by gulfs and bays with plains at their heads. Finally, to the south of Syracuse, stretches of cliff and small beaches alternate rapidly, whilst the country inland is generally low.

The coasts of Italy are described in sections, as follows:

- (1) The Ligurian coasts (including the Riviera di Ponente and Riviera di Levante) from the French frontier to the mouth of the F. Magra, together with the region of Liguria;
- (2) The Pre-Apennine coast from the mouth of the F. Magra to Terracina;
- (3) The Campanian coast from Terracina to Agropoli;
- (4) The Lucanian coast from Agropoli to Diamante;
- (5) The west coast of Calabria from Diamante to Point Pellaro;
- (6) The south and south-east coast of Calabria from Point Pellaro to Cape Colonne;
- (7) The gulf of Taranto between Cape Colonne and Cape S. Maria di Leuca;
- (8) The Apulian coast from Cape S. Maria di Leuca to Torre Mileto;
- (9) The Adriatic coast from Torre Mileto to Rimini;
- (10) The coast of the Northern Plain from Rimini to Sbocco del Timavo, and
- (11) The Istrian coasts from Sbocco del Timavo to Fiume.



The coasts of Sicily are described in the following sections:

- (1) The west coast from Cape S. Vito to Cape Granitola;
- (2) The south coast from Cape Granitola to Cape Passero;
- (3) The north coast from Cape S. Vito to Cape Peloro, and
- (4) The east coast from Cape Peloro to Cape Passero.

For convenience the coastal sections are sometimes subdivided, but at the end of each section there is a general description of the vegetation, population, and ports. The communications are usually described under the subdivisions and, where there are no subdivisions, before the general descriptions of vegetation, population, &c.

The topographical features and the facilities of the ports and harbours are described in detail in Vol. III. Those marked with an \* have, in addition, economic and historical surveys.

#### LIGURIA AND THE LIGURIAN COAST

The Ligurian riviera is made up of the Riviera di Ponente, about 95 miles long between the French frontier and Genoa, and the Riviera di Levante, about 50 miles long between Genoa and the mouth of the F. Magra. The whole forms a wide sweeping curve on either side of Genoa and is backed by the Maritime Alps to the west of Savona, and the Northern Apennines to the east. The mountains rise for the most part steeply from the coast, and the name 'riviera' is given to the narrow strip below 500 metres (about 1,600 ft.), the approximate upper limit of Mediterranean vegetation. The Riviera di Ponente is, as a whole, made up of small bays separated from each other by blunted hill-spurs and headlands, and is not so indented as the French Riviera, its western continuation. The Riviera di Levante has a more even coastline, except for the promontory of Portofino and the gulf of Spezia.

##### *Riviera di Ponente; French Frontier to Genoa*

##### *French Frontier to Albenga (Fig. 7)*

The hills from the French frontier to the ancient walled town of Albenga are the seaward spurs of the Maritime Alps, which include the Ligurian and Mongioie ranges. These are folded parallel to the coast, and are largely composed of limestones and sandstones. Foothills with peaks 900-1,900 feet high usually rise straight from



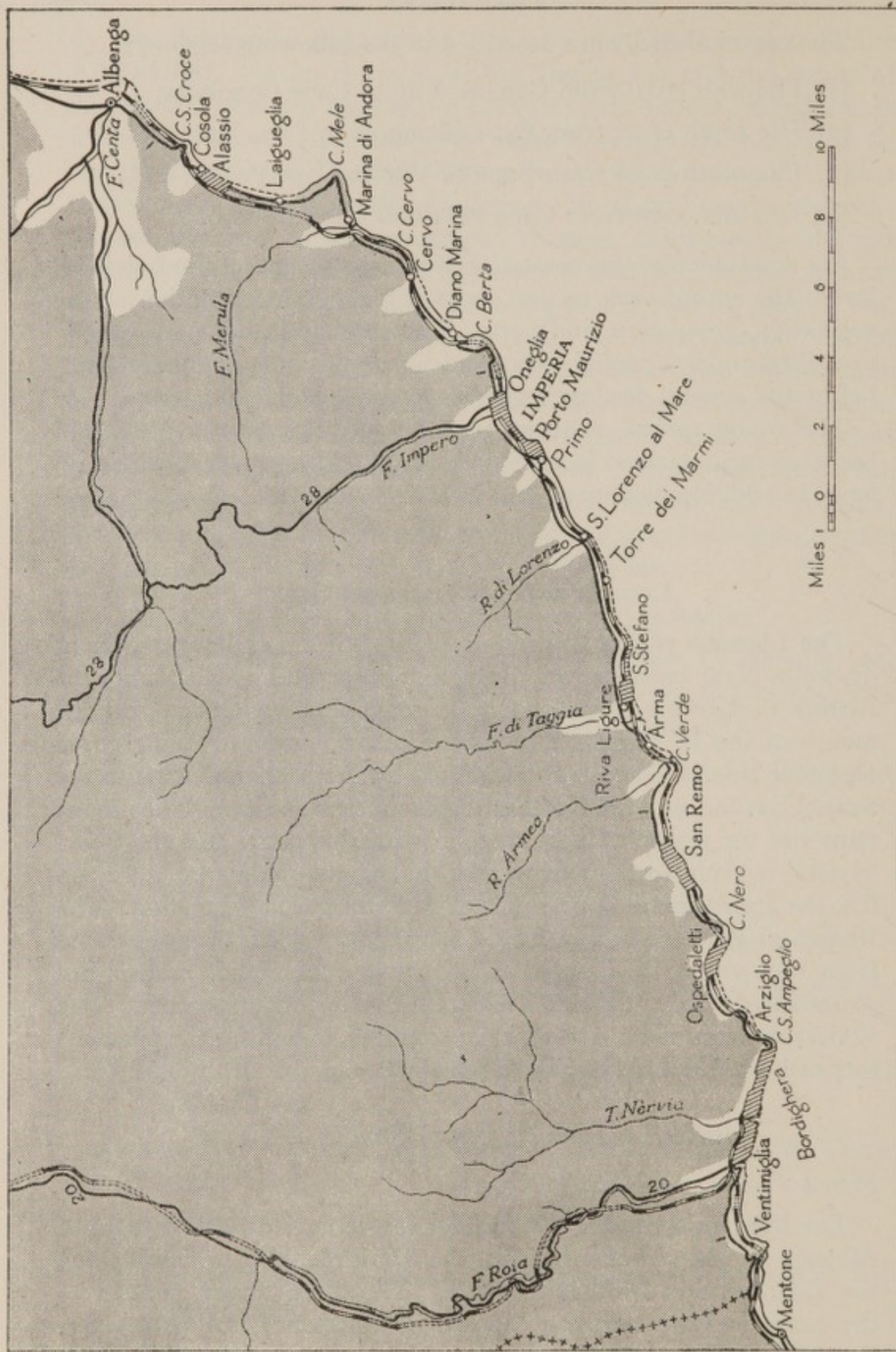


FIG. 7. The coast: French frontier to Albenga. (For Key see p. 54)



the sea almost direct to the watershed of the Maritime Alps. The divide between the tributaries of the river Po and the Ligurian coast streams is both farther inland and higher to the west of Albenga than to the east. In the west it is up to 30 miles inland and 9,600 feet high, and in the east only 10 miles inland and 3,500 feet high. But it is notable that the rise from the coast is equally steep in the two areas. To the west it is the increased heights farther inland, and the deeper and longer valleys, that constitute the principal differences between the two areas. Throughout, the steep rise of the coast is only interrupted by small, level plains at the mouths of the deep, flat-bottomed valleys. The streams have a fair volume of water, owing to the comparatively high rainfall of the region. The nature of the coast makes the passage of the coastal road and railway difficult.

The coast from the frontier to the outskirts of Ventimiglia is irregular, being made up of low red cliffs broken by sandy coves, and by short beaches alternating with rocky headlands. From Ventimiglia a beach continues uninterrupted to the low, rocky Cape S. Ampeglio, whence it sweeps northwards round the shores of a small bay to Ospedaletti (Plate 1). The latter stretch is interrupted by several low, rocky headlands, and east of Ospedaletti terminates in the perpendicular cliffs of Cape Nero. Between Ventimiglia and Arziglio, and at Ospedaletti, the beach is backed by a narrow coastal plain occupied by villas, and gardens of palms and citrus trees. The gentle hill-slopes behind the towns are artificially terraced for market and flower gardens, and most of the lower slopes above the cliffed sections are heavily wooded. The F. Roia and T. Nervia, both of which have wide pebbly beds, together with several streams, flow across the beach between Ventimiglia and Bordighera.

The coast forms a small, open bay between Cape Nero and Cape Verde. The sea-side resort of S. Remo extends along the greater part of the shores of this bay, which, though fronted by beaches, is mostly bordered off shore by rocks. The sandy bathing-beach at S. Remo, protected by a long mole, is the most accessible of these. The town and health resort spread on to the low, artificially terraced foothills (Plate 2) which are themselves enclosed by an amphitheatre of gently sloping mountains, ridged only by small streams. Between Cape Verde and Cape Berta the coast is irregular, though the bays and headlands are less clearly defined. From the mouth of the R. Armea, north-east of the cliffed Cape Verde, to north of S. Lorenzo al Mare, there extends a discontinuous sand and gravel beach, which is generally bordered by rocky shoals, and backed by rocks or cliffs



to the west of Torre dei Marmi and S. Lorenzo al Mare. The best beach for landing and bathing extends from Arma di Taggia to Riva Ligure (part of Riva S. Stefano) and is at the mouth of the valley of the F. di Taggia. In this coastal region the hills, for the most part, slope directly from the shore except at the mouths of the F. di Taggia, where there is a small plain, and of the R. di Lorenzo, which has a minute level area at S. Lorenzo al Mare. North-east of S. Lorenzo al Mare the coast, though it remains low, is rugged as far as Primo. The port of Imperia\*, which includes Porto Maurizio and Oneglia, is, however, bounded by low, gently sloping, terraced, and wooded hills round the bay between Primo and Oneglia.

There is a small bay with low, partially beach-fringed shores between Cape Berta (east of Oneglia) and Cape Cervo, both of which are steep-sided and rugged. The two best beaches here for landing and bathing are at the small sea-side resort of Diano Marina and to the west of Cape Cervo. The first of these is about 400 yards long and is backed by a wooded mountain spur. The other at Cervo is bounded by a very small coastal plain, above which hills rise fairly steeply. Another small bay extends between the rocky Cape Cervo and Cape Mele, which consists of a rounded and wooded hill (751 ft.) bounded by cliffs. The shores of the bay are low, and there is a beach on either side of the mouth of the F. Merula at Marina di Andora.

Between Cape Mele and Cape S. Croce there is a small sweeping bay, bordered by a beach of fine sand from south of the village of Laigueglia to Cosola. The bay is enclosed by an amphitheatre of hills, which rise steeply from the beach except behind the sea-side resort of Alassio (Plate 3), where the slope is more gradual. These hills, though well rounded, are often furrowed by ravines and covered with a luxuriant growth of pines, palms, and olives. The coast is low from north-east of Cape S. Croce to the delta of the F. Centa, on which the ancient walled town of Albenga stands.

### *Albenga to Savona (Fig. 8)*

From Albenga to Cape Caprazoppa the coast has few indentations. Dolomitic limestone hills rise from the low coastal strip to the watershed of the Maritime Alps, less than 7 miles inland. The hills are cut into long ridges, at right angles to the coast, by streams and rivers, the most important of which, the F. Arroscia (25 miles) and T. Neva (18 miles), unite near the coast and form the F. Centa. The rivers farther east are only about 9 miles long.

Between Albenga and Cape Caprazoppa a series of small sea-side



resorts extend along a sand and shingle beach which is only interrupted by a few low, rocky promontories. The beach fronts a fairly

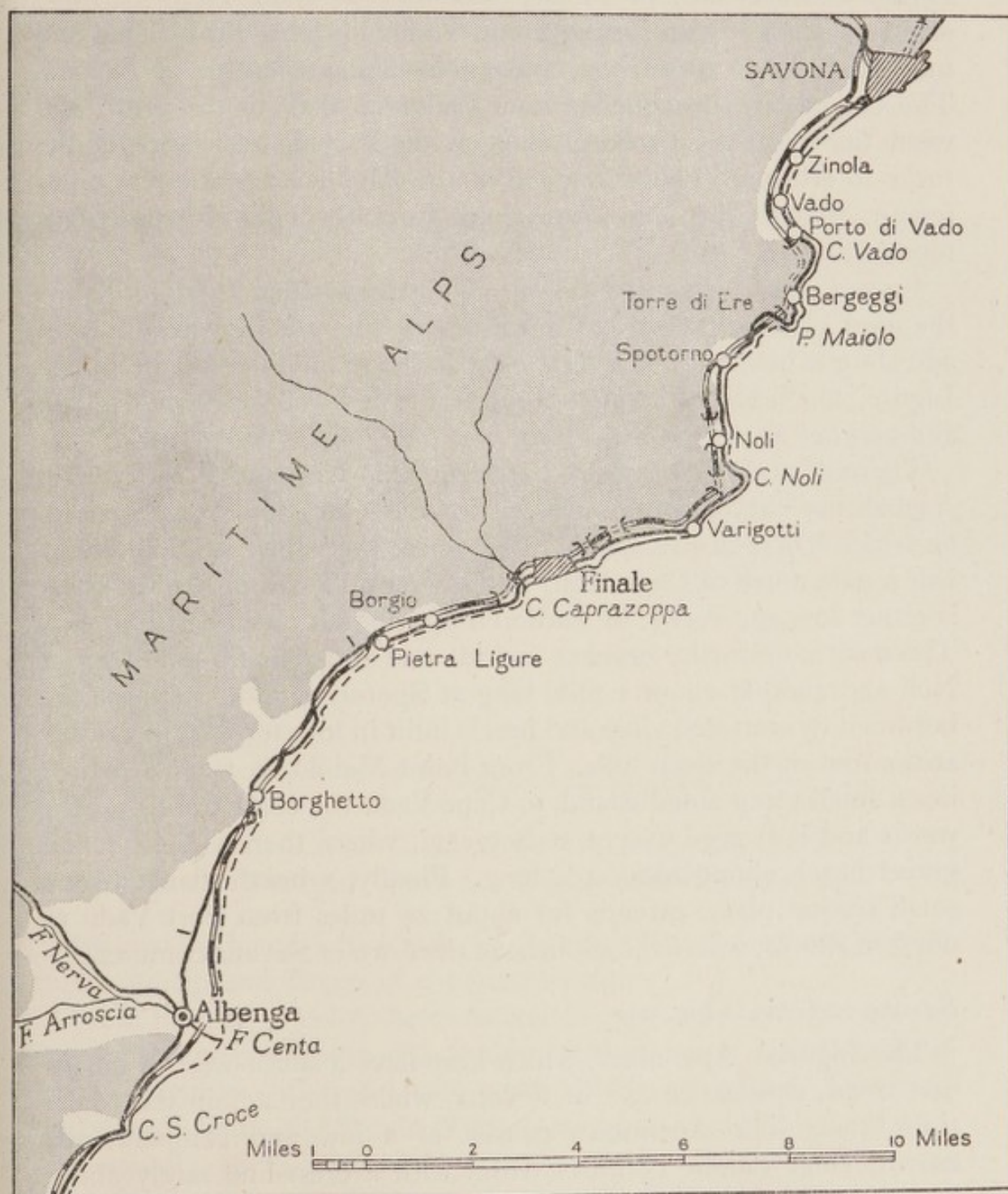


FIG. 8. *The coast: Albenga to Savona.* (For Key see p. 54)

flat, cultivated, and well watered coastal plain, which is widest ( $2\frac{1}{2}$  miles) at the mouth of the F. Centa and is interrupted by hill-spurs near Borghetto (S. Spirito), Pietra Ligure, and Cape Caprazoppa.

Between Cape Caprazoppa and Savona the structure of the



Maritime Alps is more complex and results in a rapid alternation of rock types: Triassic limestone between Cape Caprazoppa and Finale, Permian schists east of Finale, limestone at Cape Noli, Permian schists again between Bergeggi and Vado, Pliocene sands, clay and marl from Vado to Savona, and gneiss and serpentine at Savona. The coast is in consequence more indented than to the south and west, the irregularities depending on the varying resistance of the rocks to erosion. The watershed of the Alps is only about 6 miles inland, though the immediate slope from the coast is sometimes more gradual.

From Cape Caprazoppa to Cape Noli the wooded coastal hills for the most part rise abruptly from the sea. There is, however, a sand and shingle beach about a mile long at the sea-side resort of Finale Ligure, which lies at the mouth of a fertile and well-cultivated valley, and another about three-quarters of a mile long at Varigotti.

The gulf of Genoa extends between Cape Noli and Point Mesco. A small bay curves between the cliffed Cape Noli and Point Maiolo, on which Torre di Ere stands. From near the village of Noli (about half a mile north of Cape Noli) to the west of Torre di Ere the coast is either low and rocky, or bordered by a beach of sand and gravel. The most noteworthy beaches include one about half a mile long at Noli and another about 1 mile long at Spotorno. Both of these are bordered by scattered villas and hotels built in low, fertile depressions at the foot of the steep hills. From Point Maiolo, in front of which lies a small steep-sided island, to Cape Vado the coast trends northwards and is rugged except at Bergeggi, where there is a sand and gravel beach about 200 yards long. Finally, a beach, flanked by a small coastal plain, extends for about  $2\frac{1}{2}$  miles from Port Vado to north of Zinola, where the suburbs of the town of Savona commence.

#### *Savona to Genoa (Fig. 9)*

The Ligurian Apennines, which here have a south-west to north-east trend, commence east of Savona, where they adjoin the Maritime Alps. The Apennines consist of a low and comparatively narrow ridge (about 15 miles wide) with a crest-line rarely above 3,000 feet (M. Ermetta 4,157 ft.; M. Beigua 4,223 ft.) generally only 3-6 miles inland. As a result the rise from the coast and the ascent to the passes, which are often comparatively low (Cadibona 1,427 ft.; Giovi 1,549 ft.), are usually very steep. The valleys cutting into the seaward slopes are generally steep-sided and short. The rocks of which these mountains are composed can be divided into two



distinct and similar groups: (1) the Savona group, extending from Savona to Celle Ligure, mainly made up of a crystalline massif of granite and gneiss with a narrow strip of Pliocene clays and marls along the coast, and (2) the Voltri group, which stretches from Celle Ligure to Sestri Ponente, and consists of Triassic calc-schists, and mica-schists and *pietre verdi*. The coastal hills of the Savona group are generally low and rounded, whilst in the schistose areas of the

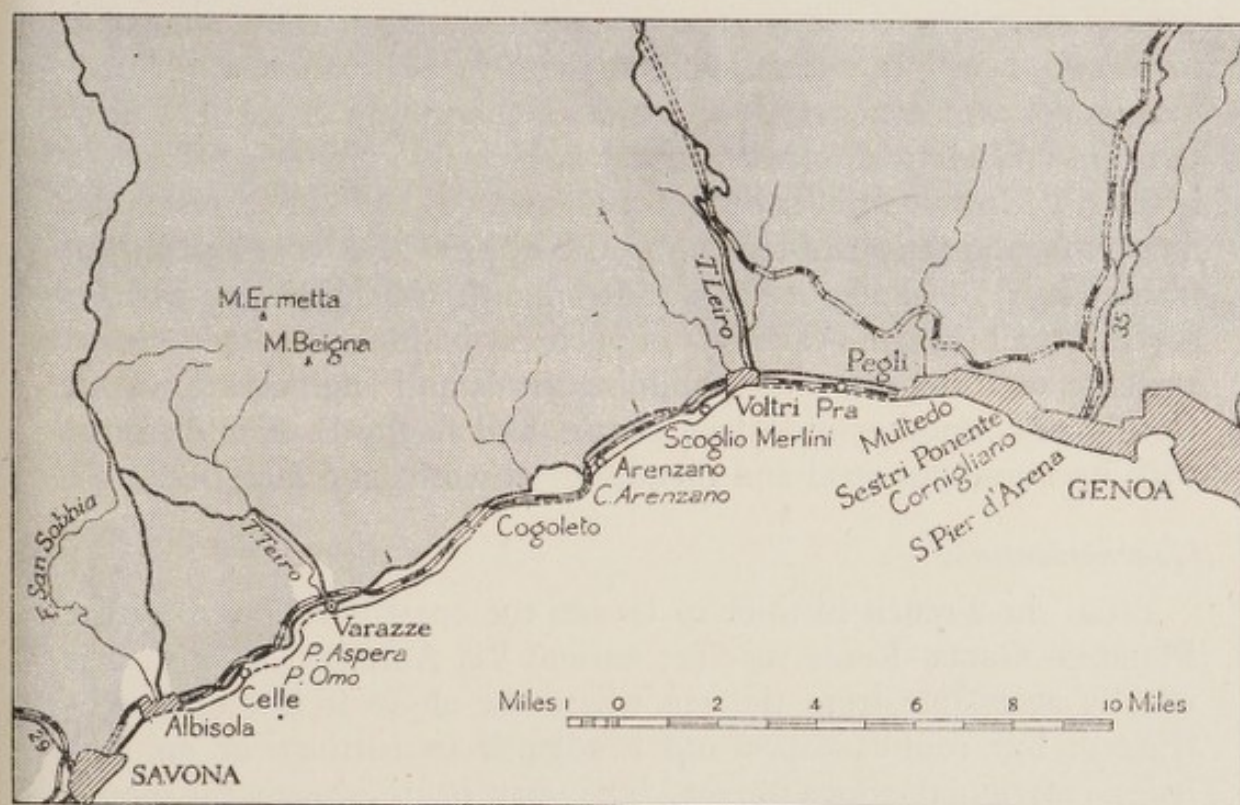


FIG. 9. The coast: Savona to Genoa. (For Key see p. 54)

Voltri group the tree-clad hills rise evenly from the sea in contrast to the precipitous slopes of the *pietre verdi*.

From Savona to Voltri the coast trends north-east, and though cut into by several small bays with beaches at their heads, is, for the most part, rocky and cliff-edged with steep hills rising inland. The sand and shingle beach at Albisola (Plate 4), a small sea-side resort almost immediately north-east of Savona, is about 600 yards long and extends east and west of the mouth of the T. Sansobbia, where there is a fertile low-lying area. A rugged stretch of coast, including Cape Albisola, separates this beach from another, more than 500 yards long, at the sea-side resort of Celle Ligure. This sandy beach is bounded by a railway retaining-wall, and a plain sloping gently up to rounded and wooded hills. North of the twin headlands of Point



Omo and Point Aspera there is another sand and shingle beach, about  $1\frac{1}{4}$  miles long, at Varazze. Here hills, deeply ravined by small streams, and well wooded with olives and pines, rise from the shore at first gently and then steeply; the T. Teiro, the largest of these streams, has a small level area at its mouth. The coast is rocky from Varazze almost to Cogoleto, where there is a small shingle beach. North of Cape Arenzano ( $2\frac{1}{2}$  miles east of Cogoleto) and in front of the town of Arenzano there is a sand and shingle beach about 400 yards long. The coast is rugged and fairly steep from Arenzano to Scogli Merlini; west of Voltri there is a beach about three-quarters of a mile long on either side of the mouth of the T. Leiro.

From Voltri to Genoa the coast, which is often beach-fringed, is lined with industrial suburbs of Genoa. These extend along the narrow coastal strip and spread up the hill-sides. First there is Pra, fronted by a beach about half a mile long, then Pegli, which with its several small shingle beaches is popular for bathing, Multedo, Sestri Ponente with important shipbuilding yards and engineering works, Cornigliano, another industrial centre, and finally S. Pier d'Arena, with its numerous steel and metallurgical works and factories.

### *Communications*

From the French frontier to Genoa the coast is followed by the Mentone-Genoa-Rome road (1; ancient Via Aurelia). This road is usually accessible from the sea where the shore is low or beach-fringed, but rounds capes and headlands in cuttings or on rock ledges, often high above the sea. The main roads crossing the mountains to the Po plain from road 1 commence at Ventimiglia (20; Tenda pass), Imperia (28; Nava pass), Albenga (S. Bernardo pass), Savona (29; Cadibona pass), Albisola (Giovio pass), Varazze (Giovio pass), Voltri (Turchino pass—the shortest route between the coast and the Northern Plain)—and Genoa\* (three main roads). In addition there are several secondary roads which either cross the mountains direct or link up with the main roads.

The main French frontier-Genoa-Rome railway, like the main road, follows the coast as closely as possible and tunnels through the headlands. Railways cross the Ligurian Alps to the Po plain from Ventimiglia, Savona, and Genoa.

### *Vegetation*

The region is generally fertile, and the vegetation, including many Mediterranean and exotic plants, is luxuriant. From the French





PLATE 1. *Ospedaletti*



PLATE 2. *Hill-slopes terraced for cultivation east of San Remo*





PLATE 3. *Alassio*



PLATE 4. *The Via Aurelia at Albisola*



frontier to near S. Remo the hill-slopes are extensively terraced for the growth of flowers, palms, fruit, and vegetables, which are marketed in the neighbouring regions and in towns much farther afield. Farther east, vines, citrus trees, palms, and olives are intensively cultivated on the small coastal plains and up the hill-slopes, which are sometimes terraced. The steeper slopes of the hills, especially above the cliffs, are covered with pines, cypresses, oleanders, myrtles, and aloes. The same vegetation is also found on the higher slopes as well as wild olives and rough scrub.

### *Population*

Health and sea-side resorts, agricultural and fishing villages and towns, all of varying size, line the coast almost continuously and spread on to the lower hill-slopes. The larger settlements are at the mouths of rivers and on the small coastal plains, whilst the industrial suburbs of Genoa extend as far west as the town of Voltri. Small and comparatively unimportant, though picturesque, villages are perched on the valley-slopes and on the mountain sides. The major coastal towns are Ventimiglia, S. Remo, Imperia, Albenga, Savona, Varazze, Genoa. On headlands and mountain spurs ruined towers, built originally for protection against pirates, are a notable feature and provide good landmarks for shipping.

### *Ports*

There are few harbours and few large piers or quays along the Riviera Ponente, except for the ports of Imperia\*, Vado, Savona\*, and Genoa\*. The following places have facilities for small craft: S. Remo, Diano Marina, Alassio, Albenga, Pietra Ligure, between Borgio and Cape Caprazoppa, Albisola Marina, Celle, Voltri, and Pra.

### *Riviera di Levante; Genoa to the Mouth of the F. Magra*

#### *Genoa to the Mouth of the F. Magra (Figs. 10, 11)*

In the Riviera di Levante the Northern Apennines usually rise without a break of slope from the coast to peaks about 1,600–2,000 feet, and then to greater heights above them farther inland. These mountains are made mainly of Eocene schist and sandstone in the west, and sandstone and laminated clay in the east. The north-west to south-east trend of the coast and mountains is determined by the trend of the rocks, which also influences the direction of the main rivers. For instance, the Lavagna flows nearly parallel to the coast



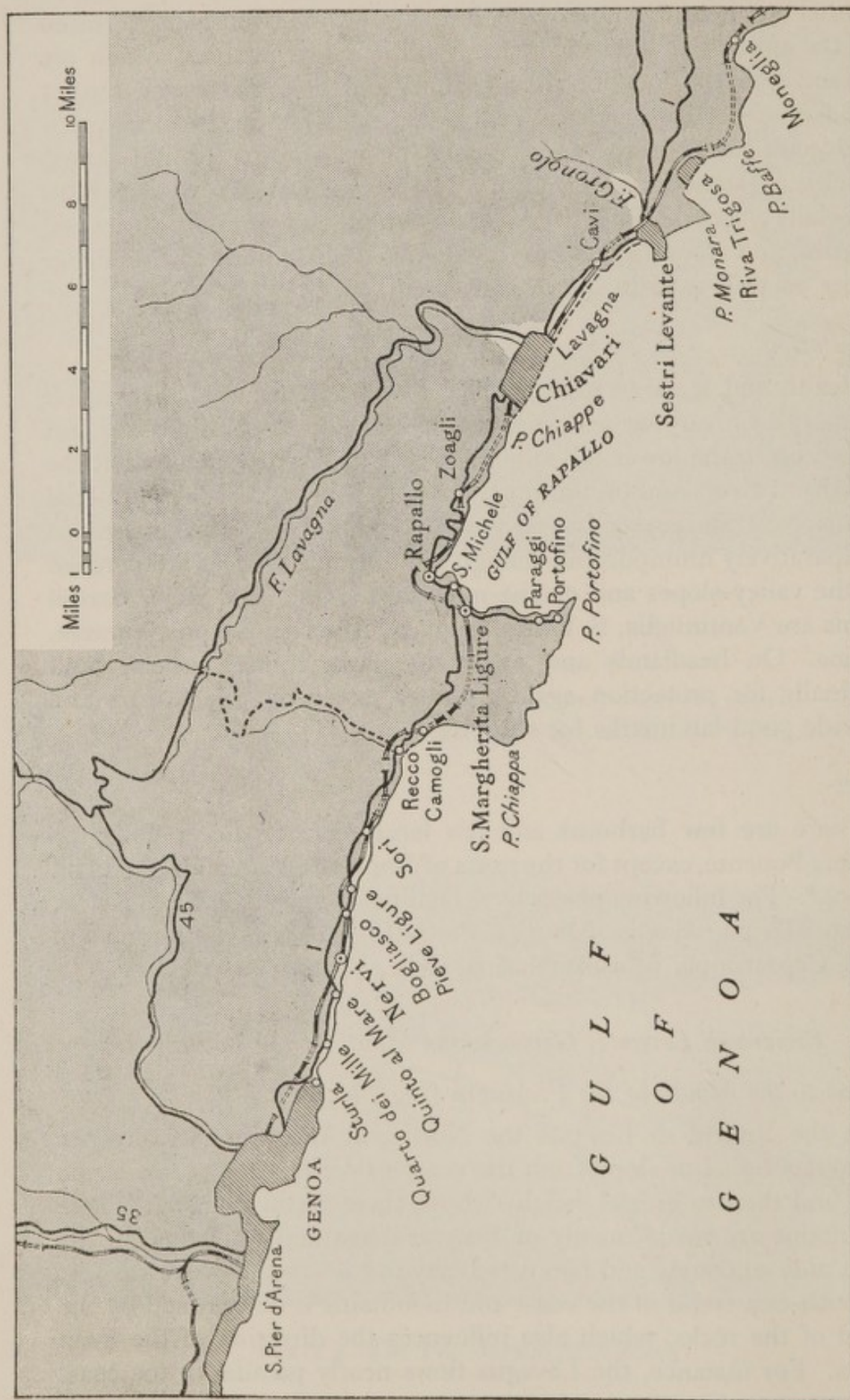


FIG. 10. The coast: Genoa to Moneglia. (For Key see p. 54)



for the first 12 miles of its course and only turns south for 4 miles near its mouth. The massive Promontorio di Portofino, which interrupts the generally even bend of the coast, is due to the outcropping of sandstone.

The coast trends south-south-east from Genoa to Camogli, and is for the most part cut into minute, fretted indentations, edged by low cliffs above which partly wooded hills rise steeply. Villas and villages, forming the outer suburbs of Genoa, line this coast especially where there are small beaches at the head of the indentations. At Sturla a shingle beach, 300 yards long, extends round the head of the small bay and is backed by the seaside resort which spreads up the hills behind. There are short, rocky beaches at Quarto dei Mille, famous as the starting-place of the Garibaldi expedition to Sicily, and at Quinto al Mare. Nervi, the most popular of these resorts, has a series of beaches, each a few yards long, at the foot of low cliffs. A small steep beach, backed by villas with gardens or olives and citrus trees, fronts Bogliasco, and another, small and rocky, lies in front of Pieve Ligure. At Sori a shingle and sand beach about 250 yards long fringes the head of a small bay at the mouth of a short, deep valley. At Recco, at the mouth of another valley, which breaks through the mountain wall, there is a steep shingle and sand beach about 300 yards long, whilst another steep, shingle beach fronts the adjoining picturesque town of Camogli.

The rugged mountainous Promontorio di Portofino (Plate 5), whose highest point, 2,000 feet, is only half a mile from the shore, extends between Camogli and Rapallo (Plate 6). The west shore of the promontory from Camogli to Point Chiappa is high and rocky, the south between Point Chiappa and Point Portofino (Madonna del Capo) is perpendicular and steep. The east coast from Point Portofino to Rapallo, which also forms the west shore of the gulf of Rapallo (Golfo Tigullio), consists of a number of small bights, often with minute beaches or small harbours at their heads, separated from each other by low cliffs and rocky headlands. This coast is lined with holiday resorts and small ports. Portofino, the most southerly of these, is a small haven and town built round several of the bights and headlands and backed by undulating hills, wooded with olives, pines, and cypresses. Paraggi, immediately north of Portofino, has a small beach backed by steep, wooded hills. Farther north S. Margherita Ligure extends round the head of a small bay, fringed with several small and usually rocky beaches, of which the largest, south of the railway station, is about 200 yards long and is of shingle and sand. The hills



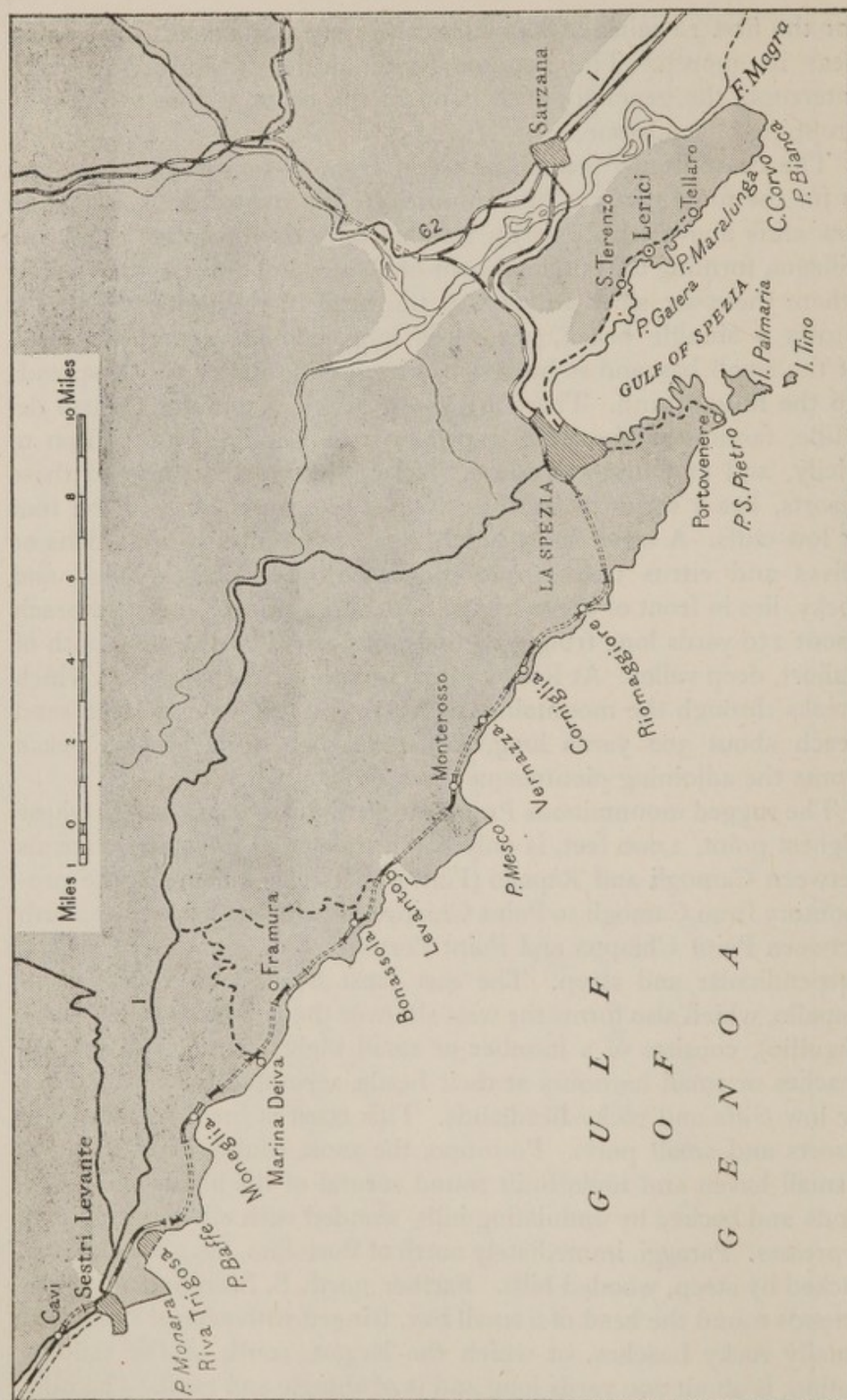


FIG. 11. The coast: Sestri Levante to the mouth of the F. Magra. (For Key see p. 54)



rising behind this bay are well wooded, like the rest of the peninsula, though they slope somewhat more gradually inland. S. Michele di Pagana, another small seaside resort at the head of a bight, has a short shingle beach. At Rapallo, at the head of the gulf of Rapallo, there is a beach about half a mile long. This is interrupted by piers, moles, and the mouths of several small streams. The greater part of Rapallo lies in a small depression at the mouth of a valley, whilst the rest straggles along the low-cliffed shores of the gulf and up the sides of the wooded hills.

From Rapallo to Sestri Levante the coast has a fairly straight and even line. Except for a cove with a shingle beach at Zoagli, it is bare and steep as far as Point Chiappe. A sandy beach commences near the latter point and continues as far as Cavi (Cava di Lavagna), a distance of almost 5 miles. This beach, crossed by the mouth of the F. Lavagna, one of the longest rivers in Liguria, is lined first with the villas and houses of Chiavari and Lavagna and then by isolated houses and the village of Cavi. Chiavari and Lavagna are built on a small plain about half a mile wide, well cultivated with vines, but between Lavagna and Cavi the level strip narrows to 200 yards. A very short section of steep, high cliffs leads to Sestri Levante, west of Point Monara. Here there are two sandy beaches, one about half a mile long on the north-west, and the other about 100 yards long on the south-east of the low, narrow neck which links the cliffy headland of Point Sestri to the mainland. The town extends from the headland on to the mainland at the mouth of the wide, flat Gronolo valley, which backs the longer of the beaches.

From the headland of Point Monara, shaped like an arrow-head, to the Portovenere peninsula, spurs of the Ligurian Apennines rise straight from the sea to heights of 1,000–1,600 feet. These are faced with steep cliffs which are sometimes interrupted by small bays or coves with beaches at their heads. The first beach, half a mile long, is at Riva Trigosa near the head of the bay between Point Monara (869 ft.) and Point Baffe (1,017 ft.). Moneglia has a short, sandy beach fronting a small plain which is enclosed by steep, rugged mountains. At Marina Deiva there is a sand and shingle bathing-beach where a small valley interrupts an otherwise straight section of cliff coast. The bight of Bonassola has a small sand and shingle beach at its head and is only separated from that of Levante by a blunt headland. The fine sandy beach at the latter place is 300 yards long and is backed by a concrete railway retaining-wall, behind which the town of Levante is built at the mouth of a cultivated and



wooded valley (Plate 7). At Monterosso, sheltered on the west by the headland of Point Mesco (1,020 ft.), there are two sand and shingle beaches separated from each other by a rocky spur, the western beach being 600 yards long and the eastern 150 yards; inland the steep hills are intensively cultivated with vines. Southwards of Monterosso the cliffs, which increase in height towards Portovenere, are only interrupted by tiny coves, the most notable of which are at Vernazza and Corniglia, both in an area of continuous vineyards.

The gulf of Spezia curves between Portovenere and Point Bianca. The west shore of the gulf, off which lie the two small and rugged islands of Tino and Palmaria, is cut into long, narrow, cliffed headlands, separated by bights with small beaches at their heads. At Portovenere, immediately north-east of Point S. Pietro (Plate 8), there is a small, rocky bathing-beach. The port of La Spezia lies at the head of the gulf, and the town is built on a small, coastal plain encircled by steep mountains. The eastern shore of the gulf, which is formed by a rugged limestone spur terminating in Cape Corvo and Point Bianca, is, immediately south of Spezia harbour, cut into small rock-bordered headlands and bays. The shores of one of the larger bays between Point Galera (328 ft.) and Point Maralunga (156 ft.) are bordered by a rocky beach at the village of S. Terenzo, and by a sandy beach at the bathing resort of Lerici. Olive-clad hills rise behind these beaches. From Point Bianca (c. 800 ft.) the rugged coast curves northwards to the mouth of the F. Magra, a long river which here flows in a wide valley.

### *Communications*

Between Genoa and Sestri Levante, the Mentone-Genoa-Rome road (1; ancient Via Aurelia) keeps near the coast, often high above the sea, except where it cuts across the neck of the Portofino promontory. At Sestri Levante it turns some distance inland to touch the coast again at Spezia. A second-class road skirts the east shore of the Portofino peninsula between Portofino and Rapallo, where it joins road 1. No road follows the rugged coast between Sestri Levante and Spezia, though roads lead inland from the coast at Riva Trigoso, Moneglia, Deiva, Bonassola, and Levanto. The west shore of the gulf of Spezia is followed by a tortuous second-class road from Portovenere to Spezia, and the east shore by a poor road to Spezia from Tellaro to Lerici and thence by a second-class road.

The only roads across the Ligurian Apennines to the Northern Plain lead from Recco (second class), Chiavari (first class via Bocco





PLATE 5. *Portofino*



PLATE 6. *The Gulf of Rapallo and the Promontorio di Portofino*





PLATE 7. *Levanto*



PLATE 8. *Portovenere*



pass), and Sestri Levante (first class via Cento Croci pass). A second-class road leads 6 miles inland from Spezia to join road 62 to Parma.

The Genoa-Pisa railway follows the coast closely except where it cuts across the necks of the promontories of Portofino, Portovenere, and the spur terminating in Point Bianca. It is in tunnels for the greater part of the way between Sestri Levante and Spezia. Other lines lead from Genoa and Spezia to the Northern Plain.

### *Vegetation*

The mild climate of the Riviera Levante permits the growth of a luxuriant Mediterranean vegetation in the more sheltered areas along the windswept coast. Lemons, oranges, olives, vines, small palms, prickly pears, and aloes grow in these areas, and olives, chestnuts, holm oaks, and pines on the more exposed hill-slopes. Between Genoa and Camogli gardens with a luxuriant sub-tropical vegetation, olive groves, citrus orchards, and pinewoods cluster around the seaside resorts and spread on to the lower hill-slopes. The mountainous Portofino peninsula is for the most part densely wooded with pines, olives, and cypresses, amongst which white villas nestle. From Rapallo to Monterosso the vegetation is not so dense, though the lower slopes of the hills are wooded, and vines are cultivated on the small coastal plains amongst the gardens of palms. The *Cinque Terre*, the coastal area between Monterosso and Riomaggiore, is famous for its vineyards and wines.

### *Population*

In this region, which is steep and rugged inland, settlement tends to be on or near the coast, wherever there are small level areas. The population is not so dense as in the Riviera Ponente and the settlements themselves are smaller. The larger towns and villages cluster round the heads of bays, usually at the mouths of valleys. The most important are S. Margherita, Rapallo, Chiavari, Sestri Levante, and La Spezia. The seaside towns here are rarely paralleled by hill towns as in many other parts of Italy. The coastal strip between Genoa and Camogli is lined with seaside resorts and villas which spread into the lower hill-slopes. The towns and villages round the bay of Rapallo are famous as resorts and are usually fishing-ports also. South-east of Sestri Levante, settlement, except for resorts and the five wine-producing towns, is sparse and limited to small towns and villages at the heads of the small bays and coves.



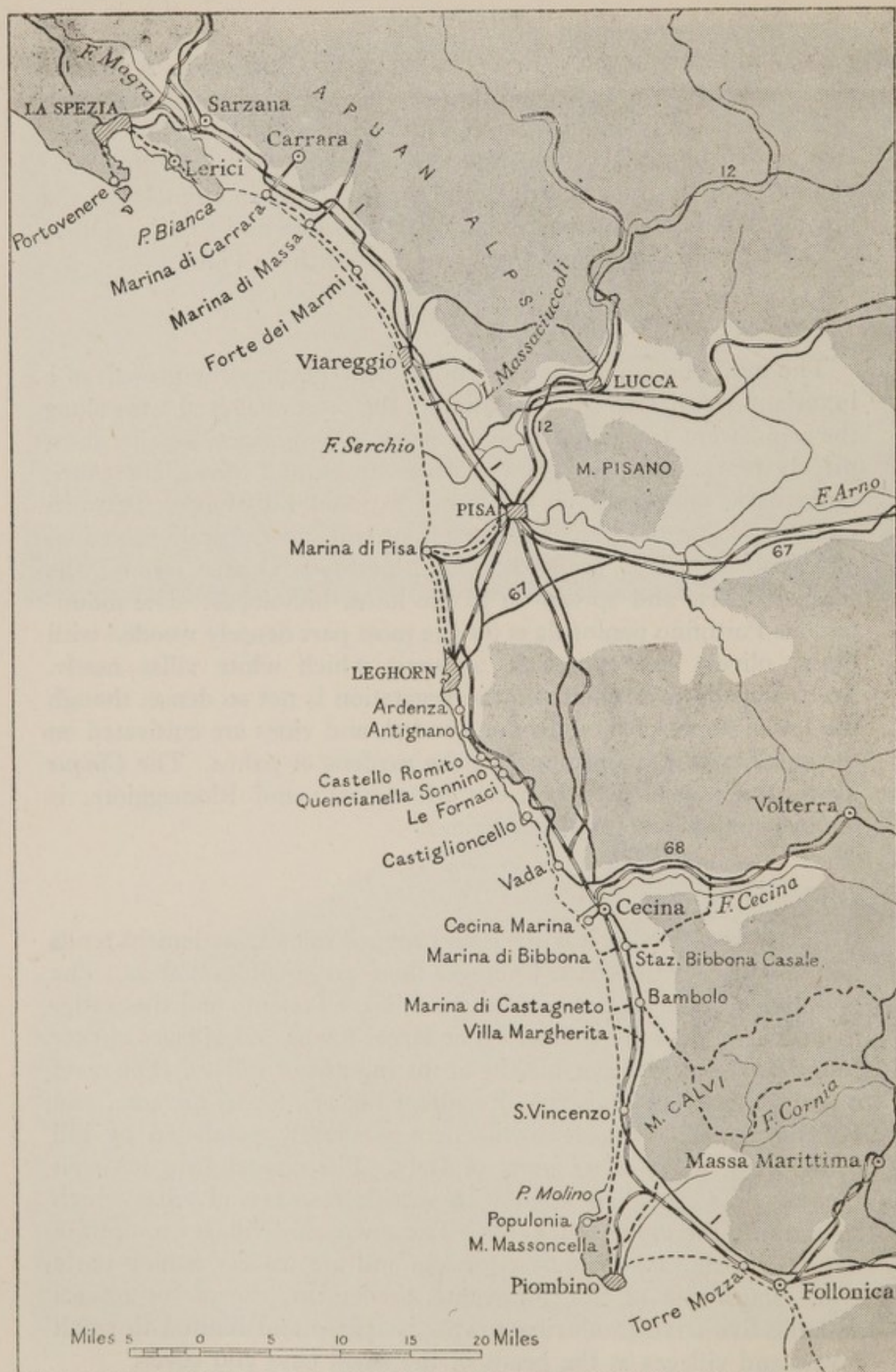


FIG. 12. The coast: the mouth of the F. Magra to Piombino. (For Key see p. 54)



*Ports*

Long beaches are rare along this coast, although those which exist are sheltered and used for beaching fishing-boats. There are few harbours with facilities for more than small craft, though there are many safe anchorages. The naval harbour of Spezia\* is outstandingly the most important. The most notable of the small harbours are Recco, Camogli, Portofino, S. Margherita, Rapallo. The following places have landing facilities: Sestri Levante, Riva Trigoso, Framura, Portovenere, and Lerici.

## PRE-APENNINES; THE MOUTH OF THE F. MAGRA TO TERRACINA

The coast of Tuscany and Latium extends in a south-easterly direction for about 350 miles. It is scalloped by broad bays and is made up of a series of beach-fringed coastal plains bounded by the Pre-Apennines, and separated from each other by rocky headlands and promontories. The latter are usually formed by the seaward spurs of the Pre-Apennines, or by isolated mountain masses, once islands but now joined to the mainland, such as M. Massoncello, M. Argentario, and M. Circeo. The area between Leghorn and Civitavecchia, where the alternation of headlands and lowlands is rapid, is known as the Maremma.

The coast between Leghorn and Promontorio Argentario is fringed by scattered, rocky islands and islets, which are known as the Tuscan archipelago. The most important of the islands are Gorgona, Capraia, Elba, Pianosa, Montecristo, Giglio, and Giamutri. These islands are strategically important as advanced observation posts. The island of Ponza, the largest of another group, lies about 22 miles south of M. Circeo.

*Mouth of the F. Magra to Cosa e Ansedonia (Figs. 12, 13)*

A beach-fringed coastal plain extends for about 33 miles from the mouth of the F. Magra to Leghorn (Livorno). The beach, which is made up of fine quartz-sand and pebbles, slopes gently beneath the sea and is sometimes bounded inland by sand-dunes and an almost continuous belt of pinewoods. The plain north of Viareggio is only  $2\frac{1}{2}$  miles wide, but to the south widens to the plain of Pisa (p. 271). The seaward border of the northern part of the plain is lined almost throughout by pinewoods and a nearly continuous row of houses and villages. Most of the latter are seaside resorts, though some have developed around piers for the export of marble. This fertile plain



is intersected by numerous irrigation channels and covered with vineyards, olive groves, and orange orchards, as well as with scattered villas and farms. The Apuan Alps (Plate 93) rise bare and rocky above the plain through wooded foothills of 650–1,300 feet to fretted peaks averaging about 6,000 feet. These limestone mountains are cut by deep precipitous ravines, and are pitted with marble quarries. Along the seaward side of the plain of Pisa the dunes become higher and the pinewoods are thicker and mixed with *ilex* trees; coastal settlements, except for Marina di Pisa, are rarer. The flat plain of Pisa, crossed by the F. Serchio and the F. Arno as well as by numerous irrigation channels, is generally covered with pasture or arable land. The marshy Lake Massaciuccoli (south-east of Viareggio) is, however, still undrained. Inland the plain is bounded in the north by the Apuan Alps, which are separated by the Serchio valley from the rounded and wooded M. Pisano (p. 271). This, rising like an island from a sea of alluvium, is in turn divided by the low Arno gap from the northern flank of the Catena Metallifera in the south.

The coast from Leghorn (Livorno) to a short distance south of Antignano is rocky and consists of low cliffs, alternating with a few short bathing beaches, as at Ardenza and Antignano. Thence to near Castiglioncello the coast is indented and rocky: the limestone and sandstone cliffs become higher and honeycombed with pot-holes, and tiny beaches, especially at the mouths of torrents, form between rocky headlands. The beaches at the seaside resorts of Quercianella Sonnino and Castiglioncello (Plate 9) are the best for bathing and have easy access to the railway and road. Between Leghorn and Castiglioncello a gentle slope above the cliffs leads to rounded sandstone hills (*c.* 1,000 ft.; p. 274), which are well wooded with pines, *ilex*, and aspens, and covered with patches of *macchia*, except near the areas of cultivation around the towns.

A sand and shingle beach 26 miles long extends from Castiglioncello to Point Molino (Torre Nuovo) and edges two plains which are separated from each other at S. Vincenzo by a spur of M. Calvi (2,119 ft.). The beach is crowned with dunes 30–50 feet high, except near S. Vincenzo where the hills come down to the shore. The gently sloping plain of Cecina, the northern of the two plains, is about 3–4 miles wide, and is drained by the F. Cecina and by numerous small torrents. Its seaward fringe is either marshy or lined with pinewoods, whilst farther inland it is generally cultivated with cereals and vines. The Catena Metallifera, here highly dissected by numerous streams, rises steeply from the plain to heights of about 1,500 feet.





PLATE 9. *Castiglioncello: coastal pinewoods*



PLATE 10. *Torre S. Liberata*





PLATE 11. *The Laguna di Orbetello from the hills of Ansedonia: low macchia in foreground*

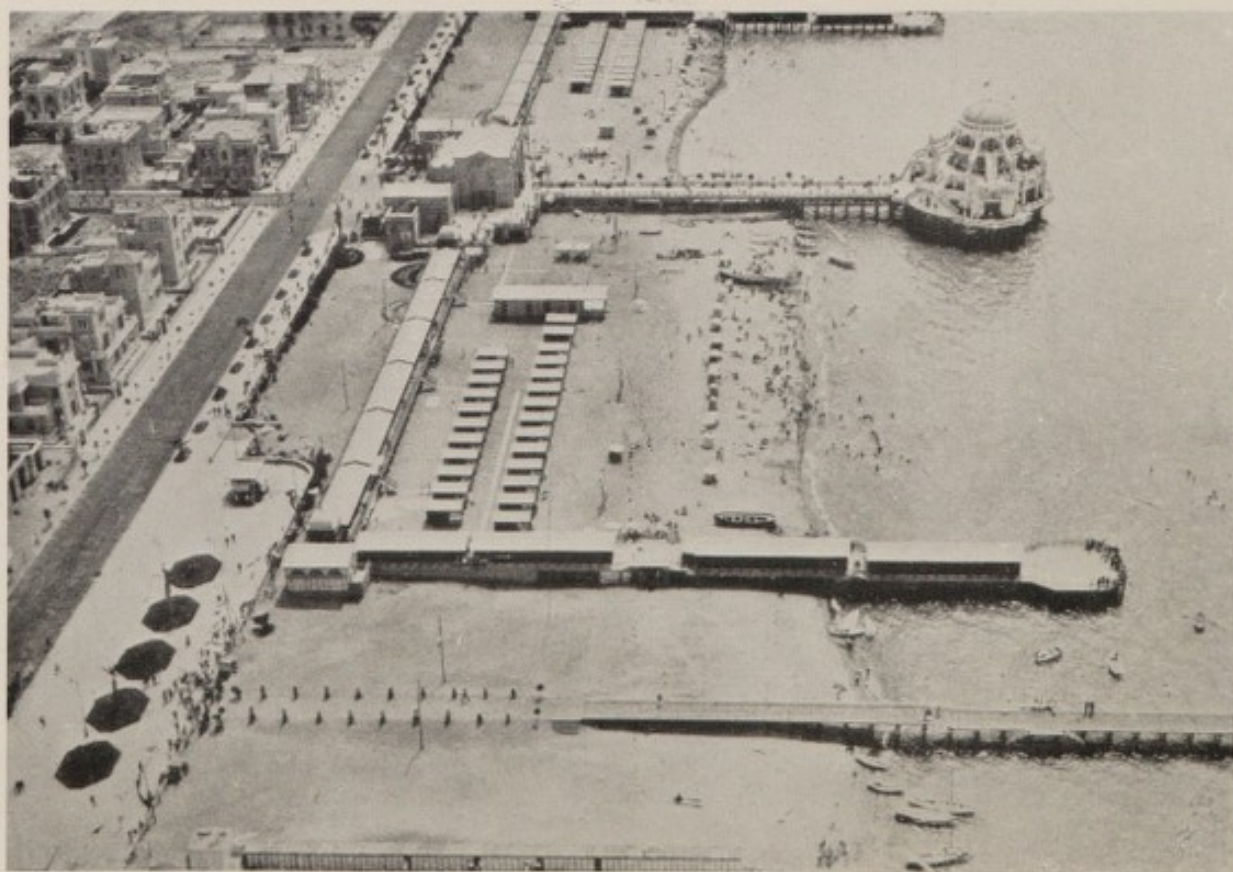


PLATE 12. *Lido di Roma*



South of S. Vincenzo the southern plain, sometimes called the plain of Cornia after the river crossing it, joins the Piombino peninsula to the mainland, and forms the northern shore of the gulf of Follonica. This plain is fertile and cultivated with vines and cereals, except north of Point Molino where there is a strip of marshland.

The coast from Point Molino to Cape Barati (east of Populonia) is rugged and backed by partly *macchia*-covered hills 300–900 feet high. Between Point Molino and the port of Piombino the rocky coast of the Piombino peninsula rises steeply to the wooded M. Massoncello (938 ft.).

The crescent-shaped gulf of Follonica extends between the Piombino peninsula and Point Ala (Point Troia). Its shores from the mouth of the F. Cornia to Castello di Portiglione are fringed by a beach crowned with sand-dunes and lined with pinewoods. This beach at first borders the fertile plain of Cornia (*see above*), which narrows to less than half a mile between Torre Mozza and Follonica, where a spur of the Catena Metallifera slopes gently to the coast. Beyond Follonica there is a flat plain, about 5 miles broad, well cultivated with vines near Follonica but elsewhere marshy.

At Castello di Portiglione the character of the coast changes as the rounded and wooded sandstone hills of M. d'Alma and Poggio Ballone rise in cliffs from the sea. The cliffs are interrupted by several small coves, and by a 4-mile long beach between the mouth of the Alma valley and Point Hidalgo, the north-western tip of the Point Ala promontory. Scoglio dello Sparviero (Isolotto Troia), a rugged rock, lies off Point Ala, where the coast turns abruptly south-east. The cliffs continue for 3 miles to a 17-mile long beach which, lined with pine-clad dunes, sweeps to the delta of the F. Ombrone and Cala di Forno. As far as Castiglione della Pescaia this beach is backed by a narrow, marshy coastal plain, enclosed by rounded sandstone hills. At Castiglione della Pescaia, however, these hills recede 8–10 miles inland and give way to the flat, alluvial plain of Grosseto, which is crossed by numerous drainage channels and by the rivers Bruna and Ombrone. The F. Ombrone, the larger and more important of the two, meanders across the plain and forms a swampy delta at its mouth. The plain, which is naturally marshy but has been undergoing reclamation, is now mostly covered with large open fields of cereals and pasture. There is, nevertheless, often a strip of *macchia* behind the dunes, whilst the marsh east of F. Bruna was still undrained in 1939. Gently sloping olive- and vine-clad hills encircle the plain.



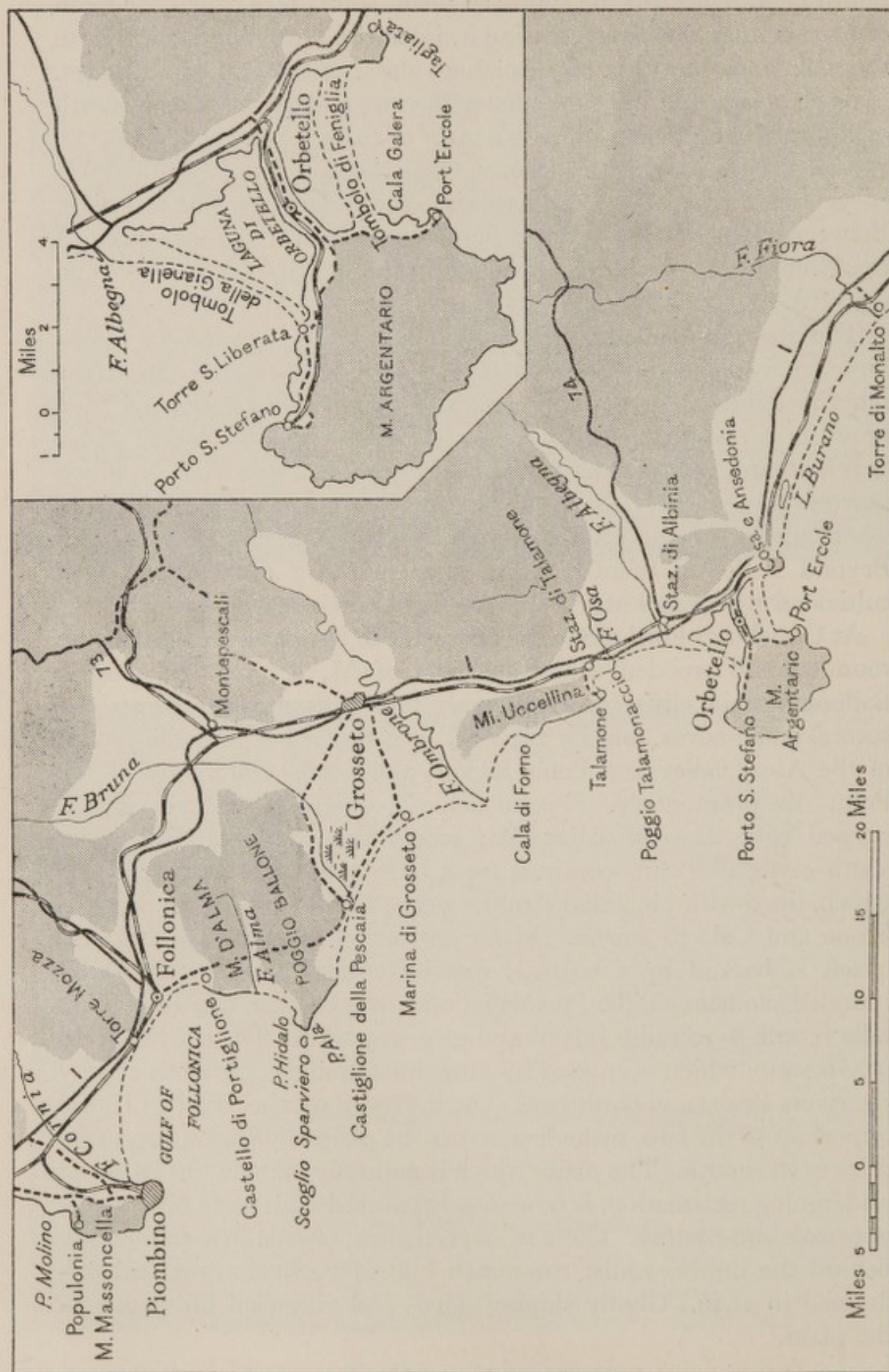


FIG. 13. The coast: Piombino to Torre di Monalto. (For Key see p. 54)



Between Cala di Forno, a rocky cove with a beach at its head, and Talamone the coast is edged with cliffs about 30-150 feet high and bordered by rocks. The *Mi. dell' Uccellina*, which are predominantly of limestone and wooded, here rise steeply to heights of 650-1,360 feet. A sharply curving beach, mostly dune-crowned, extends  $1\frac{1}{2}$  miles east from Talamone. It borders a well-drained plain, which continues inland behind the *Mi. dell' Uccellina* to connect with the Grosseto plain. Beyond the beach to the mouth of the F. Osa the coast is bordered by the low cliffs of the Poggio Talamonaccio (alt. 348 ft.). A sandy beach, backed by dunes with patches of *macchia* and pinewoods, stretches from the mouth of the F. Osa almost to Torre S. Liberata (Plate 10). Between the F. Osa and the mouth of the Albegna the beach borders a plain 6 miles wide, through which meanders the F. Albegna. The plain, which is either cultivated with cereals or wooded, is enclosed by low hills of clay, marl, and limestone, rising at first gently to about 600 feet and then more steeply to the volcanic uplands of south Tuscany. South of the mouth of the Albegna the plain gives way to the Laguna di Orbetello, which is bounded on both the north-west and south-east by narrow strips of beach (*tombolos*) extending from the mainland to the rugged M. Argentario. The town of Orbetello is built on another narrow strip, which, together with a causeway, cuts the lagoon in two and also connects M. Argentario with the mainland. The strip of beach (*Tombolo della Gianella*) between the mouth of the Albegna and Torre S. Liberata is not more than 500 yards wide and is covered with pine-woods, interspersed with patches of cultivation. The coast of the Promontorio Argentario consists of rocky headlands, above which wooded limestone hills rise steeply to M. Argentario (2,083 ft.). Between the headlands there are sandy coves. The most important of these for bathing and landing are: (1) east of the town of Porto S. Stefano, where there is a shingle beach backed by steep slopes cultivated with olives and vines: (2) at Port' Ercole, and (3) at Cala Galera. The beach or Tombolo di Feniglia, which encloses the Laguna di Orbetello on the south, is crowned with sand-dunes covered with coarse grass and low bushes. Eastwards it ends in the low, cliffed hills of Cosa e Ansedonia (Plate 11).

*Cosa e Ansedonia (near Laguna di Orbetello) to Terracina (Figs. 14, 15)*

A beach with wooded sandhills stretches for 30 miles from the east flank of Cosa e Ansedonia to the mouth of the F. Mignone, and



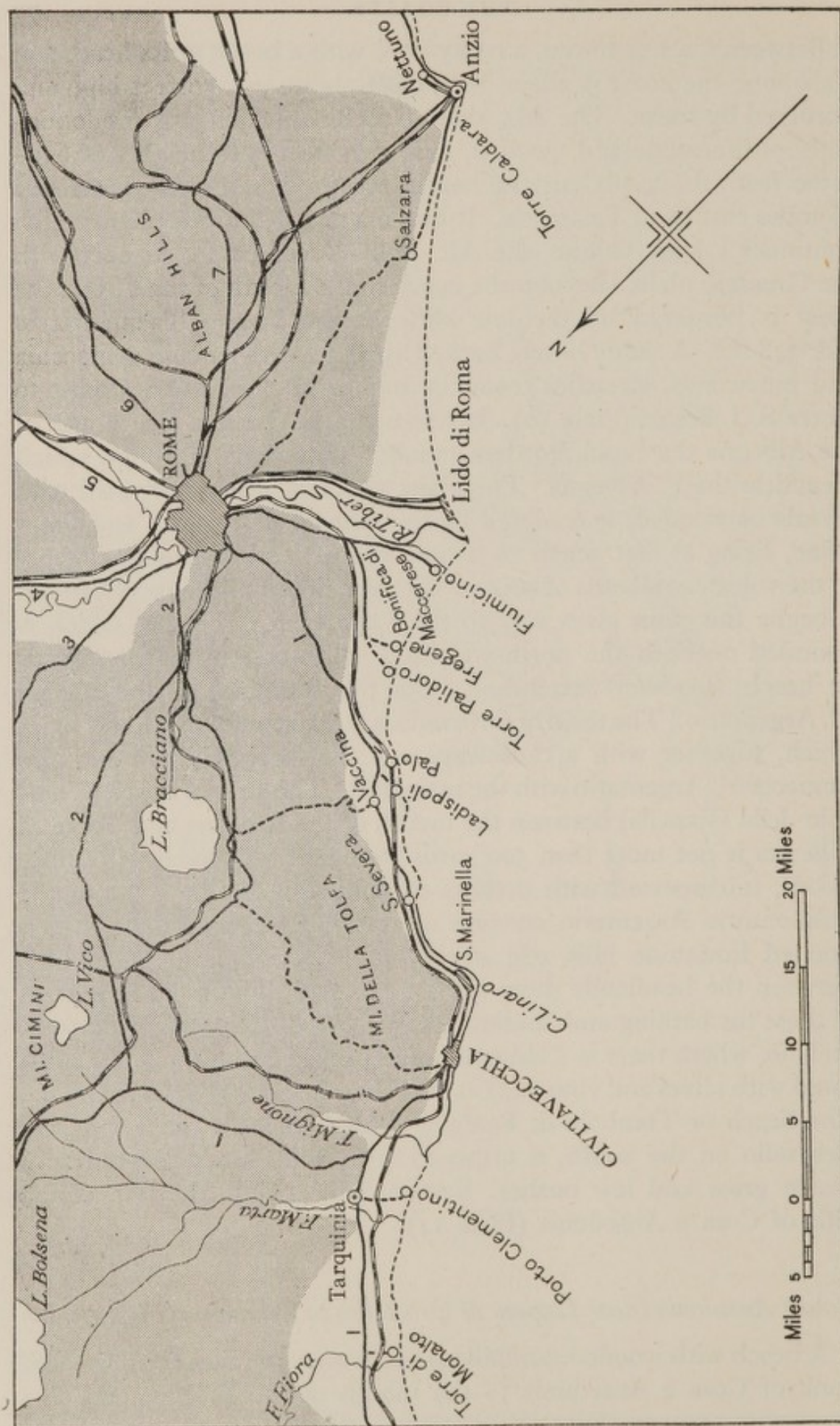


FIG. 14. The coast: Torre di Monalto to Anzio. (For Key see p. 54)



fringes an undulating and gently sloping plain,  $2\frac{1}{2}$ –5 miles wide. The beach is indented by the mouths of small streams between the F. Fiora and Porto Clementino. It is immediately backed by a strip of wooded marshland and small lagoons between Tagliata and the F. Fiora, by cork trees southwards to Porto Clementino, by salt-pans and then by fields onwards to the mouth of the T. Mignone. The greater part of the plain, however, is given over either to fields of cereals or sheep pasture. Numerous irrigation cuts and short meandering streams, often bordered by willow or poplars, cross the plain, behind which ridged Pliocene hills of clay, marl, and limestone rise gently to the volcanic craters of Mi. Volsini and Mi. Cimini (p. 277). The lower hill-slopes are generally cultivated with olives or cereals. Between the mouth of the Mignone and Civitavecchia the low and indented coast consists at first of alternations of rocks and scattered patches of sand, which give way to cliffs shortly before Civitavecchia. An off-shore bank of rocks hinders access to this stretch of coast.

From Civitavecchia almost to S. Severa the coast is indented, generally fringed with cliffs, 10–20 feet high, and bordered off shore by rocks. There are, however, some small pebble beaches at the seaside resort of S. Marinella, which lines the coast for about 2 miles east of Cape Linaro. Above a gentle, cultivated slope, partially wooded hills furrowed by numerous short streams rise steeply to the sandstone Mi. della Tolfa.

From near S. Severa a beach, about 40 miles long, curves south-eastwards to the pointed or cusp-shaped delta of the Tiber, and then continues in a similar sweep to the Anzio peninsula. Between S. Severa and Palo the beach is crowned by a few low dunes, whilst onwards to the mouth of the Tiber (Foce del Tevere) there is an almost uninterrupted girdle of higher dunes. Inland a lowland belt of alluvium,  $2\frac{1}{2}$ –3 miles wide and crossed by numerous small streams and drainage channels, borders the gently rising plain of the Roman Campagna (p. 278), which is predominantly of volcanic tuff. The lowland is either marshy, covered with rough *macchia*, or planted with pinewoods as at the sea-side resorts of Ladispoli and Fregene. Where reclaimed, it is down to pasture as in the 'polder' area of the 'Bonificazione di Maccarese', which is below sea-level and has constantly to be drained by pumping.

From Lido di Roma (Plate 12), a much frequented bathing resort near the extensive ruins of Roman Ostia, to Torre Caldara the girdle of dunes becomes wider. Inland the country remains low up to the



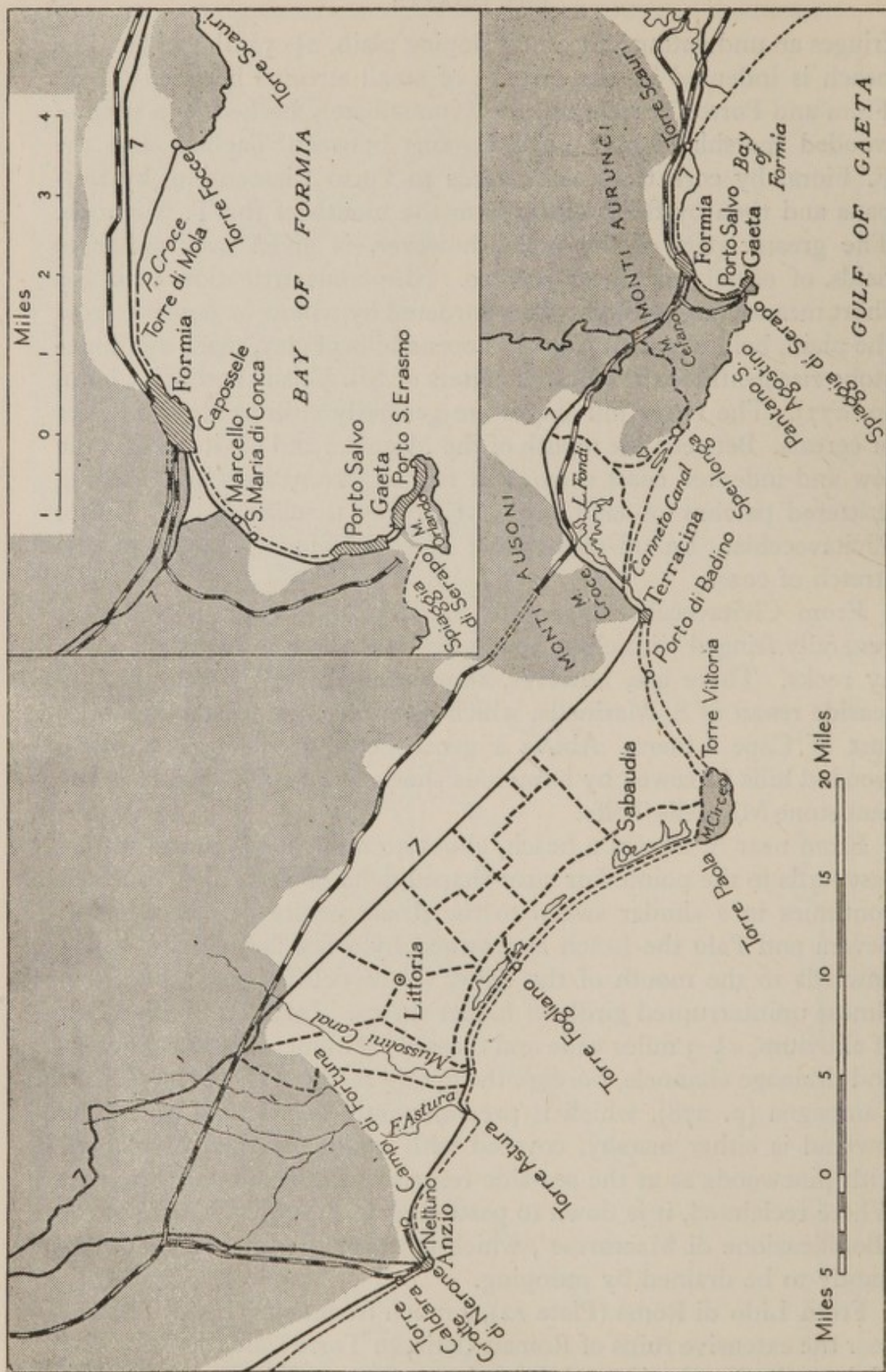


FIG. 15. The coast: Anzio to the Bay of Formia. (For Key see p. 51)





PLATE 13. *Anzio*



PLATE 14. *The Mussolini Canal at its outlet*





PLATE 15. *M. Circeo and the Pontine Marshes from Terracina*



PLATE 16. *Lake Miseno and Porto di Miseno*



foot of the Alban hills (p. 280) and consists of undulating *macchia*-and steppe-land incised by a myriad of little streams flowing in ravines. The seaward margin of this lowland, except where recently reclaimed, is thickly wooded, desolate, and uncultivated. From Torre Caldara almost to Anzio the beach is backed by low cliffs, above which hills, cultivated with vines and olives, slope inland.

The Anzio peninsula has cliffs from north of the lighthouse to the rock-fringed headland of Grotte di Nerone, east of which it is edged by the bathing beach of Anzio (Plate 13). The harbour cuts this beach in two, the western part being 600 yards long, and the eastern 900 yards long, and backed by low cliffs. The latter continue eastwards beyond the beach to Campo di Fortuna, and at Nettuno are fronted by three short bathing beaches. The country inland is fertile and cultivated with vines. A sandy beach with dunes, often over 30 feet high, extends from Campo di Fortuna to Torre Astura and is backed by undulating country, covered either with pasture or *macchia*.

From Torre Astura, the ruins of a Roman villa, to the M. Circeo peninsula, a sandy beach sweeps southwards. It is bounded by a girdle of dunes, 30–90 feet high, and backed by a wide plain, which includes the reclaimed Pontine marshes (p. 281). Between Torre Astura and Capo Portiere the plain is crossed by the F. Astura and the Mussolini canal (Plate 14). Onwards to Torre Paola numerous drainage canals lead to the coast across a chain of lagoons immediately behind the dunes, parts of which have now been reclaimed and enclosed by embankments. Behind the lagoons there is first a girdle of older consolidated dunes,  $3\frac{1}{2}$ –4 miles wide and 50–100 feet high, and then the flat plain, about 11 miles wide, of the Pontine marshes. The southern part of the consolidated dunes is occupied by the Circeo National Park, an area of woodland.

Between Torre Paola and Torre Vittoria the picturesque Circeo headland, once an island, rises out of the sea in rocky cliffs, 30–100 feet high, to the steep ridge of M. Circeo (1,404 ft.), whose lower slopes are wooded and cultivated with vines. From the eastern spurs of the headland to Terracina there extends a beach, lined with dunes about 30 feet high. The undulating and wooded Circeo National Park stretches behind the dunes but soon gives way to the southern end of the reclaimed Pontine marshes with their extensive network of drainage channels. Vines, which are also planted on the dunes, become more numerous near Terracina, where the limestone Mi. Ausoni (p. 290) drop down to the sea (Plate 15).



*Communications*

*North of the Tiber.* The main Mentone-Genoa-Rome road (1, Via Aurelia) keeps close to the coast from near the mouth of the F. Magra to Palo, 2 miles north of the Tiber mouth, where it goes inland to Rome. The road usually follows the inner edge of the coastal plains, but it turns inland to avoid the Piombino peninsula, the sandstone hills terminating in Point Ala, and the Promontorio Argentario. Many roads branch near the coast from road 1 either to cross the Apennines or to join the dense road system serving the sub-Apennine region.

The plain north of Viareggio and that of Pisa are both served by a good network of roads. A main road close to the shore links the chain of sea-side resorts between Marina di Carrara and Viareggio, and a second-class road from Pisa to Leghorn (Livorno) follows the coast between Marina di Pisa and Leghorn, whilst several lanes lead inland from near the coast to road 1. Main roads connect Viareggio with Lucca, which in turn has good road connexions with the Northern Plain, Pisa, and Florence. Pisa is also an important route centre.

In the plain of Cecina the main road runs inland south of Vada. It is, however, joined by lanes from the coast at Cecina Marina, Marina di Bibbona, Marina di Castagneto, and Villa Margherita. Where the main road turns inland between S. Vincenzo and Follonica a poor road keeps close to the coast between S. Vincenzo and Populonia, and then continues inland to Piombino, which is also served by a second-class road branching from road 1. Another second-class road parallels the coast south of Follonica as far as Castello di Portiglione, beyond which it crosses the sandstone hills terminating in Point Ala, before following the coast again from Castiglione della Pescaia almost to Marina di Grosseto. At Castiglione and Marina di Grosseto branches lead to the main road which makes a broad sweep inland between Follonica and Staz. di Talamone, which is connected to Talamone by a second-class road along the coast.

Poor tracks follow the tombolos north and south of Laguna di Orbetello, which is crossed by a second-class road from Porto S. Stefano through Orbetello to road 1. Lanes cross the plain between Cosa e Ansedonia and Civitavecchia to road 1 only from Torre di Monalto and Porto Clementino. The Roman Campagna to the north of the Tiber is fairly well served with roads, especially where there has been intensive reclamation. Roads go inland to road 1 from the beach at Ladispoli, Palo, near Torre Palidoro, Fregene and Fiumicino.



Good roads branch inland from road 1 to join the main road system of the Peninsula from Viareggio, Pisa (12, 67), Leghorn (67-*bis*), Cecina (68 and another main road), Staz. Bibbona Casale (second class), Pode Bambole (second class), Follonica (main road), Grosseto (second class), Staz. di Albegna (74), Tarquinia (main and 1-*bis*), Civitavecchia (second class), and Vaccina (second class).

The Ventimiglia-Genoa-Rome electric railway follows a route very similar to but generally to seaward of road 1.

Local branch-lines from the coast join the main railway from Marina di Carrara, Marina di Pisa (electric), Piombino (electric), Porto S. Stefano (narrow gauge), Ladispoli, and Fiumicino (electric). Other local branch-lines run from Cecina to Volterra, and from Follonica to Massa Marittima. Through lines lead inland from the main line at Sarzana, Viareggio, Pisa, Leghorn (Livorno), Vada, Montepescali, Civitavecchia, and Rome. Pisa and Rome are the most important railway junctions near the coast.

*South of the Tiber.* The Rome-Naples road (7) runs at first 13-15 miles inland, and then north of Littoria crosses the Pontine marshes within 8 miles of the coast, which it finally reaches at Terracina.

A main road (8) leads from Lido di Roma to Rome. Several poor roads run through the sand-dunes and marshes south of the Lido, but there is no good second-class road until that from Salzara to Anzio. From Anzio a good secondary road joins road 7, whilst another running between the beach and the lagoons follows the coast closely as far as Terracina, except where it turns inland to avoid M. Circeo. Several secondary roads and numerous third-class roads connect the Anzio-Terracina coast road with Littoria and the new settlements which are served by a dense network of new roads.

The main Rome-Naples coastal railway does not touch the coast in this region, but runs for the most part 8-13 miles inland. It is connected with the coast by two branch railways from Anzio and Terracina; there is also an electric railway from Lido di Roma to Rome.

### *Vegetation*

The coastal plains of the region, which tend to be marshy, have been reclaimed during the present century. They are now usually intersected by a net-work of drainage and irrigation channels, and are covered with large fields of cereals or grass. The Pontine marshes are regarded as a model of reclamation. The plain of Pisa and its northern extension has a somewhat different type of cultivation,



since much of it has been reclaimed for a longer time. Here vines, olives, and citrus trees predominate, though the Arno is lined with meadows. The coastal plain immediately south of Rome remains unimproved pasture with patches of dense *macchia*. The dunes and sandy areas backing the beaches have often been planted with pine-woods and grasses which merge landwards in the marshy areas into dense thickets. Rivers meandering across the plains are generally fringed by a line of trees. The lower hill-slopes enclosing the plains are usually cultivated with olives, but vines predominate near Leghorn (Livorno). The hills rising straight from the sea tend to be either wooded, covered with *macchia*, or rough pasture, except near settlements where there may be olive groves and, in the southern part of the region, vines.

### *Population*

This coast was, until recently, little inhabited. Now that the coastal plains are being drained and the dangers of malaria are decreasing, a series of small seaside resorts have grown up. These resorts are especially numerous where the neighbouring hills are most densely populated. Viareggio and Lido di Roma, the two largest resorts, serve respectively the plain of Pisa and Rome. The towns built on the rocky coast or where the hills come close to the sea are generally of older foundation and are of historical interest.

The narrow plain north of Viareggio is fringed by an almost continuous line of seaside resorts and marble-exporting villages. The plain of Pisa is fairly closely settled; Pisa, about 6 miles inland, and the great port of Leghorn (Livorno) are the largest towns. South of Leghorn the coast is dotted with villas and seaside resorts as far as the plain of Cecina, which is little populated except for the town of Cecina, but is bordered by a line of small hill towns. Populonia, and Piombino, an important centre of the iron industry, are the only settlements on the shore of the Piombino peninsula. South to Civitavecchia the coast is usually desolate except for Follonica, a modern town connected with the mining industry, Castiglione della Pescaia, Marina di Grosseto, Talamone, a small town of Etruscan foundation, Orbetello, an important centre of the chemical industry, and Porto S. Stefano. Between Civitavecchia and the delta of the Tiber there are only a few bathing resorts of which S. Marinella is the most important. From the large resort of Lido di Roma, near the southern mouth of the Tiber, to Anzio the coastal strip is, for the most part, desolate, though strewn with ruins of Roman villas which attest to





PLATE 17. *Cape Miseno*



PLATE 18. *The Island of Nisida*





PLATE 19. *Castellammare di Stabia at the foot of the Mi. Lattari*



PLATE 20. *Sorrento*



its former prosperity. South of the small seaside resorts of Anzio and Nettuno the once desolate Littorian coast will no doubt soon be lined with bathing-huts and small seaside towns to serve the reclaimed Pontine areas. Sabaudia, the first of these towns to grow up, is on the shores of Lake Paola (L. di Sabaudia).

### *Ports*

Natural harbours along this coast are rare, and the best ports are generally found where rocky and sandy coast adjoin. The chief ports of the region are Viareggio\*, Leghorn\* (Livorno; the fifth largest port of the country), Piombino\* (including Porto Vecchio), and Civitavecchia\*. There are small harbours or landing facilities usually connected with mines and quarries at the following places: Marina di Carrara, Marina di Massa, Forte dei Maroni, Ardenza, Castello Romito, Le Fornaci, Castiglioncello, Vada, Populonia, Follonica, Point Ala, Castiglione della Pescaia, Talamone, near Torre di S. Liberata, Orbetello, Porto S. Stefano, Port'Ercole, Porto Clementino, S. Marinella, Canale Fiumicino, Lido di Roma, Canale di Castel Fusana, Anzio, Torre Fogliano, Torre Vittoria, Porto Canale di Badino.

### CAMPANIA; TERRACINA TO AGROPOLI

This coast, which has an approximate length of 45 miles, borders the gulf of Gaeta, the gulf of Naples, and the gulf of Salerno. The coast of the gulf of Gaeta consists of beach-fringed coastal plains separated from each other by mountain spurs. The northern section of the plain of Campania is the longest and widest of the plains. The gulf of Naples is bounded by the fertile Campi Flegrei in the north, Vesuvius and the southern part of the plain of Campania in the east, and the limestone Sorrentine peninsula in the south. This rugged and usually cliff-fringed peninsula forms the northern shore of the gulf of Salerno, and the beach-bordered plain of the lower Sele basin is its eastern shore.

The islands of Ponza, Ventotene, Ischia, and Capri lie at varying distances off this coast, in the Tyrrhenian Sea.

### *Terracina to Torre Gaveta (Figs. 15, 16)*

The coast from Terracina to the mouth of the Canneto canal is steep, rocky, and bush-covered, rising to the rugged limestone massif of M. Croce (1,181 ft.) and farther inland to the greater heights of



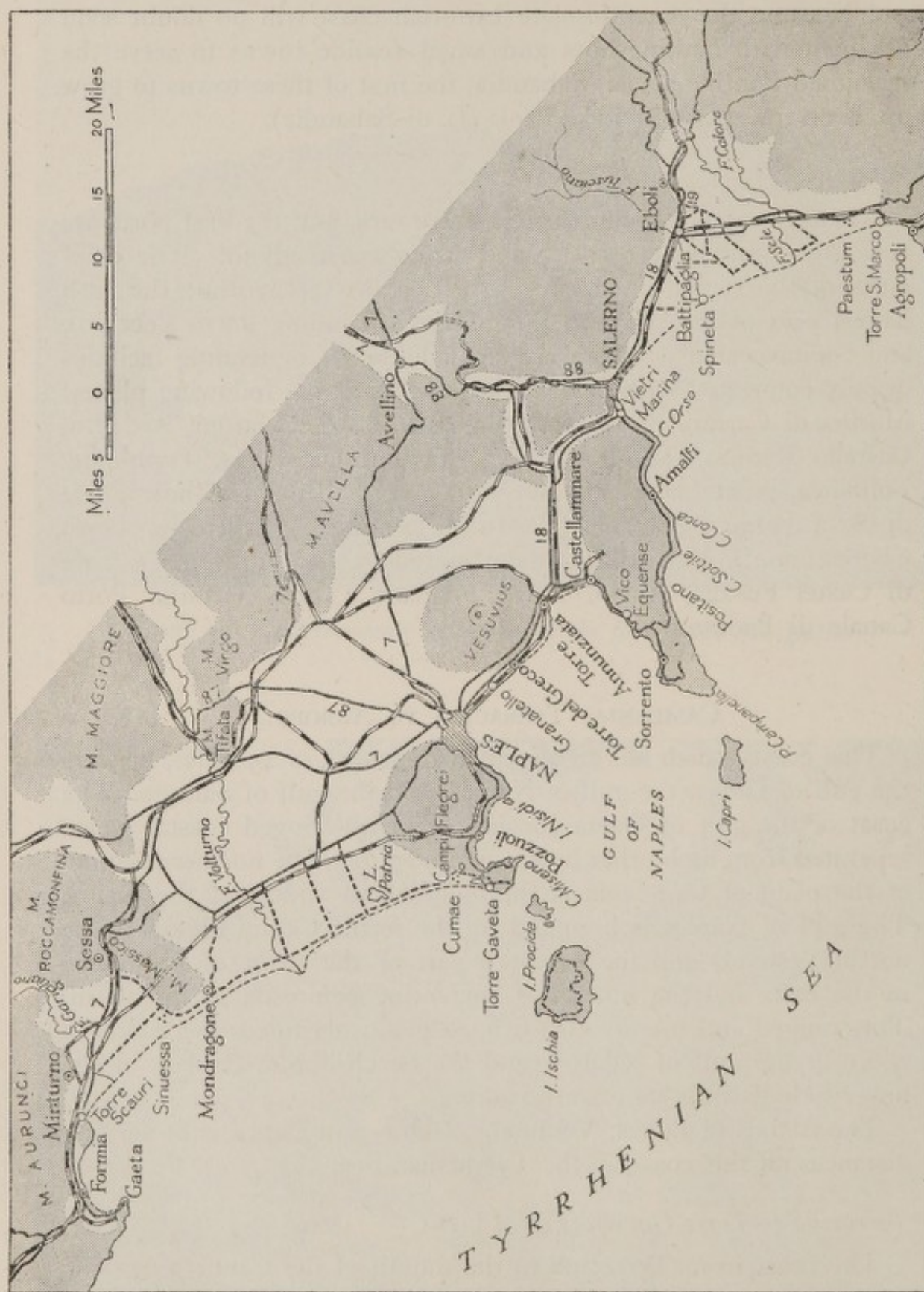


FIG. 16. The coast: Gaeta to Agropoli. (For Key see p. 54)



the Mi. Ausoni range (highest point 3,576 ft.; p. 290). Between the Canneto canal and Sperlonga there is a sandy beach crowned with dunes and bounded by a belt of marshland and small lagoons, behind which extends a flat plain about 6-9 miles wide, densely forested with pines. Lake Fondi lies in the heart of the pine forest, about  $2\frac{1}{2}$  miles inland. From the village of Sperlonga to Spiaggia di Serapo the coast is rugged, steep, and cliff-fringed, except for the sandy beach, Pantano S. Agostino, which is about 1 mile long and backed by a precipitous rise to wooded limestone mountains 900-1,800 feet high. The Spiaggia di Serapo, a beach about three-quarters of a mile long, bounds the southern side of the narrow neck of land joining the craggy M. Orlando (alt. 548 ft.) promontory to the mainland. The northern shore of the promontory and the isthmus is occupied by the town of Gaeta and its harbours Porto S. Erasmo and Porto Salvo. From Porto Salvo the bay of Formia curves gently north-east to Formia and thence east to Torre Focce, and is throughout low and either sandy or edged by rocks. Beaches used for bathing extend from Porto Salvo to S. Maria di Conca, from Marcello to Caposelle, and from Torre di Mola to Point Croce. These beaches are bounded by a line of villas usually built on a low, wooded terrace above which gentle clay and marl slopes, either wooded or clothed with vines, lead to the steep limestone hills of M. Cefalo and Mi. Aurunci (p. 290). Between Torre Focce and Torre Scauri a rocky headland rises with steep cliffs to the forested M. Scauri.

A sandy beach, usually crowned with dunes, extends for 38 miles from Torre Scauri to Torre Gaveta (Torre Alta). This beach fronts the small plain of Minturno and the northern section of the plain of Campania, which are separated from each other by M. Massico (alt. 2,661 ft.), a narrow isolated limestone massif. The alluvial plain of Minturno (p. 290), which is  $3\frac{1}{2}$ -7 miles wide, is crossed by the meandering F. Garigliano with its numerous marshy tributaries, and is usually either wooded or cultivated with vines. This plain is bounded in the north by the limestone Mi. Aurunci, and on the east and south-east by Roccamonfina (alt. 3,297 ft.; p. 290), an extinct volcano, and by M. Massico. A plain about half a mile wide between the M. Massico massif and the sea links the Minturno and Campania plains.

The dunes, fronting the northern section of the plain of Campania (p. 293), which extends between Mondragone and Torre Gaveta, are usually about 10-30 feet high and are covered with *macchia* or pine-trees. The seaward fringe of the plain tends to be marshy, especially



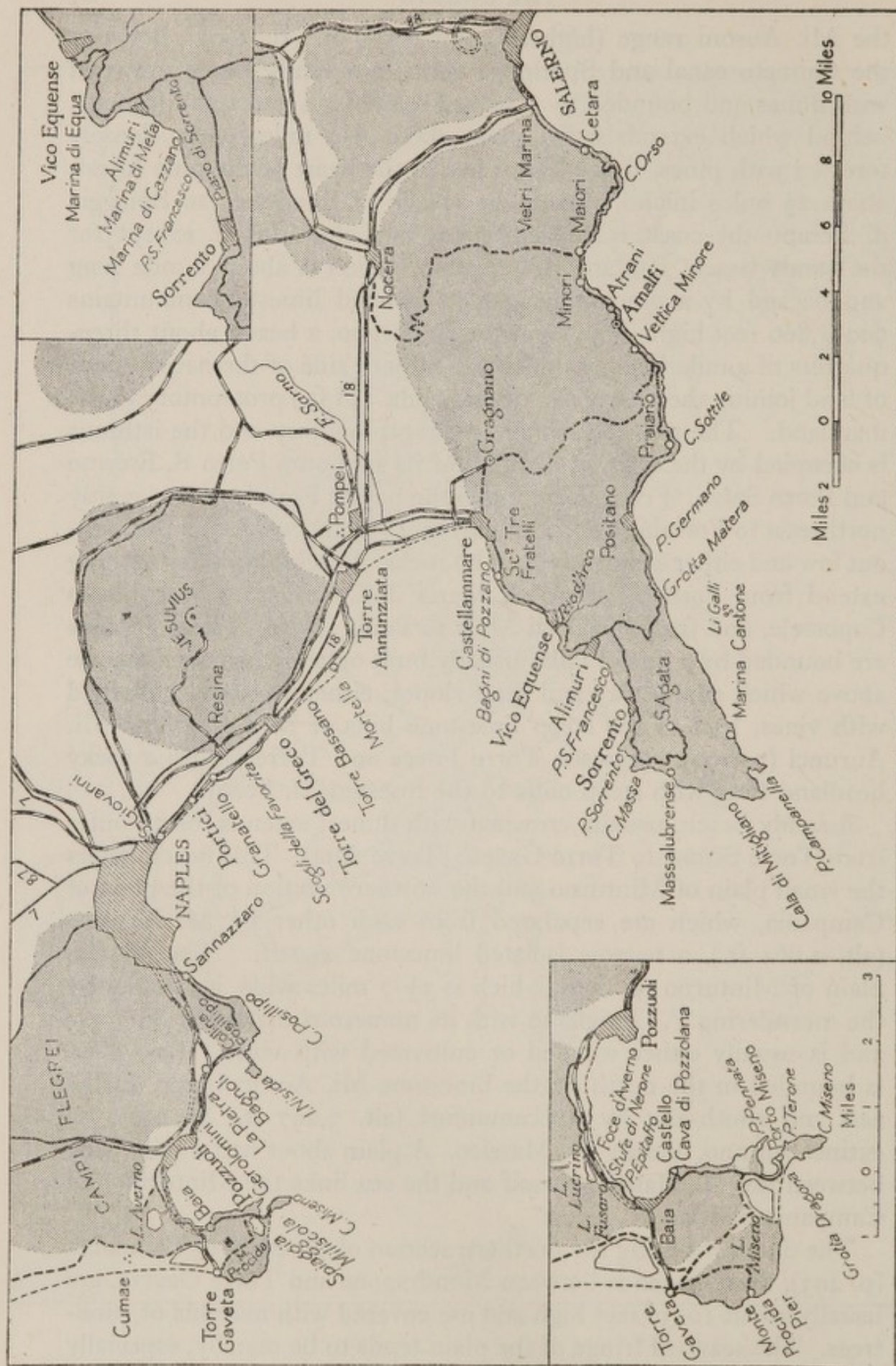


FIG. 17. The coast: the Gulf of Naples and the Sorrentine peninsula. (For Key see p. 54)



round Lake Patria, whilst south of the ancient Greek citadel of Cumae (Kyme) lies Lake Fusaro. The F. Volturno meanders across the centre of the gently sloping plain, which averages 18–22 miles wide as far as Cumae, where it dwindles to a few hundred yards and consists of alluvium and volcanic tuff. The area north of the F. Volturno is generally infertile and used only for pasture, whilst south of the river the plain is well irrigated, being intersected by numerous canals and cultivated with cereals, vegetables, olives, and vines, which are often trained up poplars. The plain is enclosed by a semicircle of highland, which includes M. Massico and Roccamonfina on the north-west, a chain consisting of M. Maggiore (3,402 ft.), M. Tifata (1,981 ft.), M. Virgo (2,100 ft.), and M. Avella on the east, and by the Campi Flegrei (p. 296) and Vesuvius on the south.

*Torre Gaveta to Castellammare di Stabia (Figs. 16, 17)*

The M. Procida peninsula with its southern projection, Cape Miseno, extends south from Torre Gaveta. South-west of the peninsula lie the fertile volcanic islands of Procida and Ischia. The gulf of Naples curves between Cape Miseno and Point Campanella, which is the southernmost tip of the Sorrentine peninsula.

From Torre Gaveta to Spiaggia Miliscola the coast is fringed by steep cliffs, 300–400 feet high, behind which rises the wooded M. Procida (1,263 ft.), a southerly continuation of the Campi Flegrei (p. 296). Spiaggia Miliscola, a sandy beach, backed by Lake Miseno (Mare Morte; Plate 16) and Porto di Miseno which are connected by a short artificial canal, extends for  $1\frac{1}{2}$  miles to Grotta Dragona on the west side of the precipitous and dome-shaped Miseno peninsula (highest point 548 ft.; Plate 17). This peninsula, which is the remains of a volcanic cone partially swallowed by the sea, terminates in Cape Miseno. Between Point Terone, on the north-east side of the peninsula, and Point Pennata curves the sheltered and partially beach-fringed harbour of Porto di Miseno, once used by the Roman emperor Augustus as a naval base. The coast from Point Pennata to Castello di Baia is usually cliff-fringed and rocky, interrupted here and there by minute sandy coves such as Cava di Pozzolana. Between Castello di Baia and Point Epitaffo lies the small gulf of Baia, the greater part of which is occupied by the port of Baia. The shores of the bay are low and beach-fringed, but north of the temple of Mercury are backed by rocky cliffs. Baia, now a small, insignificant town, was one of the most popular watering-places in the Roman world and still retains its ruined temples of Venus, Diana, and



Mercury. The coast is bordered by perpendicular cliffs from Point Epitaffo to Stufe (Bagna) di Nerone (a long, narrow passage in the rock leading to warm springs), but thence to Pozzuoli it is low, fronted in places by sandy beaches and often bounded by low hills. A beach extends from Stufe di Nerone to Foce d'Averno and is lined by bathing-huts. Lake Lucrino, in an old volcanic crater, stretches inland behind the beach and has been famous since Roman times for its oyster-beds and 'spignola' fish. Pozzuoli, which was founded by the Greeks in the sixth century as Dicaearchia and in Roman times became the important commercial port of Puteoli, is to-day a small port with cement factories and dockyards. A small beach extends from the eastern outskirts of Pozzuoli to Gerolomini, but thence to La Pietra the coast is rugged and backed inland by steep, rocky cliffs often quarried for trachyte. A sandy beach curves southwards from La Pietra to the causeway connecting the mainland with the rocky island of Nisida (Plate 18). This beach is backed by factories and settlements, including Bagnoli, which is a small watering-place with hot springs. From the causeway to Cape Posillipo the coast is rocky, rising to heights of over 100 feet, whilst between Cape Posillipo and Sannazzaro it is rugged with the narrow, wooded ridge of Collina di Posillipo rising inland to 500-600 feet. The coast between Baia and Naples is backed by the Campi Flegrei (p. 296), a fertile hill area (650-1,503 ft.) pocked with ancient volcanic cones and craters, which are now usually covered with vines, citrus and other fruit trees, chestnuts, umbrella pines, and macchia. One of the craters, half a mile from the shore east of Baia, contains Lake Averno. The town and harbour of Naples extends between Sannazzaro and S. Giovanni.

The coast between S. Giovanni and Torre Annunziata, a distance of  $10\frac{1}{2}$  miles, is generally low, and is subject to rapid change since it is formed by lava-flows from Vesuvius. The coast is rugged from S. Giovanni to the beach of Spiaggia Granatello, which stretches for a mile north of the small port of Granatello. Another beach, about 1 mile long, extends from south of the blunt headland of Granatello, which was formed by a lava stream of the 1631 eruption, to Scogli della Favorita. From Scogli della Favorita the coast continues to be rocky until south of the port of Torre del Greco. Onwards to Mortella a beach stretches for 3 miles, being only interrupted by the small cliffed headland of Torre Bassano. The coast between Mortella and the port of Torre Annunziata is mostly fringed by low cliffs. Inland between S. Giovanni and Torre Annunziata a gentle slope of



either rather bleak, pine-wooded country or of fertile fields of cereals mixed with olive groves and vineyards, leads to the dark towering cone of Vesuvius which backs the coast. Resina is built on top of the ancient town of Herculaneum, which was buried in the eruption of A.D. 79 (p. 472) by a stream of mud, ashes, and pumice stone.

A sandy beach,  $3\frac{1}{2}$  miles long, extends from Torre Annunziata to the port of Castellammare di Stabia (on the site of the ancient Stabiae also destroyed in A.D. 79; Plate 19), and is backed by the southern part of the plain of Campania, called the Sarno plain, which is well populated and intensively cultivated with olives, vines, and cereals.

*Castellammare di Stabia-Salerno-Agropoli (Figs. 16, 17)*

The Sorrentine peninsula (p. 298) projects from the mainland between Castellammare di Stabia and Salerno. Its north coast from Castellammare to Point Campanella is half as long as the south coast, which extends from Point Campanella to Salerno. The peninsula is made up of a west-to-east mountain mass, which consists of two main blocks, the first about 1,600 feet high extending from Point Campanella almost to Positano, whilst the other rises eastwards to about 3,300 feet. The peninsula is of limestone with patches of volcanic tuff which provide the most fertile of its soils. The island of Capri, about  $2\frac{1}{2}$  miles west of Point Campanella, was once part of the peninsula. The cliffs of the peninsula and of Capri are in places honeycombed with grottoes.

A beach continues from Castellammare to west of Bagni di Ponzano, whence the coast is generally bordered with rocks and backed with steep cliffs as far as Vico Equense; there is, however, near Scoglio Tre Fratelli, a small beach about 400 yards long which is bounded by a road at the foot of cliffs. Vico Equense is built on a small headland (318 ft. high) edged with cliffs, at the foot of which there are two small sandy beaches, one east and the other west of the town. The western beach is at the mouth of the fertile Rio d'Arco valley. A headland, consisting of a rounded limestone hill fringed with cliffs over 300 feet high, separates Vico Equense from Alimuri. Thence to Sorrento the coast is edged with perpendicular limestone cliffs, behind which stretches the gently sloping 'Piano di Sorrento'. In front of the cliffs there are beaches much used for bathing, the largest of which are at Alimuri, Marina di Cazzano (Cassano), two south of Point Francesco, and at Sorrento along the shores of Marina piccola and Marina grande. The fertile Piano di Sorrento, which



is sheltered by its surrounding hills, is intersected by numerous deep ravines and is covered with a dark green vegetation consisting of orange, olive, mulberry, fig, and pomegranate trees. The seaside resort of Sorrento (Plate 20), built on cliffs 160 feet high, is separated from Massalubrense, the next major settlement, by the two cliffed headlands of Point Sorrento and Cape Massa, behind which the hills rise in steps. The coast continues steep and rugged as far as Point Campanella (the ancient Cape of Minerva) and is often cut by deep ravines. At the foot of one of the ravines is the small beach of Cala di Mitigliano. The Bocca Piccola separates Point Campanella from the famous island of Capri.

Between Point Campanella and Positano steep rugged cliffs, over 900 feet high and far more precipitous than those of the north coast, form a wall generally terminating in a jagged peak or large block of limestone. There is, however, a cove with a narrow beach at Marina del Cantone. Off this desolate coast lie the small group of islands called 'Li Galli', where the sirens who tried to beguile Ulysses are reputed to have lived. Positano is at the head of the small cliff-fringed bay which curves between Point Germano and Cape Sottile. The town is at the mouth of a wide valley and spreads up the steep side of a hill-spur, to the east and west of which lie sand and shingle beaches. The eastern beach is the larger (about 300 yards long) and is popular for bathing.

From Cape Sottile, behind which climbs the town of Praiano, to Cape Conca the coast is indented and precipitous. The small bay of Amalfi extends between Cape Conca and Cape Orso. Here limestone and tuff hills, whose dark green vegetation is slashed by white gullies, rise from the sea in rugged, cliffed spurs (Plate 21). These cliffs are fronted by several small beaches, which are used by fishermen to beach their boats but have poor access inland. Amalfi (Plate 22), which in the early Middle Ages rivalled Pisa and Genoa commercially and is still of local importance, is built on a level patch at the mouth of a steep-sided valley and up the hill-slopes inland. There are sand and gravel beaches over 300 yards long at the head of the tiny harbour. Atrani, which is separated by a small headland from Amalfi, is built on steep cliffs but has a small beach with access inland. In front of Minori, once the arsenal of Amalfi, there stretches a beach about 200 yards long backed by a gentle rise inland. This beach is followed by another of sand and shingle, 1,300 yards long, at Maiori, which stands on a tiny plain at the mouth of the Valle di Tramonte and spreads up hill-slopes terraced for lemon groves.





PLATE 21. *The Sorrentine peninsula near Ravello*



PLATE 22. *Amalfi*





PLATE 23. *Vietri Marina*



PLATE 24. *Isola di Dino*



Between Cape Orso and the harbour of Salerno the coast continues to be bordered by cliffs rising precipitously to the hills. There is, however, a beach in front of the village of Cetara (Citara), whilst the sandy beach at Vietri Marina (Plate 23), used for beaching boats, is about 1,000 yards long. Vietri Marina itself is built on a limestone spur at the mouth of a small valley.

A sandy beach extends from Salerno, which is at the head of the gulf of Salerno, for about 30 miles to Torre di S. Marco near Agropoli. Behind the beach lies a gently sloping alluvial plain which, south of Salerno, is about  $3\frac{1}{2}$  miles wide and is called the plain of Salerno and farther south, where it is 4–6 miles wide, the plain of Paestum after the ancient Greek city. The ruined temples at Paestum are well preserved. The F. Tusciano is the most important of the numerous small streams watering the plain of Salerno, whilst the F. Sele, with its large tributary F. Calore, meanders across the plain of Paestum. Behind the plains of Paestum and Salerno is the plain of Eboli, a flat-topped terrace at about 160–200 feet. All three plains, collectively known as the lower Sele basin (p. 299), are in process of being drained and settled, and areas once malarial and swampy are producing cereals and grass. The plains are hemmed in by limestone hills with perpendicular scarp edges, the lower slopes of which are often overlaid with clay (Plates 112, 126).

### *Communications*

*North of Naples.* North of Naples the main Rome–Naples road (7), though running never more than 15 miles inland between Terracina and Naples, only follows the coast closely from Terracina to the Canneto canal and from Formia to the east of Scauri; between Sessa and Naples it is duplicated by a first-class road which crosses about 7 miles inland the northern part of the plain of Campania. There is a coastal track between the Canneto canal and Torre Anastasia. A good road running close to the shore links Gaeta with Formia. The ancient Via Appia, now little more than a track, crosses the plain of Minturno 1–2 miles inland, whilst a second-class road follows the shore closely between the ancient Sinuessa and Mondragone. Lanes or local roads go inland from the shore at Torre Anastasia, Sperlonga, and Torre Viola to the main road. A lane, however, runs inland from the dunes between Mondragone and Cumae, and is joined by roads to the main road network which covers the plain of Campania.

Torre Gaveta is connected with Monte di Procida pier by an inland



route. A first-class road leads from Porto Miseno to Naples and closely follows the north shore of the gulf of Naples, except between Point Annone and Cape Posillipo.

The main Rome-Naples railway pursues a similar course to the main road, then tunnels through M. Massico about 4 miles inland. It next runs across the plain of Campania 6-7 miles inland to Pozzuoli, whence it continues about 1 mile inland to Naples.

A branch-line, generally 1 or 2 miles from the shore, runs from Gaeta to the main line at Formia. A local line, often close to the coast, connects Torre Gaveta with Naples. Inland the plain of Campania is well served by railways.

*South of Naples.* South of Naples the main Naples-Reggio road (18) and two railways run close to the coast between Naples and Torre Annunziata, the main Naples-Reggio railway being on the seaward side of the road. The main road, which is doubled by the Naples-Pompei autostrada at the foot of M. Vesuvius, cuts through numerous grey lava flows before turning inland at Torre Annunziata across the base of the Sorrentine peninsula to its southern shore at Vietri. A first-class road skirts the north coast of the peninsula to Alimuri, usually on the cliffs high above the sea. From Alimuri one branch of this road continues near the north shore to Sorrento and Massalubrense and thence inland to S. Agata; a second branch crosses the peninsula from Alimuri to Grotto Matera on the south coast, which it follows closely eastwards, often through tunnels and generally along ledges blasted out of the rocks, to Vietri. A secondary road links the north and south coasts of the peninsula, between Castellammare di Stabia and Vettica Minore, whilst another runs north from Maiori to the Naples-Reggio road. No railway serves the Sorrentine peninsula, but an electric tramway connects Castellammare di Stabia with Sorrento.

The main Naples-Reggio road (18) keeps close to the coast from Vietri to the east of Salerno, whence it follows 4 miles inland the lower foothills behind the plain of the lower Sele, before coming within a mile of the shore near Paestum. Lanes lead inland to this road from Spineta and the mouth of the Sele. The main railway follows road 18 closely throughout, and only approaches the coast at Torre S. Marco.

Transpeninsular roads connecting with the Adriatic coast road are frequent; the most important of them lead from Formia, Naples, which is a great route centre, Torre Annunziata, and Salerno.

Transpeninsular railways branch off the main line to the Adriatic



coast railway from Sparanise, Naples, Nocera, Salerno, and Battipaglia.

### *Vegetation*

Vines are cultivated on the lower hill-slopes near Terracina, between Sperlonga and Gaeta, and near Formia, whilst citrus groves are numerous between Gaeta and Formia and near Mondragone. Olives, sometimes interspersed with cork oaks, usually grow on the hill-slopes above the vineyards, and pinewoods are planted on the dunes fringing the plains. The greatest extent of pines is between Lake Patria and Lake Fusaro. The plain of Campania is very fertile, especially where composed of volcanic tuff. Cereals are grown on the plain itself, but a mixed cultivation of vegetables, vines, and fruit trees predominates, especially round its inner edge on the Campi Flegrei and near Naples, where cultivation is most intensive. Vegetables are grown under olives, citrus trees, and vines trained between poplars. The older volcanic deposits on the lower slopes of Vesuvius are covered with vines and olives alternating with fig trees and fields of grain, whilst chestnut groves are found on the higher slopes. The more recent lava-flows are usually barren, though near the coast they are planted with prickly pears and umbrella pines, which are a feature of the Neapolitan landscape and grow in clumps in the less fertile areas all round the bay.

The Sorrentine peninsula is, for the most part, fertile and much terraced for cultivation, especially near the towns, but *macchia* grows on the steeper and less accessible slopes. Citrus and other fruit trees are numerous on the north-west coast, but on the south coast vines predominate. Olives and chestnuts are grown throughout the peninsula. The plain south of Salerno is undergoing reclamation and largely consists of open fields of cereals and pasture. Vines are cultivated on the hills north of the plain, and olives on those south of it.

### *Population*

The region of Campania, as a whole, is one of the most densely populated in Italy. The majority of the towns are generally at the foot of the hills and up their lower slopes, so that where the coastal plains are broad the towns are generally some distance from the coast. The littoral itself is sparsely inhabited between Terracina and Torre Scauri, with the exception of the ports and seaside resorts of Terracina, Gaeta, and Formia, and the village of Sperlonga. Between Torre



Scauri and Torre Gaveta there are no houses at all on the three-quarters of a mile wide coastal strip of marsh and dunes which fronts the plains of Minturno and Campania. The town of Mondragone, however, is extending seawards from the foot of M. Massico and has bathing-huts on the beach, and south of the F. Volturno, where there has been extensive reclamation, villages and houses have recently been built 1-2 miles inland. The inner edge of the plain of Campania, north of Naples, is scattered with numerous towns, many of ancient origin.

In contrast, the north shore of the gulf of Naples is lined with towns, dockyards, and factories. Naples, with a population of 739,349, and numerous suburbs lie in squalid splendour at the head of the gulf, whilst on the eastern shores there are the flourishing coastal towns of Portici, Torre del Greco, Torre Annunziata, and Castellammare di Stabia, with scattered villas and farms in between them. Farther inland farms and villages cluster up the side of M. Vesuvius, and small towns are scattered over the plain of Campania south-east of Vesuvius. The north coast of the Sorrentine peninsula is lined with a series of small seaside and health resorts, whilst the Piano di Sorrento is particularly well populated. The steepness of the south coast of the peninsula as far east as Positano has prevented settlement. From Positano to the port of Salerno numerous small towns, such as Praiano, Amalfi, Atrani, Ravello, Minori, Maiori, and Vietri, cluster up the hill-sides. The plain, extending from Salerno to near Agropoli, has few coastal habitations, though immediately south of Salerno itself there are some isolated farms. The towns on the hill-slopes round this plain are generally small.

### *Ports*

Apart from the great port of Naples\*, the harbours and small ports in this region are generally found where the coast is rocky, or where rocky coast adjoins sandy beach, and are usually protected by moles.

Gaeta\*, with the two harbours of Porto S. Erasmo and Porto Salvo, is the chief port along the shores of the gulf of Gaeta, and Formia the second in importance. Terracina and Formia are fishing-havens and there are landing facilities at the head of the bight in front of Torre Scauri and at Torre Gaveta (Alta).

On the north coast of the gulf of Naples the chief ports are Pozzuoli and Bagnoli. Other landing-places here include Porto Miseno, Baia, and Monte di Procida village. Numerous piers project from the sandy beaches of this region. The most important of these are four



between Point Pennata and Castello di Baia, several north of Point Epitaffo, and others projecting from Pozzuoli beach.

The chief ports south-east of Naples are Portici, Torre del Greco, Torre Annunziata, and Castellammare\*. Other landing-places include two short quays south-east of Punta dell' Inglese and a pier at La Saliera.

Sorrento is the main artificial harbour along the north coast of the Sorrentine peninsula. There are landing facilities at Marina di Vico Equense, Marina di Equa, Marina di Cassano, Marina di Puolo, and at the cove of Marina di Massalubrense. Along the south coast of the peninsula fishermen draw their boats up the small beaches; there are harbour facilities at Porto Amalfi, Vietri Marina, and Salerno\*.

#### LUCANIA; AGROPOLI TO DIAMANTE

The coast between Agropoli and Diamante has a length of 110 miles. Between Agropoli and Policastro, the Cilento, a rectangular mountain block, projects into the sea with M. Stella (3,710 ft.) at its north-west end and M. Bulgheria (4,119 ft.) at its south-eastern. To the north of this rectangular headland lies the gulf of Salerno, and to the south-east the gulf of Policastro. From Sapri to Diamante the mountains of northern Calabria (p. 338) rise usually sheer from the sea, and are only broken by a few short and narrow coastal plains.

##### *Agropoli to Sapri (Figs. 18, 19)*

The town of Agropoli climbs up the side of a steep, cliffed hill, which forms the northern shore of a small cove. West of the town a beach extends from Trentova Scoglio to Point Tresino, and is backed by a fairly steep rise to limestone hills which are dotted with vineyards. The limestone coast is rugged as far as Torre del Pagliarolo, whence a sandy beach stretches for 2 miles to the north of S. Maria di Castellabate and is separated by rocks and cliffs from a shorter beach south of the village. The northern beach fringes the mouth of a wide, gently sloping, and cultivated valley which cuts between the limestone ridge of M. Tresino (1,804 ft.) in the north, and the rounded sandstone foothills of M. della Stella in the south. The southern beach partially fronts a gap separating the headland of M. Licosa (1,050 ft.) from the rest of the Cilento mountain block. The headland is cliffed round P. Licosa as far as the beach (half a



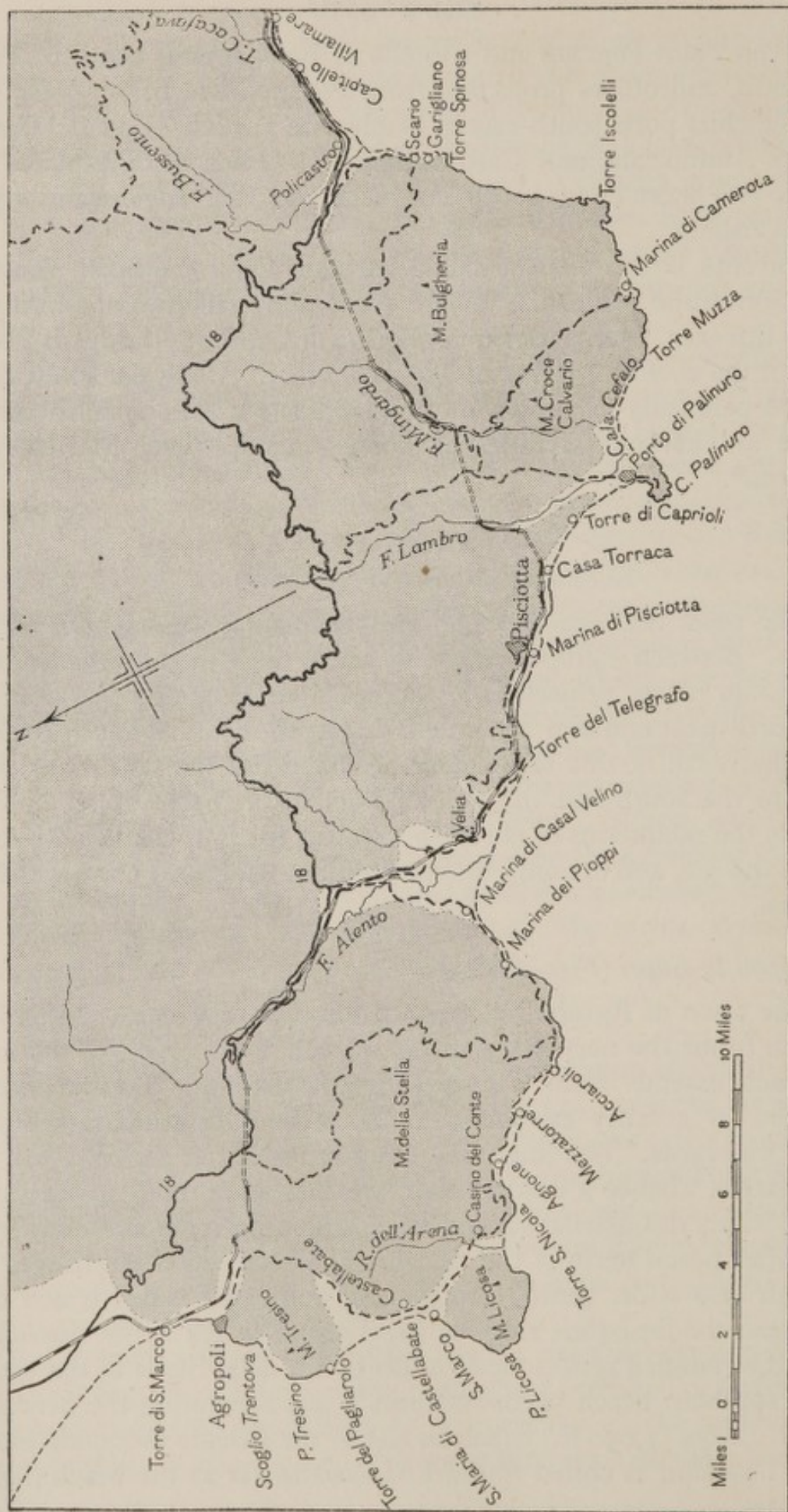


FIG. 18. The coast: Agropoli to the Gulf of Policastro. (For Key see p. 54)



mile long) at the mouth of the fertile Rivo del Arena valley, which forms the southern end of the gap between M. Licosa and M. della Stella.

Beyond the Arena valley the coast is cliffed as far as Torre S. Nicola. Thence to Acciaroli there is a sandy beach only interrupted by cliffs near Mezzatorre. Inland the rounded sandstone range of M. della Stella (3,710 ft.) rises steadily and is penetrated by several small fertile valleys, the largest of which is at Agnone. From Acciaroli to Marina di Casal Velino the coast consists of rugged mountains rising directly from the sea; there is, however, a narrow shingle beach at Marina dei Pioppi. Between Marina di Casal Velino and Torre del Telegrafo, a sandy beach, about 4 miles long, fringes a plain which is broad at the mouth of the F. Alento valley and narrows considerably south of the ruins of the ancient Greek city of Velia. This alluvial valley, cultivated with olive-groves, separates the sandstone hills on the north-west from the more highly dissected clay hills of the main Cilento massif on the south-east. The coast from Torre del Telegrafo to near Casa Torraca is cut by numerous short streams and is very steep except at Marina di Pisciotta, where there is a shingle beach. The town of Pisciotta (alt. 558 ft.) is built on a steep hill-slope inland from its marina. Between Casa Torraca and Porto di Palinuro there is a beach, about 4 miles long, which is interrupted by the headland of Torre di Caprioli and is screened by rocks in front of Palinuro; inland the beach is bounded by steep hills of laminated clay, often with calanchi (p. 489) slopes.

The rugged limestone Cape Palinuro promontory is indented with small capes and bays and is edged by cliffs. Immediately east of the promontory, at the mouth of the F. Lambro, there is a beach, separated by a perpendicular cliff from a longer beach, Cala del Cefalo, which extends for  $1\frac{1}{4}$  miles from the mouth of the F. Mingardo to Torre Muzza. Between Torre Muzza and Torre degli Iscolelli the steep cliff coast is cut into by several small coves with sandy beaches at their heads. Of these the beach at Marina di Camerota is the longest and most accessible. From Torre degli Iscolelli to Torre Spinosa the coast, which trends abruptly east-north-east, slopes more precipitously from the sea to heights of 300–1,000 feet. Inland between F. Mingardo and Torre Spinosa a barren limestone massif, which has its highest points in M. Croce del Calvario and M. Bulgheria, rises from the rugged coast to heights of 2,000 and 4,000 feet.

The gulf of Policastro curves like a horse-shoe between Torre degli Iscolelli and Isola Sant' Ianni. A sandy beach extends from near Garigliano to Villamare, and is bounded by a narrow coastal strip,



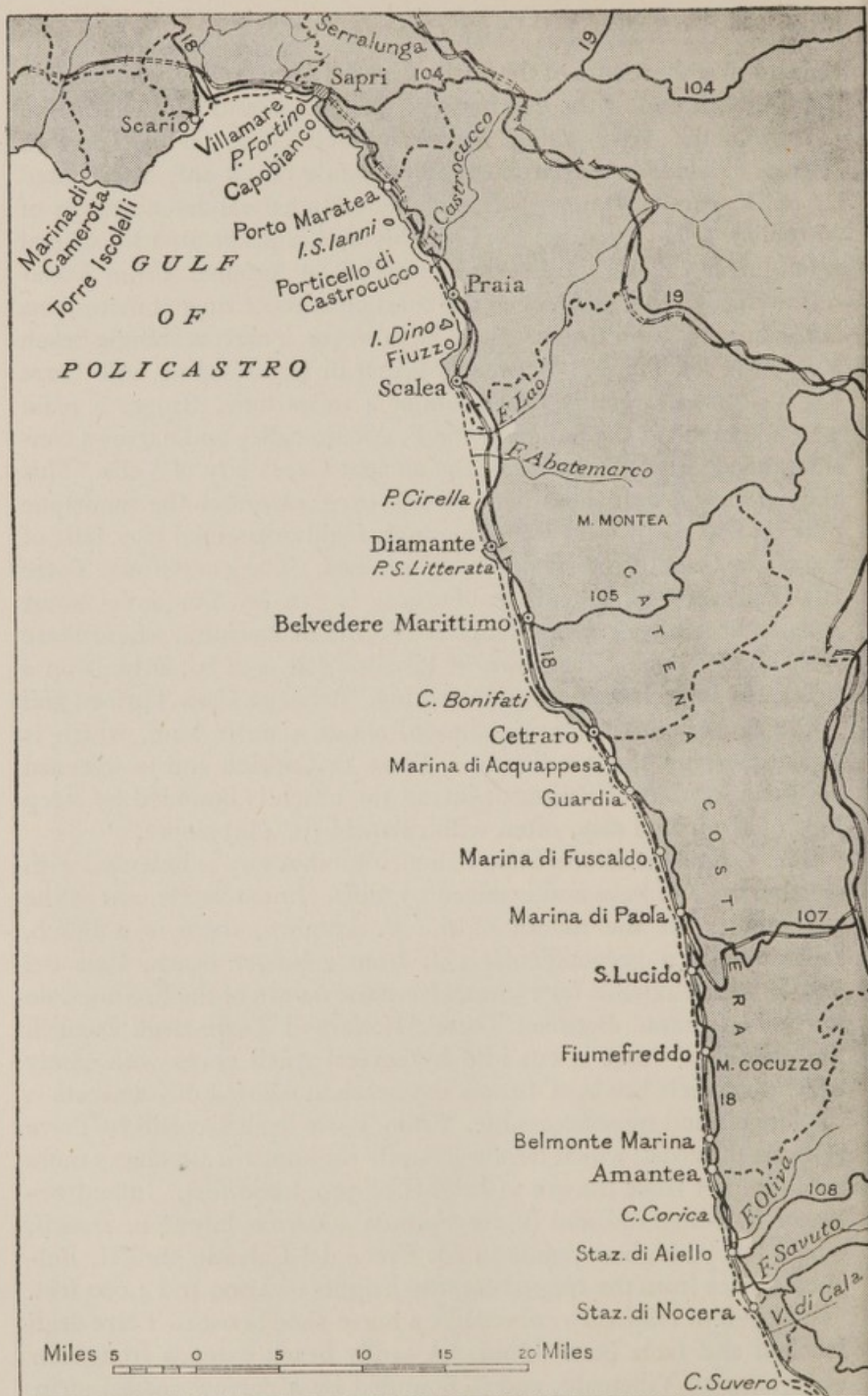


FIG. 19. The coast: the Gulf of Policastro to Cape Suvero  
(For Key see p. 54)



which widens at the mouth of the F. Bussento to a fertile and fairly well-populated plain, and almost disappears east of the village of Capitello. The coastal strip again broadens at the mouth of the R. Cacafava to a small plain on which the seaside resort of Villamare stands. A short beach stretches from east of the low, cliffed Villamare headland to Point Fortino. Between Point Fortino and Torre di Capobianco lies the small bay of Sapri, which has rugged shores except at its head, where a pebble beach fronts the town and minute plain of Sapri. Inland from the coast between Garigliano and Sapri there are rounded wooded hills of soft laminated clay, never higher than 1,300 feet.

*Sapri to Diamante (Fig. 19)*

Between Capobianco and Porticello di Castrocuco the limestone hills of the Serralunga-Montea ridge (p. 338) rise steeply from the sea to heights of 2,000-3,500 feet, and are edged with cliffs varying in height from 30 to 300 feet. The even line of the coast is often broken by small sickle-shaped bays which are generally separated from each other by headlands frequently terminating in small islands. These bays often have pebble beaches at their heads when they have been formed at the mouth of the ravines which have cut through the cliffs. At Porto Maratea one of the longer beaches is backed by a low cliff which permits access inland.

A beach of sand and limestone pebbles extends from Porticello di Castrocuco to near Fiuzzo and is bounded at the mouth of the F. Castrocuco (F. Noce) by a fertile alluvial plain, over 1 mile wide, which narrows to about 500 yards south of the town of Praia. The plain is enclosed by limestone hills rising in terraces which become steeper south of Praia. A strip of rough grass and a ridge of river debris 15 feet high fringe the seaward side of the coastal plain, which is covered with arable fields and fruit trees, mainly citrus, except near the mouth of the F. Castrocuco, where there is a swamp overgrown with low scrub and coarse grasses. Near Praia the plain is irrigated, whilst date palms grow on the lower hill-slopes immediately behind the town. The F. Castrocuco, which has a bed 300 yards wide and is fringed by low woodland, is the principal river of the plain. There are several smaller streams, which lose their mouths in pools and marsh behind the beach. The Isola di Dino, a small cliffed island with a flat top, lies about half a mile off Fiuzzo (Plate 24). From Fiuzzo to Scalea the coast is indented and fringed with limestone cliffs over 100 feet high, above which hills rise 260-300 feet.



Between Scalea and Point Cirella there is a wide sand and pebble beach over 6 miles long, fringed in places by marshy thickets and backed by a fertile plain. This plain, partly overgrown with *macchia* and partly planted with vines, slopes inland gently to low foothills above which rise the steep south Lucanian Apennines (p. 338). The F. Lao and F. Abatemarco, both in wide pebbly beds bordered by low embankments, together with several streams, cross the plain. A sand and pebble beach, about 3 miles long, extends from the cliffed Point Cirella headland to about half a mile south of Diamante, and is only interrupted by the low cliffs on which Diamante stands. Wooded and terraced hills rise steadily inland from the beach.

### *Communications*

No road follows the coast throughout between Agropoli and Diamante. The main Reggio-Naples road (18) runs inland from the plain of Paestum (5 miles north-east of Agropoli) and crosses the M. Stella-M. Bulgheria massif 4-15 miles inland to Policastro, whence it follows the shore closely as far as Sapri. From Sapri to Diamante the main road keeps close to the coast, although on cliffs high above it, except where it skirts the two plains of Praia and Scalea about 1-2 miles inland.

Between Agropoli and Pisciotta a second-class road serves the coast and is accessible between S. Maria di Castellabate and S. Marco, while between Casino del Conte and Velia it is rarely more than 500 yards inland, but usually at least 100 feet above the sea. No road follows the coast between Pisciotta and Scario. A poor road runs near the shore from Scario to the junction with road 18. Third-class roads lead inland to road 18 from Acciaroli, Porto di Palinuro, and from Marina di Camerota.

Between Sapri and Diamante roads lead inland to join the main road system from Sapri (104), Porto Maratea, and Scalea. A lane goes inland from the coast at Porto Maratea to join road 18, while another lane parallels the coast of the Scalea plain between Scalea and the F. Lao.

The main Naples-Reggio railway, from near Agropoli, runs inland behind M. Stella and then down the Alento valley to the coast, which it follows with some tunnels between Castellammare di Velia and Pisciotta. East of Pisciotta the railway leaves the coast, tunnelling round M. Bulgheria to reach the shore again at Policastro Vetere. Between Policastro and Sapri the line runs near the coast inland of



road 18. From Sapri to Diamante its course is mostly in tunnels, but it crosses the plains of Praia and Scalea in the open 1-2 miles inland.

### *Vegetation*

The valley mouths and the coastal plains of the Cilento region, between Agropoli and Cape Grosso, are generally fertile and are covered with olive groves, vines, figs, and carobs, whilst tomatoes are intensively cultivated on the plain of Alento. The hills are often barren above the olive groves and pinewoods which cover their lower slopes. The vegetation round the west shore and the head of the gulf of Policastro consists largely of dense olive groves, whilst pines and chestnuts clothe the lower slopes of the hills. The white limestone hills between Sapri and F. Castrocucco are usually overgrown with dwarf shrubs, and there is little cultivation. The plains of Praia and Scalea are generally cultivated with fields of maize and wheat. Orchards of citrus and other fruit trees, together with olives, continue up the terraced hill-slopes inland.

### *Population*

A series of small villages, and coastal resorts or marinas, and some isolated settlements line the coast between Agropoli and Cape Grosso; their parent towns are usually on the hills often only half a mile inland. The most important of the seaside villages are S. Maria di Castellabate, Agnone, and Porto di Palinuro. Except for Marina di Camerota there are no settlements between Cape Grosso and Garigliano. Thence a series of villages line the shore of the gulf of Policastro as far as Sapri. Coastal settlement is rare between Sapri and Diamante, the most important towns, such as Praia, Scalea, and Diamante, being generally found on the inner margin of the coastal plains and up the hill-slopes. Recently, however, isolated houses have been built on the coastal plains.

### *Ports*

At Agropoli there is a short pier, but other accommodation for vessels is limited along this coast.

## WEST COAST OF CALABRIA; DIAMANTE TO POINT PELLARO

The coast has a general north-south trend, only interrupted by the gulfs of S. Eufemia and Gioia, which are separated from each





FIG. 20. The coast: Cape Suvero to Siderno Marina. (For Key see p. 54)



other by the mountainous M. Poro massif. Except for the plains of S. Eufemia and Gioia, the coast is backed throughout by steep, terraced mountains, by the Catena Costiera and M. Mancuso between Diamante and Cape Suvero, and by the Calabrian Apennines which, near Bagnara, give way to the plateaux of Aspromonte. The sea is usually deep close inshore. Its floor curves rapidly upwards usually to a narrow ledge, occupied by a beach and a coastal strip, above which the mountains rise steeply. The mountains of Calabria are lowest where the peninsula is narrowest (22 miles) across the Catanzaro depression between the gulf of S. Eufemia and the gulf of Squillace. The total length of this coast is about 175 miles.

*Diamante to Cape Suvero (Figs. 19, 20)*

The coast between Diamante and Cape Suvero is fringed, almost throughout, by a gently sloping beach of pebbles and sand. The beach normally merges into a narrow, almost level plain, generally bordered on the seaward side by a railway embankment, often over 30 feet high, and inland by steep terraces of varying height. North of Amantea the Catena Costiera mountain chain (p. 347) rises steeply in terraces to crests of about 3,000–4,000 feet, while south of Amantea the rugged M. Mancuso (p. 353), the seaward spur of the M. Reventino massif, reaches precipitous heights of 4,370 feet.

Immediately south of Diamante there is a short section of steep coast. This soon gives way to the beach and narrow coastal plain, which extend as far as Cape Bonifati (Cittadella del Capo) and are only interrupted by the small rockbound Point S. Litterata. The beach and plain widen in front of the town of Belvedere Marittimo, which stands on a sandstone cliff, about 160 feet high, above the citrus groves on either side of the railway embankment. South of the town as far as Cape Bonifati the narrow coastal strip is backed by a steep-sided terrace 25–40 feet high. The coast now becomes almost entirely edged by high cliffs, which rise abruptly to terraced mountains of crystalline schist. The beach and coastal plain commence again three-quarters of a mile north of Cetraro, but south of Marina di Acquapesa both narrow and almost disappear at the foot of the steep, terraced hills. From Guardia to S. Lucido the beach and the well-cultivated coastal strip, which are widest in front of Marina di Fuscaldo and Marina di Paola, are cut into by numerous watercourses (*fumare*) with wide pebbly beds. Southwards to Cape Corica the coastal plain, cultivated with olive, almond, fig, and peach trees, is narrow except in front of Fiumefreddo and Amantea, where



it is more than 500 yards wide at the foot of the rugged limestone M. Cocuzzo (alt. 5,055 ft.; p. 348). The plain at Amantea is particularly fertile and well irrigated, vines and vegetables being cultivated in addition to the more usual crops. South of the rocky cliffs of Cape Corica the beach recommences and continues to Cape Suvero. Between Cape Corica and the mouth of the Val di Cala the beach is fringed on the landward side by a narrow strip of marshland, often overgrown with willows, poplars, and tamarisk thickets, behind which lies the plain of Nocera. This plain, consisting mostly of rough pasture, is about three-quarters of a mile wide and is crossed by the broad, pebbly beds of the F. Oliva and F. Savuto. The deep, spectacular Savuto valley, which is connected with the Crati valley across the flat watershed of the Piano del Lago, separates the Catena Costiera from the M. Reventino massif. The narrow beach between the mouth of the Val di Cala and Cape Suvero (alt. 100 ft.) is backed by M. Mancuso, which rises comparatively gently in a series of well-defined, though narrow, terraces.

*Cape Suvero to Point Pellaro (Fig. 20)*

The deep gulf of S. Eufemia extends between Cape Suvero and Cape Vaticano. For 11 miles from Cape Suvero to Foce dell'Angitola the bay is bordered by the plain of S. Eufemia, which is fringed by a 100-yards-wide sandy beach and south of the mouth of the F. Amato by dunes. A strip of marshland, fronted seaward with sclerophyllous bushes (drought-resisting, evergreen shrubs), tamarisks, tough grasses, and brambles, extends behind the beach except near Staz. S. Eufemia Marina, where there is a chain of small lagoons in which fishermen anchor their boats. The alluvial plain of S. Eufemia slopes gently inland for about 4-6 miles in the north and for half a mile in the south. The main coastal railway roughly marks the inner limit of the plain, which is well watered by many rivers and streams. These include the short F. Bagni, with a pebbly bed in some places about half a mile wide, the F. Amato, which has many distributaries with wide beds, and the F. Angitola. The hills backing the plain rise in the north above a gentle wooded slope, through steep-sided terraces to the crystalline M. Mancuso (4,270 ft.) and M. Portella (3,407 ft.), and in the south-east more abruptly to the tabular lands of the Catanzaro depression (pp. 353-6).

From Foce dell'Angitola to Marina di Vibo Valentia (Porto S. Venere) the coast continues to be fringed by a sand or shingle beach, though usually backed by a series of broken but steep-sided granite



terraces of varying heights. These impede access inland, except at Pizzo, where roads and paths lead to the town, which is built at two levels of about 165 feet and 330 feet. The terraces here are particularly fertile, and vines, figs, peaches, citrus fruits, and cereals grow in profusion.

The massif of M. Poro juts out to form the south shore of the gulf of S. Eufemia, which it separates from the gulf of Gioia. The south coast of the first of these gulfs is terraced and rises steeply in three or more tiers of calcareous sandstone to heights of about 2,000 feet. Numerous deep ravines, dropping steeply to the sea, cut through and break down these terraces. The coast, from the artificial harbour of Marina di Vibo Valentia to Cape Vaticano, is fronted by a narrow, usually pebbly beach, interrupted by dolomitic limestone cliffs near Cape Cozzo and Tropea, and by granite cliffs at Cape Vaticano. The beach is generally backed by steep rocks or cliffs, remnants of an ancient coastal terrace, which make access inland difficult. Between Marina di Vibo Valentia and Briatico, however, the beach is broader and merges into the coastal plain of Bivona, half a mile wide and with gentle terraced slopes leading inland to sandstone hills. This plain is fertile and well irrigated and produces vegetables, citrus fruits, and even castor-oil plants. From Cape Cozzo to near Tropea the beach is also bordered on the landward side by a narrow coastal plain with a steady rise to the terraces.

The gulf of Gioia extends between Cape Vaticano and Cape Paci, about 23 miles south-south-westwards. The north shore of the gulf between Cape Vaticano and Marina di Nicotera is formed by the massif of M. Poro. Canyons with vertical walls cut through the terraced mountain as it drops to the sea. Their streams bring down boulders and rubble which often form mounds near the shore. The coast is accordingly made up of steep granite cliffs and headlands alternating with patches of pebbly beach. The two principal beaches are immediately south of Torre S. Maria, about half a mile long, and between Point Spinoso and Torre Ioppolo; both are immediately backed by more gently sloping country which gives access to the railway running 600 yards inland at a height of about 160-200 feet.

From Marina di Nicotera to the cliffs of Cape Triari the gulf is bounded by the sand and gravel plain of Gioia (p. 359). The shore of the plain consists of a broad sandy beach which is often bordered landward by piles of pebbles and boulders. The plain is low and comparatively flat for about 2 miles inland in the north and for



about half a mile in the south. It then rises fairly steeply, and at its widest is 15 miles from the sea and about 1,300 feet high. The F. Mesima and its many tributaries, often bordered by grassy retaining-walls, cross the northern part of the plain and the F. Petrace the southern. In the north-east the plain is enclosed by hills which rise in wide tiers to M. Bazia (alt. 807 ft.), while south of F. Mesima hills slope gently inland to the steep Calabrian Apennines and the Aspromonte (p. 359).

From Cape Triari to Torre Rosci (north of Bagnara) the coast is bordered by steep cliffs rising inland to the flat-topped ridge of Palmi, 1,700–2,000 feet. An almost continuous beach, which is often very narrow and boulder-strewn, extends from Torre Rosci to Cape Paci. The beach is widest (1) in front of Bagnara and Favazzina, where it is bounded by a narrow coastal strip generally followed by the road and railway, and (2) at the head of the small bay between the headland, on which Scilla castle perches, and Cape Paci (Plates 25, 26). The country flanking these beaches rises in a series of four steep-sided terraces, cut in gneiss and at heights of about 260, 440, 820, 980 feet, to a flat-topped ridge of hills at 1,800–2,100 feet. Further inland terraces ascend from this ridge to the Piani d'Aspromonte. The lower vine-covered slopes of these hills are furrowed with small ravines whose streams carry vast quantities of clay and stones to the coast.

The section between Cape Paci and Point Pellaro forms the east shore of the turbulent and dangerous straits of Messina. The coast continues westwards from Cape Paci to Cannitello lighthouse, where it turns southwards to Point Pellaro.

The coast from the cliffs of Cape Paci to Point Pellaro is fringed with a pebble and sand beach, which varies considerably in width, but is widest at the deltas of rivers and streams and especially at the mouths of the Catona, Gallico, S. Agata, and Valanidi. The narrow coastal plain, which borders the beach and slopes gently inland, is generally about a quarter of a mile wide; it almost disappears immediately south-west of Cape Paci and broadens near the mouths of the rivers to as much as  $1\frac{1}{2}$  miles. This fertile plain rises to a series of very broken terraces, whose steep, crumbling slopes are dissected by streams (Plate 27). Finally the terraces rise to the plateaux of Aspromonte. The beds of the rivers and streams are usually wide and pebbly in their lower courses and ravine-like and narrow higher up. Reggio Calabria is situated at the mouths of several of these streams where the coastal plain is at its widest.



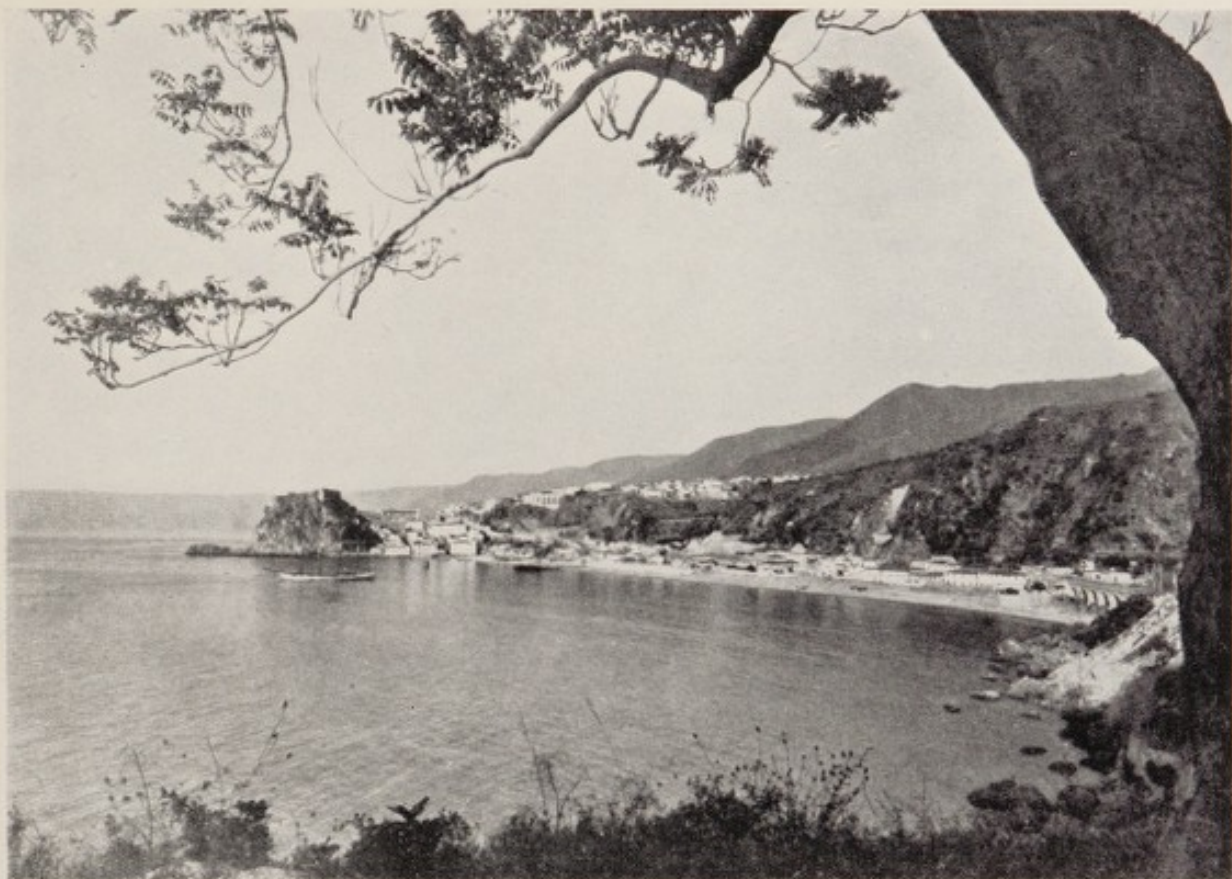


PLATE 25. *Scilla Castle*



PLATE 26. *Scilla*





PLATE 27. *The coast of Calabria and the Aspromonte from Cape Peloro*



PLATE 28. *'Calanchi' south of Reggio*



*Communications*

The coast is followed, usually closely, between Diamante and Cape Pellaro by the Rome-Reggio road (18) and its continuation (106). From Diamante to near Staz. di Aiello road 18 generally follows the lower terraced slopes of the hills and is often more than 150 feet above the shore, which it rarely approaches. Beyond Staz. di Aiello the road turns inland to follow the lower slopes of the hills almost encircling the plain of S. Eufemia, only to return close to the coast, and about 350 feet above it, near Pizzo; a poor road follows the shore in this section at a distance of 2 miles. From near Pizzo the main road goes inland again and cuts behind the M. Poro massif along the Mesima trough to the plain of Gioia. A second-class road keeps close to the shores of the M. Poro massif between Pizzo and Tropea, whence a poor lane continues to Staz. Ricadi. This road is probably only accessible from the coast between Marina di Vibo Valentia and Briatico, and at Tropea. From Cape Vaticano to Nicotera there is no coastal road. Road 18 crosses the plain of Gioia 1-4 miles inland, but rejoins the coast near Gioia and continues to Bagnara through hilly country some distance from the shore. Though near the coast between Bagnara and Cannitello, it generally follows one of the terraces and is not always accessible from the sea. Onwards to Reggio and Point Pellaro the road (18; 106) usually runs along the narrow coastal plain or the gentle lower slopes of one of the terraces. Poor roads or lanes go inland from the coast to the main road (18) from Marina di Fuscaldo, Marina di Paola, S. Lucido, Staz. di Fiumefreddo, Bruzio, Belmonte, Calabro Marina, Amantea, Staz. di Nocera, Staz. di Falerna, Cape Suvero and Staz. di S. Eufemia Gizzeria, Marina di Vibo Valentia, Marina di Nicotera (second class), S. Ferdinando, Gioia soap factory, Taureana, Catona, Gallico Marina, and Archi.

Main roads lead from the coast road to road 19, which parallels the coast 15-30 miles inland, or across the peninsula to the Ionian coast from Belvedere (105), Cetraro (second class), Paola (107), Amantea (second class), Staz. di Aiello (108), near Staz. di Francavilla Angitola (110), Gioia (111), Bagnara (112), and Gallico (second class). South of Aiello they usually lead across the peninsula to the Ionian coast.

The main coastal railway keeps closer to the coast than the road between Diamante and Staz. di S. Eufemia Gizzeria. It mostly runs on an embankment about 30 feet high along the narrow coastal



strip and only tunnels through rocky headlands and under the pebbly beds of torrents. The railway runs 1-3 miles inland, across the plain of S. Eufemia to Staz. di Francavilla Angitola, whence it continues near the coast, often in tunnels, round the M. Poro massif. Here it is most accessible from the sea at Pizzo and between Marina di Vibo Valentia and Briatico. The plain of Gioia is crossed, often on embankments 1-3 miles inland, to Gioia. Thence to Bagnara the line keeps near the coast, though usually inaccessible from it, since most of the route between Palmi and Bagnara is in tunnels. From Bagnara to Point Pellaro the railway runs near the shore on the seaward side of the road.

From south of Paola a branch line leads inland through Cosenza to Sibari on the gulf of Taranto, while from S. Eufemia Lamezia a branch crosses the Calabrian peninsula to Marina di Catanzaro. A narrow-gauge line leads from Marina di Vibo Valentia to Mileto. From Gioia narrow-gauge lines lead to Cinquefrondi and Sinopoli.

### *Vegetation*

The terraced hill-slopes of western Calabria are generally very fertile and planted with fruit trees, while the alluvial plains, which have largely been reclaimed, are generally arable land. The landward margins of the beaches throughout the whole of Calabria and the gulf of Taranto are usually overgrown with sclerophyllous (drought-resisting and usually evergreen) bush and heath, and the steep slopes of the terraces by *macchia*. The stony river-beds often have a cover of low bushes where they cross the lowlands, and sometimes a fringe of poplars, willows, and alders.

Between Diamante and Cape Suvero the country round the towns and smaller settlements is generally intensively cultivated with fruit-trees, especially oranges, lemons, figs, olives, almonds, and peaches, while the intervening coastal strip is covered with low scrub. Cultivation is usually landward of the railway embankments. Olives, mulberries, and date palms grow on the lower mountain slopes, and *macchia*, deciduous oaks, and chestnuts on the higher.

The greater part of the plain of S. Eufemia is under cultivation, some of it being meadow land, whilst the lower slopes of the hills round it are planted with vines, cereals, figs, and olives, with alternating patches of sclerophyllous plants, deciduous bushes, and evergreen oaks. Between Pizzo and Cape Vaticano the lower hill-slopes are cultivated with cereals, vines, and fruit orchards, while



the higher seaward slopes are overgrown with broom, brambles, and pistaccia.

The lower terraces, where accessible, along the north shore of the gulf of Gioia have walled orchards of olives alternating with patches of barren country. The plain of Gioia is under cultivation, and, like that of S. Eufemia, has meadow land near its rivers. Along the F. Petrace there are fields of beans and wheat, as well as olive groves, which are very numerous on the hill-slopes round the plain. From Gioia to Cannitello vines trained up bulrushes and chestnut-stakes are the principal crop of the terraced hills. On some of the lower slopes near the sea, citrus trees and cork oaks give the landscape a dark green hue.

From Cannitello to Point Pellaro citrus trees predominate. These trees grow in shady, irrigated groves enclosed by stone walls, the water for irrigation being stored in large reservoirs. Other kinds of fruit orchards usually have vegetable crops grown in their shade, whilst mulberry trees often line the river valleys.

### *Population*

The west coast of Calabria has a denser population than the east, but the peninsula as a whole is not thickly populated. The dangers of malaria and earthquakes and the limited natural resources of the region have caused many to emigrate to America. The greater proportion of the population settled in hill towns near the coast to escape pirates, and has remained in them to avoid malaria. These towns and large villages are predominantly agricultural in occupation.

Between Diamante and Cape Corica, along the south shores of the gulf of S. Eufemia, and from Palmi to Cape Paci, the towns are built on the steep terraced slopes of the hills near the coast. They are usually on cliffs 160–200 feet high, often only 200 yards to a quarter of a mile inland. The railway stations, bathing resorts or marinas, and suburbs of the towns often straggle on to the narrow coastal strip at the foot of the cliffs, and even on to the beach itself. Elsewhere settlements on the narrow coastal plain are rare, though there are scattered houses on the hill-slopes inland.

Between Cape Corica and F. Angitola the plain, though wider, is even more desolate along the coast except near the lonely railway station of S. Eufemia. Along the south shore of the gulf of S. Eufemia the principal coastal villages and towns (Pizzo, Briatico, and Tropea) are all built on steep-sided terraces except for some scattered houses, the small harbour of Marina di Vibo Valentia, and the village



of Bivona with its medieval castle. The coast of the plain of Gioia, though slightly more populated than that of S. Eufemia, has only Marina di Nicotera, S. Ferdinando, Gioia, and a few scattered settlements. Nicotera, half a mile inland, is one of the larger towns on the hills which encircle the plain.

South of Gioia density of coastal settlement increases. Palmi, Bagnara Calabria, and Scilla, the two last being built largely on terraces above the beach, are the principal coastal towns between Gioia and Cape Paci. From Cannitello to Point Pellaro the coast is lined with a series of towns and villages which include Villa S. Giovanni and Reggio Calabria. Reggio is the most important of these; it forms the focal point for the commerce and communications of the region, and is the most important town of Calabria.

### *Ports*

There are few ports or harbours along this coast, which is not of a type to encourage shipping because the gulfs are too sandy close inshore and good sheltered anchorages are rare. Fishing is of no great importance, and there are small harbours only at Marina di Paola (being built in 1936), Bastione di Malta, Pizzo, Marina di Vibo Valentia, Tropea, Scilla, Villa S. Giovanni, and Reggio\*.

### THE SOUTH AND SOUTH-EAST COAST OF CALABRIA; POINT PELLARO TO CAPE COLONNE

This section of coast extends from Point Pellaro to Cape Colonne and borders the most southerly portions of the mainland of Italy. The south coast is short and only extends for 28 miles from Point Pellaro to Cape Spartivento. Here the general direction changes to north-north-east, but the gulf of Squillace with its wide sweeping curve of about 200 miles interrupts the general trend, and is succeeded by the pentagonal Crotona promontory.

The coast consists of a narrow beach-fringed plain above which deeply dissected ridges, where landslips are frequent, rise to the highlands of Aspromonte, Serre, and Sila. But in the Crotona promontory cliffs rise straight from the sea to a low tableland.

### *Point Pellaro to Cape Colonne (Figs. 20, 21)*

From sandy Point Pellaro to Cape Armi the coast is bordered by a continuous pebble beach, backed by a narrow coastal plain cultivated with orchards and citrus groves. The hills, which slope inland



in broken and almost unrecognizable terraces to the Aspromonte mountains, usually rise immediately from the plain in soft crumbling cliffs furrowed by steep ravines. At Cape Armi perpendicular calcareous sandstone cliffs drop about 300 feet sheer to the beach, which is strewn with rocks and boulders. From Cape Armi to Cape Spartivento the coast trends eastwards and is edged by a beach which is only interrupted at Cape Grisafi and Torre Mozza. Between Melito di Porto Salvo and Cape Spartivento the beach is sometimes bounded with sand-dunes. The coastal plain adjoining the beach broadens to over quarter of a mile between Cape Armi and F. Melito, and for the rest is narrow except at the mouth of the wide pebbly bed of the F. Amendolea. Bare hills, often with 'calanchi' slopes (Plate 28), rise steeply from the broader parts of the coastal strip, and sometimes in almost perpendicular cliffs from the narrower parts. These hills are largely made of Tertiary sandstone (p. 35), and are cut into clearly defined north-south ridges by the great watercourses (*fiumare*; p. 343). The latter, though they mostly have wide beds for the first 2-3 miles inland from their marshy deltas, generally flow in deep ravine-like valleys.

The coast between Cape Spartivento and Cape Stilo, a distance of about 40 miles, is fringed by a beach usually of pebbles with a thin covering of sand near the sea. The beach is only interrupted at Cape Bruzzano, where cliffs about 100 feet high rise steeply from the sea, and is bordered by off-shore rocks in front of Marina di Brancaleone, near the mouth of the Fiumara di Bruzzano, and immediately south of Cape Bruzzano. The beach, throughout, fronts a narrow coastal plain which varies considerably in width. Between Cape Spartivento and Cape Bruzzano it is only about 150 yards wide and backed closely by low, rounded hills of marls and clays. The plain broadens to about 500 yards from Cape Bruzzano to the mouth of the F. Buonamico, and to half a mile between the mouths of the F. Buonamico and F. Turbido. This fertile plain, covered with citrus and olive trees, is backed by low Tertiary hills (p. 361), largely of sandstone and clays, which extend inland for 4-8 miles and reach heights of about 1,500 feet before climbing more steeply to the Aspromonte. These hills have been cut into steep-sided ridges by numerous *fiumare* at intervals of 2 or 3 miles. Most of the lower courses of the *fiumare* are wide and pebbly, but upstream they become wild ravines. The beds of the F. la Verde, F. Buonamico, and F. Turbido are 400-500 yards wide, whilst the rivers themselves are trickles in the dry season. From the mouth of the F. Turbido to Roccella Ionica the plain



narrows to about a quarter of a mile and thence to Cape Stilo to 100-300 yards, except at the mouths of the F. Allaro and F. Stilaro. The hills rising above this plain between the F. Turbido and Roc-

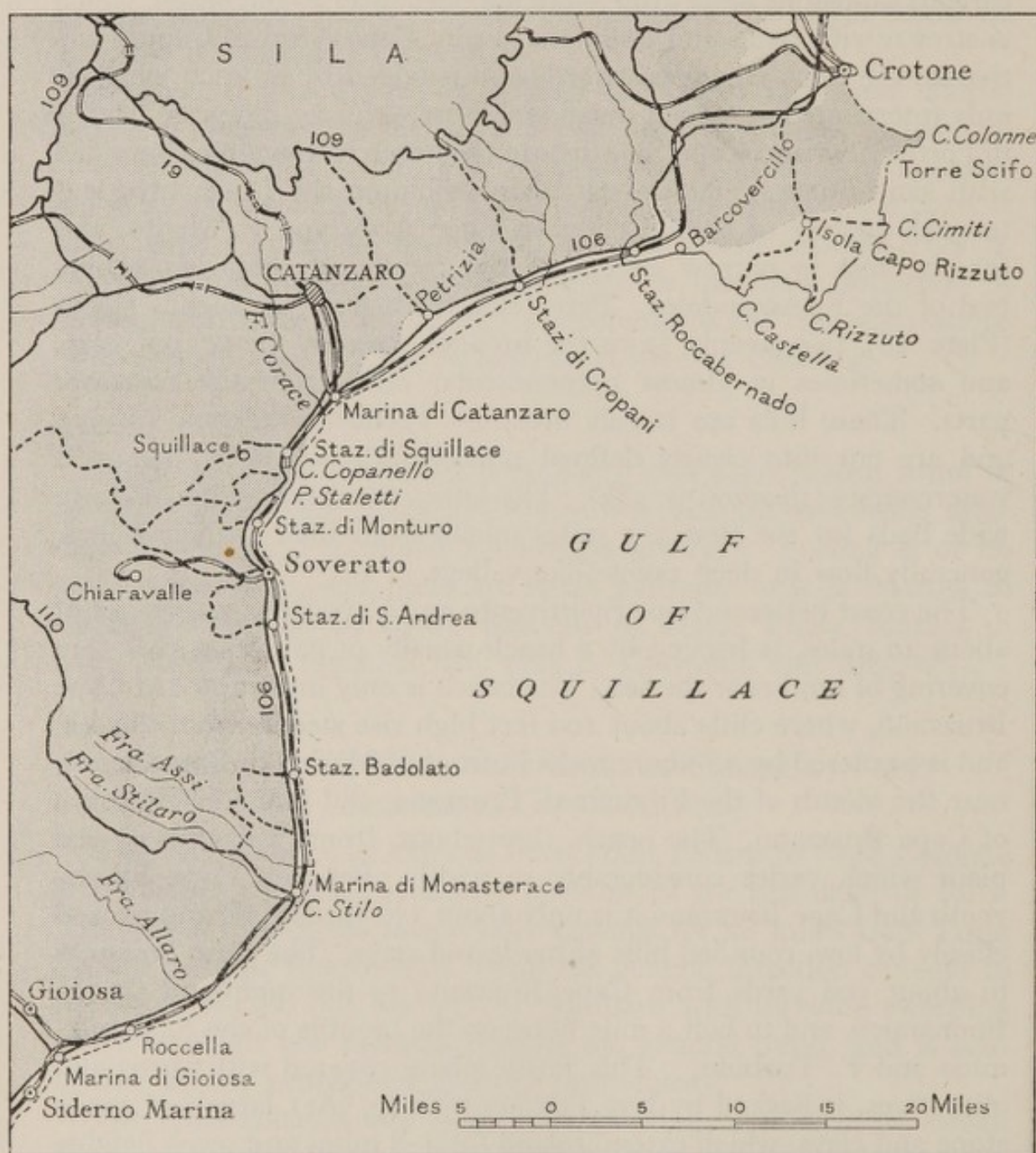


FIG. 21. *The coast: Siderno Marina to Crotona.* (For Key see p. 54)

cella reach to heights of over 1,000 feet near the sea. The town of Roccella itself stands on almost perpendicular cliffs overlooking the plain. Between Roccella and Cape Stilo the hills are lower than those farther south and form peaks about 550 feet high.

The gently curving gulf of Squillace extends between Cape Stilo



and Cape Rizzuto. The coast between Cape Stilo and Staz. Roccabernardo is very similar to the preceding stretch. From the low, sandy Cape Stilo to Soverato the beach continues in front of the narrow coastal plain. This only widens at the mouth of F. Assi, and from north of Staz. Badolato to Soverato, where it is up to half a mile wide. The Tertiary hills (p. 361) behind the plain are cut into low, narrow ridges crowned with numerous, little, rounded peaks. The sides of the ridges, together with the soft marl and clay cliffs, which sometimes rise abruptly from the plain, are often steep and crumbling. Near Cape Stilo the hill-slopes above the cultivation is overgrown with cacti and evergreen oaks. The town of Soverato is perched on cliffs about 130 feet high, which interrupt the beach, and is surrounded by fertile fields of cereals, olive trees, and almonds. Between Soverato and Il Fondaco there extends a small crescent-shaped bay, fringed by a beach and backed by the gently sloping and fertile Piano Sanguinario, which rises inland through marl and clay to granite hills. This plain is cultivated with olive and almond trees, beans and cereals. From Il Fondaco to Point Staletti (alt. 1,253 ft.) granite spurs rise from the sea and are edged by cliffs; between them there is a small steep-sided cove with a beach 500 yards long.

The coast from Cape Copanello (near Point Staletti) to Staz. Roccabernardo is fringed throughout by a sandy beach bounded by dunes and by a strip of sclerophyllous bushes and heath. This merges into a deserted grass-covered plain which is about half a mile wide as far as Marina di Catanzaro, where it narrows to a quarter of a mile before broadening again to a mile onwards to Staz. Roccabernardo. Numerous torrents and streams flow across the plain. They are very short between Cape Copanello and the mouth of the F. Corace, to the north-east of which they increase in length and width. Their beds are stony and they are often bordered by unhealthy marshland near their mouths. The Tertiary (p. 361) hills inland from the coastal plain are of clay and soft sandstone, and are cut into terraces and olive-clad ridges about 500 feet high by torrents. Two or three miles inland behind these ridges the hills rise more steeply to the mountains of the Sila (p. 352).

East of Staz. Roccabernardo the character of the coast changes, and as far as Cape Colonne is rugged and indented. The transition begins between Staz. Roccabernardo and Barcovercillo, where the low and often sandy coast is backed here and there by small cliffs. From Barcovercillo to Cape Rizzuto steep cliffs, usually about 60 feet high, rise abruptly from the sea to a platform of marl and



sandstone at 60-160 feet. Fronting these cliffs there are often large blocks of sandstone covered with seaweed which make the sea appear deceptively shallow. In the bay between Cape Castella and Cape Rizzuto there are short stretches of sandy beach usually backed by low cliffs. At Cape Rizzuto the coast changes from an easterly to a northerly direction. The section between Cape Rizzuto and Cape Colonne is cliff-fringed and indented, but at Torre Scifo there is a small beach with a narrow valley leading inland to the grassy, wind-swept platform. This rises abruptly to undulating, terraced tableland about 600 feet high.

### *Communications*

Between Point Pellaro and Point Staletti the coastal road (106) and railway follow the coastal plain, except between Marina di Brancaleone and Cape Bruzzano, where the road winds among the coastal hills 2-3 miles inland. The railway generally runs, sometimes on an embankment, on the seaward side of the road, which usually keeps close to the foot of the coastal hills. At Point Staletti the railway tunnels through the granite headland, while the road runs above the cliffs. Between Point Staletti and Staz. Roccabernardo the road and railway again follow the coastal plain, generally at the foot of the hills about a mile inland. The Cape Rizzuto-Cape Colonne promontory is not served by main road and railway, which cut across its base from Staz. Roccabernardo to Crotona; tracks, however, lead inland from the coast at Cape Castella, Cape Rizzuto, and Cape Cimiti, and unite at Isola Capo Rizzuto, whence a lane leads to road 106.

Major roads go inland from the coastal road 106 to cross the Calabrian peninsula from Bovalino Marina (112), Locri (Gerace Marina, 111), Gioiosa Marina (second class), Marina di Monasterace (110), Soverato (second class), Staz. di Squillace (second class), and Marina di Catanzaro (19).

Numerous fairly good roads leave the coast to follow the ridges to the hill towns where they terminate; local roads of greater importance leave the coast at Staz. Badolato, Staz. di S. Andrea, Staz. di Monturo, Petrizia, and Staz. di Cropani.

Narrow-gauge branch railways lead inland from Gioiosa Marina to Mammola, from Soverato to Chiaravalle Centrale, and from Marina di Catanzaro to Cosenza. A normal-gauge line also runs from Marina di Catanzaro to Catanzaro, whence it crosses the peninsula to S. Eufemia Lamezia on the west coast railway.



*Vegetation*

The vegetation of the coastal strip between Point Pellaro and Cape Spartivento is transitional between that of the Tyrrhenian and Ionian coasts.

The coastal plain between Point Pellaro and Cape Armi is generally well cultivated with many fruit orchards and citrus groves, amongst which there are scattered windmills for pumping water for irrigation. From Cape Armi to Cape Spartivento cultivation on the coastal strip is generally limited to near the villages and railway stations, where orchards of citrus, and mulberry trees, and olive groves are often found. Elsewhere scrub and grass flourish.

The Ionian coast north of Cape Spartivento, owing to the comparative aridity of its climate, is not highly cultivated. Except for the coastal strip and lower hill-slopes between Bovalino Marina and Roccella, where there are fruit orchards and arable fields interspersed with scattered trees and agaves, the whole coastal area between Cape Spartivento and Cape Stilo is generally barren and treeless. A feature of this region is the cultivation of the broad valleys which are irrigated and artificially terraced for the growth of vegetables and fruit.

From Cape Stilo to Staz. Roccabernardo the coastal strip is largely overgrown with coarse grass and opuntias and sometimes with oak thickets, except for olive groves on the lower hill-slopes. Between Badolato and Soverato, however, and on either side of Marina di Catanzaro there are fields of cereals with mulberry and olive trees alongside them. Around the hill-towns and villages a few miles inland there are fields of cereals and beans, and some olive and almond trees. Between Staz. Roccabernardo and Cape Colonne the coastal platform is covered either with coarse grasses or with sclerophyllous bushes, whilst the tableland is largely down to pasture and cereals, though the slopes leading to it are usually covered with bushes and stunted oak groves. Valley cultivation is less common in the region between Cape Stilo and Cape Colonne, except near Badolato, Soverato, and Catanzaro. Elsewhere the stony beds of the rivers are overgrown with bushes and stunted oaks.

*Population*

A feature of the Ionian coast of Calabria is the line of hill-towns which are often paralleled at the coast by seaside resorts, called marinas. The agricultural population near the coast lives in the



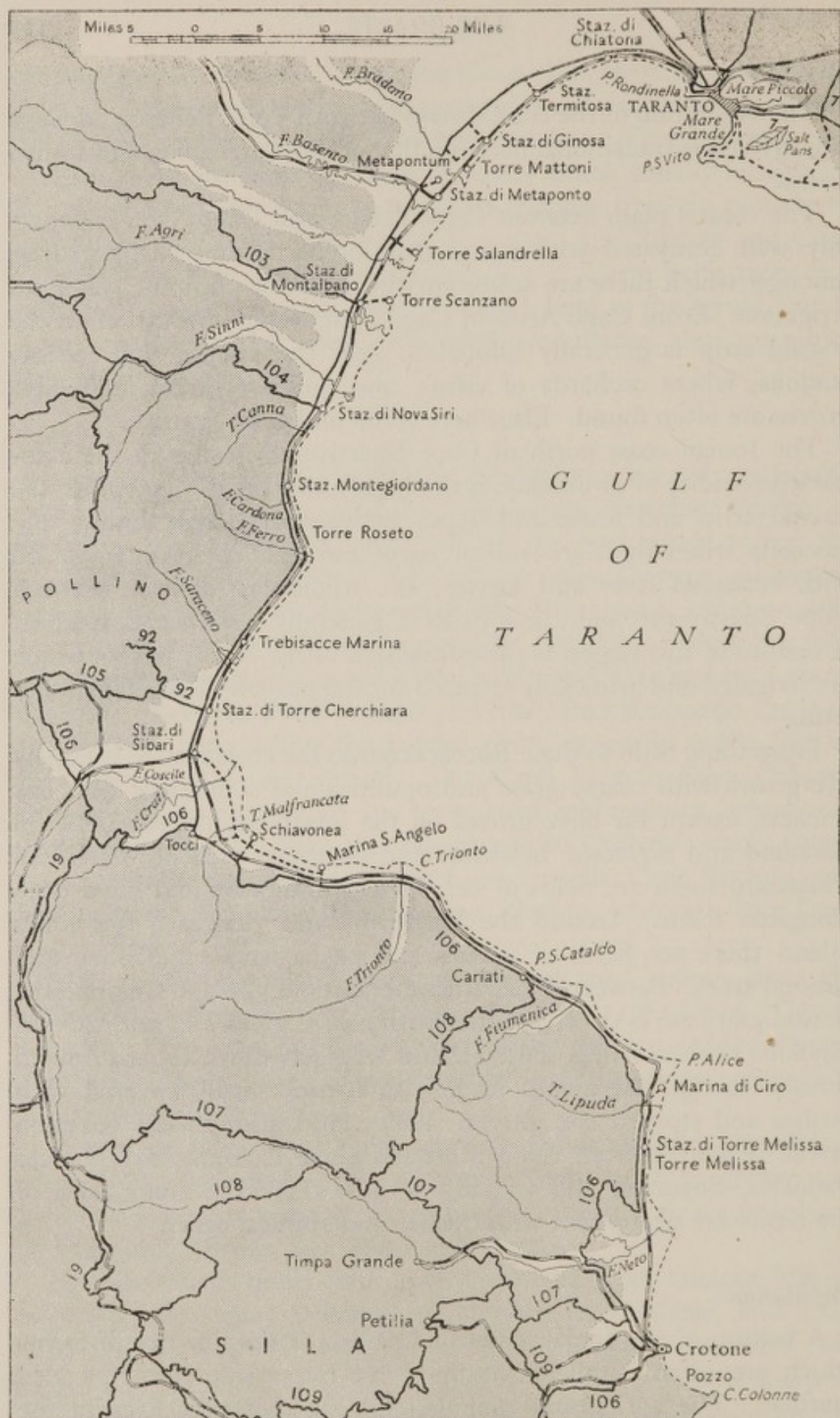


FIG. 22. The coast: Crotona to Taranto. (For Key see p. 54)



towns, to which they return at night, leaving the countryside desolate and unprotected.

Between Point Pellaro and Cape Armi houses intermittently line the coastal road, but thence to Cape Spartivento become less frequent except at the villages of Melito di Porto Salvo, Bova Marina, and a few isolated railway stations. From Cape Spartivento to the mouth of the F. Buonamico, Brancaleone Marina and Bianco are the only notable settlements. The fertile plain between the F. Buonamico and Roccella is, however, more densely populated; numerous new villages have sprung up round the railway stations, and there are scattered farms. Some of the marinas in this region have become larger than their parent towns on the hill-slopes. The larger of these coastal villages include Bovalino Marina, Marina di Ardore, Locri (Gerace Marina), Siderno Marina, Gioiosa Marina, and Roccella. North of Roccella as far as Cape Colonne there are no large villages and only a few houses clustered round the railway stations, except for Soverato, which is of medieval origin and nestles round an ancient fort, and Marina di Catanzaro. The hill-towns and villages, 2-6 miles inland, are, like their marinas, particularly numerous between the F. Buonamico and F. Turbido, and rare between Point Staletti and Cape Colonne. Gioiosa, Squillace, and Catanzaro are the largest of these towns, which are usually connected with the coast either by winding roads or by mule tracks.

### *Ports*

There are no harbours or ports in this region, though there are landing facilities at Siderno Marina, Soverato, Marina di Catanzaro, and Cape Castella.

### GULF OF TARANTO BETWEEN CAPE COLONNE AND CAPE S. MARIA DI LEUCA

The gulf of Taranto, with a coastline of 300 miles, extends between Cape Colonne and Cape S. Maria di Leuca and forms the instep of peninsular Italy. It is open to the south-east, and bounded on the south-west by northern Calabria, on the north-west by the Lucanian Apennines, and on the north-east by the Salentine peninsula. Its western shores are usually formed by a narrow strip of lowland, which broadens to the plains of Neto, Sibari, and Metapontum at the foot of high hills. The north-east coast is very different and consists of low, undulating plateaux.



*Cape Colonne to Taranto (Fig. 22)*

The coast is edged by cliffs 65–100 feet high from Cape Colonne to Pozzo, whence a beach, partially backed by low dunes, extends almost to the port of Crotone. Thick beds of seaweed grow off shore and are often swept on to the beach. A low, flat platform backs the cliff coast, and broken clay and marl hills rise fairly steeply to about 500 feet behind the beach. From immediately north of Crotone to about  $1\frac{1}{2}$  miles south of Torre Melissa the coast is fringed by a beach fronting the large delta of the F. Neto. Inland the desolate and infertile plain of Neto broadens from  $1\frac{1}{2}$  miles to over 3 miles near the swampy delta, which is fringed by tangled woodland. Near Crotone, however, there are market gardens and olive groves. South of the Neto the plain is bounded by monotonous clay and marl hills which are the highly dissected remnants of the plateau south-west of Crotone. These hills are steep with flat summits, 400–500 feet high, and are cut into many little valleys by tributary streams. North of the Neto the hills are equally rugged, but tend to reach greater heights and are more jumbled in appearance. From about a mile south of Torre Melissa to near Staz. di Torre Melissa the coast is edged with sandstone cliffs 30–60 feet high. These cliffs drop to a narrow beach; above, a steep slope leads to terraced clay and marl hills, which rise in tiers to the Sila mountains. Near Torre Melissa the hills are dotted with smoking lime-kilns and pocked by the pits and holes of the limestone workings.

Between Staz. di Torre Melissa and F. Malfrancata there is a beach backed by varied country. The beach is of sand from Staz. di Torre Melissa to Point Fiumenica, where there are dunes, of mixed shingle and sand thence to Cape Trionto, and of shingle on to the F. Malfrancata. Between Staz. di Torre Melissa and Point Alice, a sandy headland, the beach is backed by the fertile plain of Ciro which is richly cultivated with wheat, beans, sainfoin, and with mulberry, almond, fig, and peach trees edging the fields. This plain is about half a mile wide, except at the mouth of T. Lipuda and near Point Alice, where it broadens considerably. This clay, marl, and limestone hills inland and to the west of Point Alice rise, often gradually, in two clearly defined terraces at about 150 and 350 feet. The coastal strip narrows to 200–300 yards from Point Alice to near Cape Trionto, only broadening notably at the wide delta of the Fiumenica. Near Cape Trionto, which is at the delta of the T. Trionto, the plain widens to  $1\frac{1}{2}$  miles and continues at about this



breadth to the mouth of the F. Malfrancata. The domed foothills backing the coastal strip between Point Alice and F. Malfrancata rise steeply to high, sandstone and granite hills which eventually lead to the Sila. The foothills, which are at their highest (about 500 ft.) between Point S. Cataldo and Cape Trionto, are generally terraced at heights of about 230, 330, and 400 feet, and covered with olive trees. These terraces are particularly well defined between Cape Trionto and the F. Malfrancata.

The shingle beach continues from the mouth of the F. Malfrancata to the north of the F. Saraceno (12 miles) and merges into a strip of sclerophyllous heath, behind which extends the plain of Sibari. This plain, which is being reclaimed, is formed of the combined flood plains and deltas of several rivers. The F. Crati, which flows across the centre of the plain from a gorge 10 miles inland, has largely determined its shape. South of the mouth of the Crati the plain is  $3\frac{1}{2}$ –4 miles wide, whilst to the north, where the river is joined by the F. Coscile, it widens to 6–10 miles before dwindling to about a mile near the F. Saraceno. The plain slopes gradually inland to a height of about 125 feet, and is bordered by a low rim of clay terraces, above which hills rise in the south fairly steeply to the granite and crystalline mountains of the Sila (p. 352), and in the north above scree slopes to the bare, scarped limestone hills of the Pollino (p. 339). The F. Crati is bordered near its mouth by a very thick and impenetrable strip of woodland with an undergrowth of brambles and bushes, whose thickets make it impossible to leave the foot-paths. In this woodland many swamps are formed, despite the retaining walls built to prevent the river from meandering and forming malarial pools. The streams and torrents to the north of the Crati, including the F. Saraceno which bifurcates near its mouth, tend to have longer courses than those to the south and to deposit much stony debris on the plain.

The coast from the broad mouth of the F. Saraceno to Torre Roseto is bordered by a narrow shingle beach behind which lies a fairly fertile coastal strip 200–300 yards wide. Dome-shaped hills rise fairly steeply in broken terraces from this coastal strip and are cut into massive ridges by numerous short torrents and rivers with wide pebble beds. The F. Ferro has a bed about a quarter of a mile wide. At Torre Roseto low, grey cliffs rise straight from the sea and interrupt the beach and coastal terrace for a few hundred yards. Thence almost to the mouth of the T. Canna the coast is bordered by a beach of limestone pebbles which merges into a narrow coastal strip at the foot of terraced hills. This strip is only about 10 yards wide, but



broadens at the mouths of the F. Cardona and T. Canna. Near the Staz. Montegiordano it is so narrow that the railway embankment has to be protected by large boulders from the force of the sea.

The coast from the mouth of the T. Canna to Point Rondinella is bordered by a beach behind which extends a coastal plain generally 2-5 miles wide. The beach is usually backed by a belt of low dunes, intermittent between T. Canna and F. Agri, up to 20 feet high, and planted with pines between the mouth of the F. Bradano and Point Rondinella. Malarial swamps interspersed with tangled thickets extend behind the dunes between the Sinni and Agri rivers whilst similar swamps have been drained and irrigated between the mouth of the F. Bradano and Point Rondinella. The coastal plain itself is made up of sands and gravels and rises gradually, sometimes through lines of ancient sand-dunes, to a terrace (50-65 ft. high) which is most clearly marked north of the Agri. On a projecting spur (c. 60 ft.) of this terrace the remains of the Greek temple of Metapontum form a conspicuous landmark. South-west of the F. Bradano marl and clay hills with 'calanchi' slopes (p. 368) rise from the plain in a series of steep and clearly marked terraces (p. 368). These have been cut into north-west to south-east ridges by numerous long, parallel rivers. These rivers, which flow between steep banks in beds often a mile wide, deposit vast patches of gravel and alluvium. North-east of the F. Bradano the low sand, clay, and marl foothills rise in less clearly defined terraces of 115 feet and 230 feet to limestone ridges 500-1,500 feet high; here there are no broad river valleys.

*Communications.* The main road from Crotone to Taranto, sections of which have only been recently completed, generally keeps near the coast. Where the coastal plain is narrow it usually follows the lower hill-slopes close to the sea and goes as much as 3-8 miles inland behind the plains of Neto and Metapontum. It leaves the foothills to cross the hilly Point Alice peninsula, and deserts the foothills to cross the plain of Sibari about  $3\frac{1}{2}$  miles inland. The main road is paralleled seaward from Marina S. Angelo to Staz. di Sibari by a poor road.

Several lanes lead from the shore to the main road from Marina di Ciro on the Point Alice promontory; from Marina S. Angelo and Schiavonea in the plain of Sibari; from near Torre Scanzano, Torre Salandrella, near Metapontum, Torre Mattoni, Staz. di Ginosa, Staz. Termitosa, and Staz. di Chiatona in the plain of Metapontum.

Main roads, usually interconnected, lead across the Calabrian peninsula either to the Naples-Reggio road (18) or to the Catanzaro-



Battipaglia road (19) from Crotone (107), Cariati (108), Tocci (106), Staz. di Torre Cherchiara (92 and 105), Staz. di Nova Siri (104), Staz. di Montalbano (103), and Taranto. Poorer roads often lead from the main coast road to the hill-towns where they either terminate or continue to join the main road system.

The Reggio-Taranto railway follows the coast closely between Crotone and Taranto. It is always on the seaward side of the coastal road, and never more than 3 miles inland. The branch-lines from the main railway are from Crotone to Petilia (narrow), and also to Timpa Grande hydro-electric station (narrow), from Staz. di Sibari to Cosenza and to the west coast, from Staz. di Metaponto to Naples. Taranto is an important railway centre.

*Taranto to Cape S. Maria di Leuca (Fig. 23)*

The bay of Taranto (Mare Grande) forms a semicircle between Torre Rondinella and Cape S. Vito and is separated from the Mare Piccolo by the narrow neck of land on which the town of Taranto stands. The coast between Cape S. Vito and Torre Zozzoli (Sassoli) is low, very indented, and generally consists of limestone cliffs about 15-45 feet high. A beach with sand-dunes about 10-30 feet high extends from Torre Zozzoli to near Torre Columena and is only interrupted by a rocky stretch near Torre dell' Ovo. Two small rocky bights, backed by an area recently reclaimed, interrupt the even line of the coast between Torre Columena and the headland of Torre Presciutto, which projects between two sandy beaches with a total length of  $1\frac{1}{4}$  miles. Clifed and rocky coast continues to Torre Lapillo. The whole stretch between Torre dell' Ovo and Torre Lapillo is, however, fronted by a bank off shore. Between Cape S. Vito and Torre Lapillo the coast rises through a narrow coastal plain to the steep-sided, bare, flat ridge of the Murge Tarantine (c. 350 ft.; p. 373).

At Torre Lapillo the trend of the coast changes from west to east to north-west to south-east. There are between Torre Lapillo and Torre Cesareo several small crescent-shaped bays with beaches at their heads. The most important of these beaches extend from Torre Lapillo almost to Torre Chianca, a distance of about 2 miles, and from Torre Cesareo to Bellannova. The coast between Torre Squillace and Torre dell' Alto Lido is generally indented, and edged by either low rocks or cliffs 10-20 feet high, interrupted here and there by tiny coves. A beach stretches from south of Torre dell' Alto Lido to Torre Sabea, and is flanked in the north by a scarp



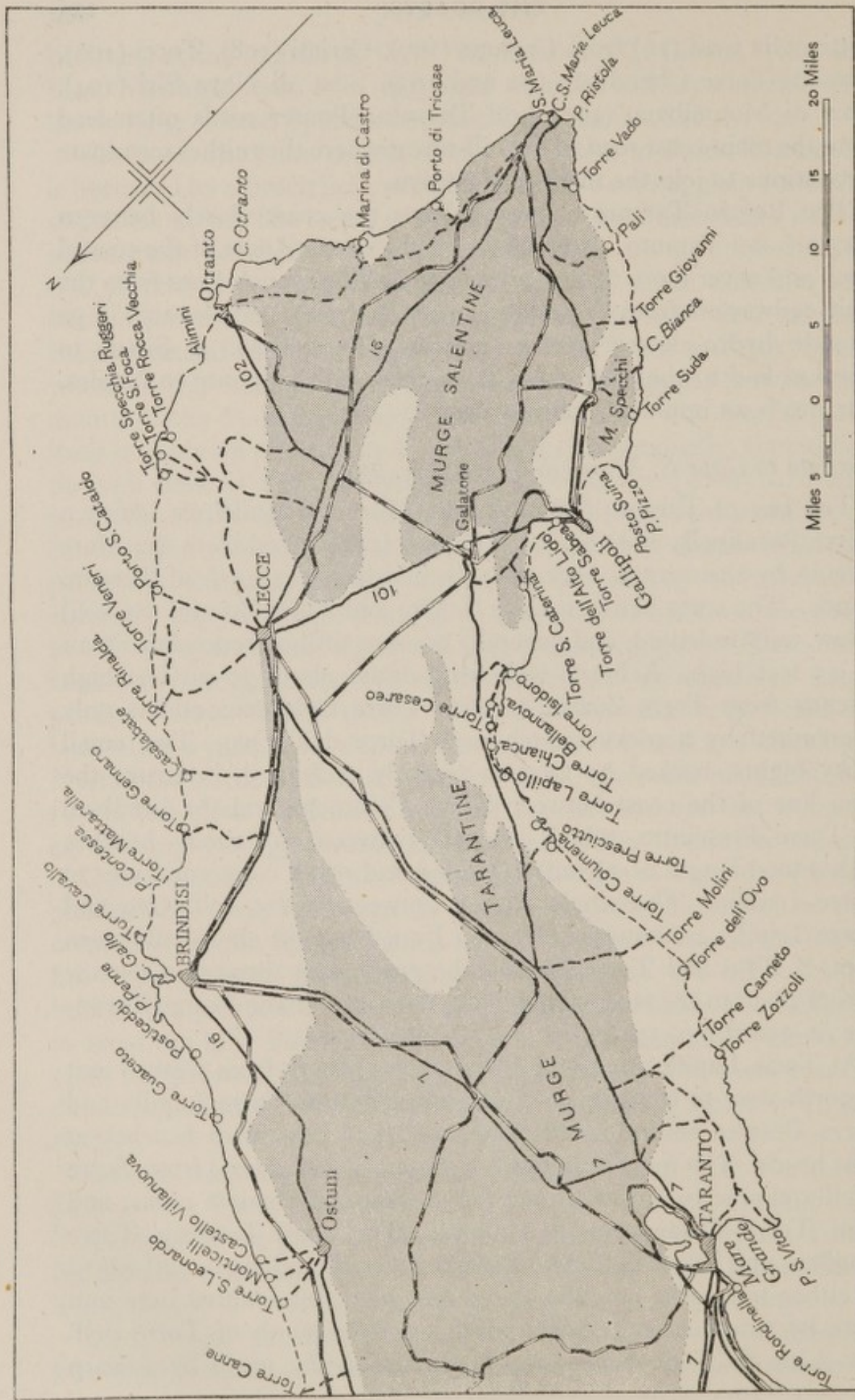


FIG. 23. The coast: the Salentine Peninsula. (For Key see p. 54)



rising to plateau land. Very low cliffs edge the coast from Torre Sabea to the town of Gallipoli, which is on a rocky island and connected with the mainland by a causeway and a narrow promontory. The low island of S. Andrea is about a mile west of the port. The bay of Gallipoli forms a gentle curve between Gallipoli and Point Pizzo. It is fringed between Torre Giovanni and Posto Suina with sand and dunes, which give access to gently sloping country, but elsewhere there are low cliffs. The coast between Torre Lapillo and Torre S. Caterina is backed by a low, but often steep-sided, dry, stony plateau, and onwards to Torre del Pizzo by a narrow coastal plain, above which the country rises gently to the scarp edge of the low limestone hills of the Murge Salentine.

Between Point Pizzo and Torre Giovanni the coast is low, rocky, and fretted by numerous minor indentations. Here the land rises gently inland to the ridge of M. li Specchi (341 ft.), which drops steeply eastwards to a trough separating it from the Murge Salentine. A beach extends from Torre Giovanni to near Torre Vado, but is bordered off shore by a bank and many scattered rocks. From immediately south of Torre Vado to Point Ristola the height of the coast increases and cliffs of 20-60 feet often occur. A rugged bight lies between Point Ristola and the cliff-edged Cape S. Maria di Leuca, the southernmost point of the heel of Italy. Between Torre Giovanni and Cape S. Maria di Leuca the plateau of the Murge Salentine rises usually steeply from a narrow coastal strip, and often forms small north-south ridges of limestone separated from each other by valleys of soft sand.

*Communications.* The Salentine peninsula is served by a network of roads and lanes which is particularly dense near Gallipoli. Despite this the coast is rarely followed by roads for any distance. A main road, the ancient Via Salentina, from Taranto to Gallipoli goes about 8 miles inland as far as the neighbourhood of Point Presciutto, and then from 2 to 5 miles inland to Galatone. Lanes and tracks from the coast join the main system from Torre Canneto, Torre Molini, Torre Columena, and Torre Isidoro. In addition a lane follows the coast from Torre Lapillo and Torre Cesareo, with various branches inland, and another from Torre S. Caterina to near Gallipoli; both of these have several branches inland. Between Gallipoli and S. Maria di Leuca lanes lead inland from the coast at Torre Suda, Cape Bianca, Torre Giovanni, Masseria i Pali, and near Torre Vado. Many roads lead across the peninsula to the Adriatic coast. Taranto and Gallipoli are the only coastal towns served by railways.



*Vegetation*

The coast of the gulf of Taranto is not highly cultivated, because of the aridity of the climate.

The plain of Neto is remarkably infertile except near Crotone and is covered with desolate fields surrounded here and there with low trees and bushes. The coastal strip from north of Staz. di Torre Melissa to Cariati is fertile and covered with fruit trees and fields of cereals. From Cariati to F. Malfrancata there are monotonous fields of pasture succeeded by almost continuous olive groves; in the latter region the railway stations are surrounded by gardens and fruit trees. The lower hills between Point Alice and F. Malfrancata have numerous olive groves and gardens near the settlements, whilst farther inland still, high, impenetrable *macchia* alternates with fields of cereals and pasture. The rivers and their deltas are well wooded, the Fiumenica being remarkable for its olive groves.

The plain of Sibari, which is being reclaimed, usually consists of meadow and pasture land enclosed with wire fences, whilst the bordering terraced slopes are usually either cultivated with wheat or overgrown with oaks and shrubs. Northwards the narrow coastal strip between Trebisacce and T. Canna is covered with fields and olive groves, and here, as in the plain of Sibari, the beds of the rivers are overgrown or lined with stunted oaks, pines, scrub, and oleanders.

From the F. Sinni almost to Metapontum the plain and lower slopes of the hills, once famous for their fertility, are covered with rough pasture and meadow land, interrupted here and there with patches of rough *macchia*. Many of the rivers are lined with trees and bushes, and at their mouths there is often a tangled jungle of woodland which contrasts with the arid treeless landscape inland. From near Metapontum to Taranto the plain has been reclaimed, and there are fields of cereals and olive groves.

The region round Taranto is well cultivated with cereals and vines on the lower areas and olives on the hill-slopes. From Cape S. Vito to Cape S. Maria di Leuca there is usually a strip of *macchia* and rough country near the coast, whilst often vineyards are found less than a mile inland. In the area north of Gallipoli a wide coastal belt of pasture is found, and near Cape S. Maria di Leuca olive groves come down to the sea.

*Population*

Crotone, a growing industrial town, Taranto, an important naval base, and Gallipoli, a fishing-town, are the only large settlements on



the shores of the gulf of Taranto. Most of the inhabitants of this region live in villages and small towns on the hill-tops. These are usually 2-3 miles inland, though those behind Metapontum are often as much as 3-6 miles.

The small hamlets round the railway stations are the only settlements near the coast between Crotone and Taranto except for a few villages or scattered farms in the more fertile areas. At Ciro and between Trionto and Malfrancata there are isolated houses amongst fields, whilst the small, walled hill-town of Cariati is close to the coast. The large villages of Il Giardino and Trebisacce cluster near the shore on the northern fringe of the plain of Sibari. The plain of Metapontum is practically deserted except for the ruins of the ancient town of Metapontum. Near Taranto villages and small towns become more numerous.

The coastal areas of the eastern shore of the gulf are generally desolate and uninhabited except immediately south-east of Taranto, around Gallipoli where there are some small villages and isolated farms, and near the village of S. Maria di Leuca. The interior is served by a comparatively dense network of roads which link together numerous small agricultural towns and villages. These form a great contrast to the hill-towns along the other shores of the gulf.

### *Ports*

Crotone\*, Taranto\*, and Gallipoli\* are the only notable ports; other landing facilities are limited and include a short pier at Marina S. Angelo, a very small port at Schiavonea, a pier at Trebisacce Marina, and a pier at S. Maria di Leuca.

### APULIA: CAPE S. MARIA DI LEUCA TO TORRE MILETO

The east coast of the Apulian region borders the Adriatic and has a general north-west direction for about 330 miles between Cape S. Maria di Leuca and Torre Mileto. The east coast of the Salentine peninsula extends north from Cape S. Maria di Leuca to Cape Otranto and thence the coast of the Murge and the Tavoliere di Puglia stretches with few interruptions or major indentations north-west to the M. Gargano peninsula, the spur of Italy. This juts out between Manfredonia and Torre Mileto to form the open gulf of Manfredonia on its south side. From Cape S. Maria di Leuca to Barletta the coast is bounded inland by broad limestone plateaux which rise, often with a scarp edge, either straight from the sea or



from a coastal plain 2 or 3 miles wide. The low-lying, beach-fringed plain of the Tavoliere di Puglia forms the south-west shore of the gulf of Manfredonia. The Gargano peninsula is a limestone mountain mass.

*Cape S. Maria di Leuca to Barletta (Figs. 23, 24)*

From the steep, white cliffs of Cape S. Maria di Leuca (alt. 250 ft.), the southernmost point of the 'heel of Italy', to Cape Otranto the coast is high and cut into small indentations. It is made up of steep, crumbling or jagged, limestone cliffs about 100–200 feet high, which give way to lower, though still rocky and rugged, coast at Porto di Tricase and Marina di Castro. Above the perpendicular cliffs there is an abrupt rise to the Murge Salentine, a flat-topped ridge about 500–650 feet high. Between Cape Otranto and the port of Otranto, which is at the head of a small bay, the cliffs are somewhat lower and slope gently upwards to a lower ridge.

North of Otranto the coast is indented and edged with low cliffs, 30–60 feet high, as far as the small sandy bay of Alimini, behind which lie the Lagune Alimini. North of the bay to Torre Specchia Ruggeri the coast is low (10–30 ft.), often edged by small cliffs. It is bordered off shore, as far as Monopoli, by a bank which is interspersed with rocks, and has depths of 3–6 feet. A sandy beach extends between Torre Specchia Ruggeri and Torre Gennaro and is backed by sand-dunes (25 ft. high) fronting low, marshy country and small lagoons. Landing on this beach might be possible at Porto S. Cataldo and on either side of Torre Veneri, where there are fewer off-shore rocks. There are low cliffs, about 20 feet high, from Torre Gennaro to Cape Cavallo, interrupted by sandy beaches and dunes between Torre Mattarelle and Point Contessa and also to seaward of Salina Vecchia. The port of Brindisi (Plate 29) extends round a small cliff-fringed bay between Cape Cavallo and Cape Gallo. From north of Otranto to Brindisi the plateau of the Murge Salentine retreats inland and gives way to a wide, gently sloping coastal plain, which is usually marshy and ill-drained along its seaward margin, though there are numerous small dry ravines south of Brindisi.

The coast between Brindisi (Cape Gallo) and Torre Guaceto is edged with low cliffs, about 20 feet high, sometimes fronted by a narrow strip of beach. From Torre Guaceto to Torre S. Leonardo it is low and cut into minute indentations, a few of which have tiny beaches at their heads. A beach, about  $7\frac{1}{2}$  miles long, extends from near Torre S. Leonardo to Torre Canne, and although fronted by the





PLATE 29. *Brindisi*



PLATE 30. *Manfredonia*





PLATE 31. *Peschici*

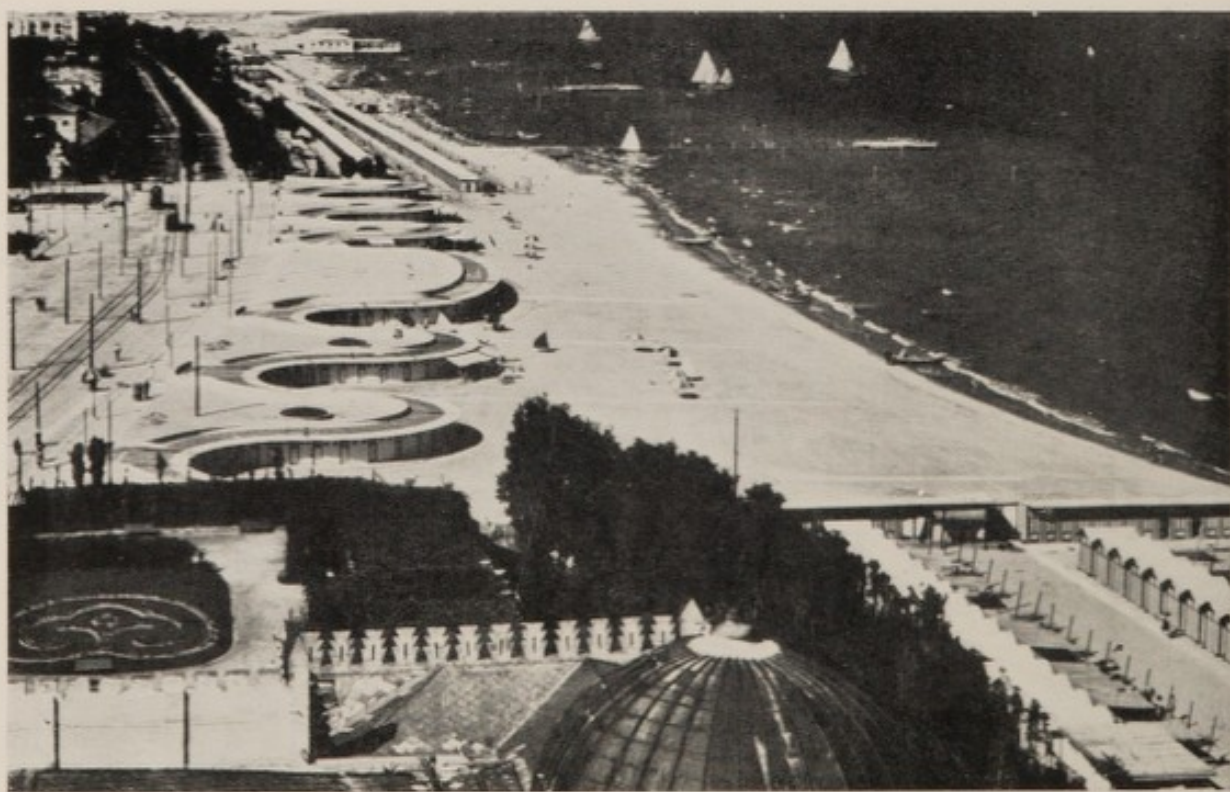


PLATE 32. *Litorale di Lido*



sandbank, has few rocks off shore. From Torre Canne to the small port of Monopoli the coast is fretted with indentations and mainly edged with low cliffs; there is, however, a beach between Torre Egnaxia and Capitolo. Between Cape Gallo and Monopoli the coastal plain, which is 2-3½ miles wide and clad with olive groves, rises steeply to the terraced slopes of the Murge table-land (p. 374).

From Monopoli to the port of Bari the coast is once more cut into small indentations, and is generally edged with low, perpendicular limestone cliffs, about 15-30 feet high, which are particularly well developed between Monopoli and Torre Ripagnola and between S. Giorgio a Marina and Torre Carnosa. There are caves and grottoes in some of the higher cliffs, particularly at Polignano a Mare, where there is a dance hall in several caves which have been artificially joined together. An off-shore bank fronts the shore closely between Torre Ripagnola and Bari, and is interspersed with numerous rocks between Mola di Bari and Bari. The plain along this stretch of coast slopes gently inland to the irregular, undulating, limestone plateau of the Murge. Few rivers water this region, though numerous deep, dry ravines, generally boulder-strewn, come down to the sea. The flooding of the mouths of these has caused the indentations of the coast.

The coast from Bari to Barletta is cut into larger indentations which likewise are usually formed at the mouths of the deep, dry ravines. These larger indentations have led to the growth of a series of small ports at a distance of 5-6 miles from each other. The coast is generally rocky and edged by low perpendicular cliffs 15-30 feet high, but there are some beaches, particularly (1) west of Bari between Faro S. Cataldo and Scala, 1½ miles long; (2) between S. Spirito and Giovinazzo, about 3 miles long; and (3) between Bisceglie and La Testa, 1 mile long. All these beaches are backed by low cliffs of varying heights, generally surmountable. The whole coast between Bari and Barletta is fronted by an off-shore bank, with depths of 3-6 feet, which sometimes approaches the shore closely and causes the small ports to silt up. Inland between Bari and Barletta there is a gentle rise to an intensively cultivated coastal terrace, 60-100 feet high, above which further wide, fertile terraces with gently sloping sides lead inland to the limestone table-land of the Murge.

*Communications.* The east coast of the Salentine peninsula is not followed by any main road. The main S. Maria di Leuca-Lecce-Brindisi road (16) runs usually 9-12 miles from the sea as does the railway, both of which have branches from Otranto. Poor second-



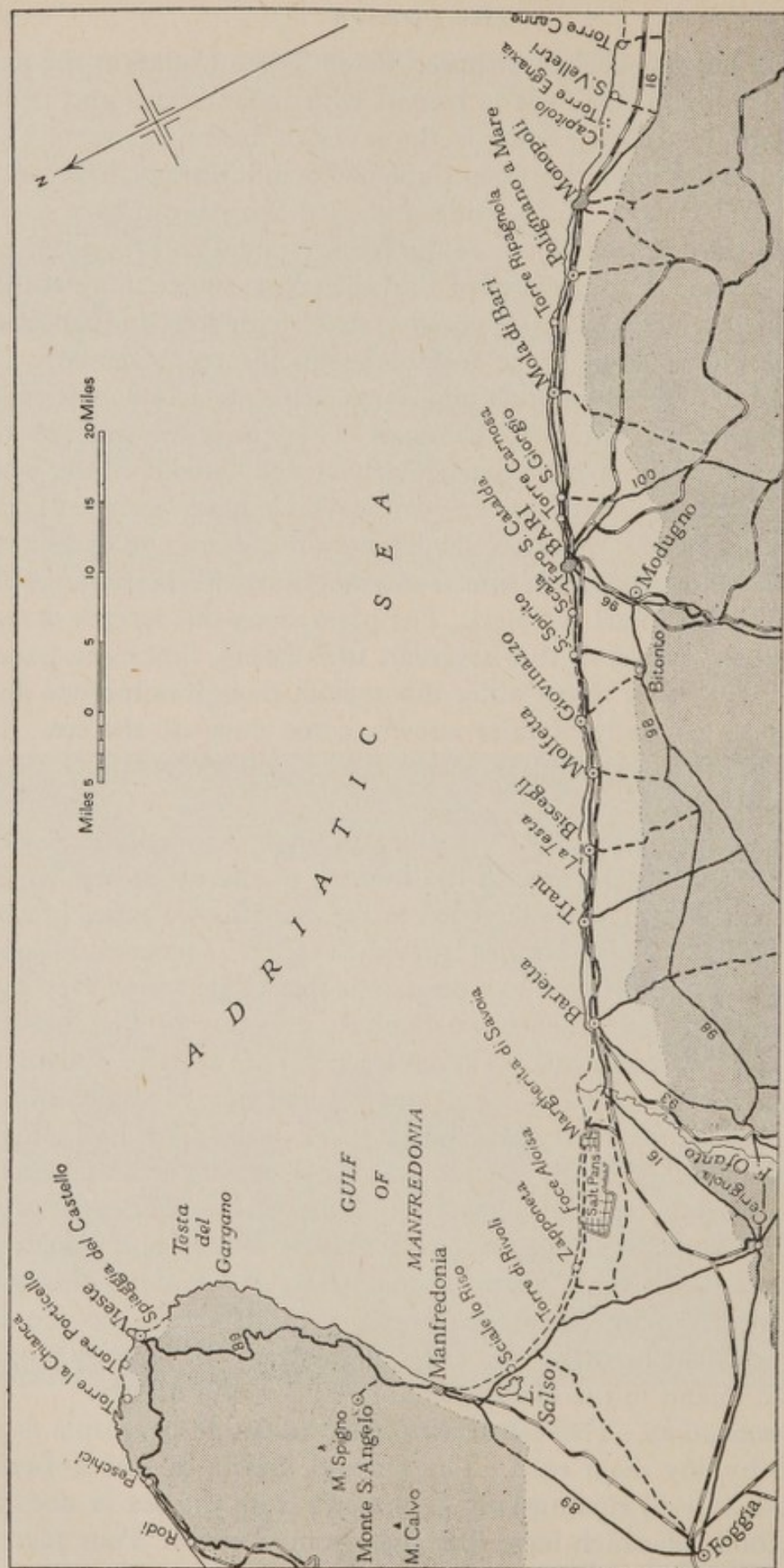


FIG. 24. The coast: Torre Canne to Rodi. (For Key see p. 54)



class roads and tracks, however, follow the cliffs from near S. Maria di Leuca to Otranto, and have a few branches leading inland to join the fairly dense network serving the interior of the peninsula. No continuous road follows the coast between Otranto and Brindisi, though good roads lead across the level coastal plain to road 16 from Otranto, Torre di Rocca Vecchia, and S. Cataldo; lanes and tracks also connect with road 16 from Alimini, Torre S. Foca, north of Torre Veneri, Torre Rinalda, Casalabate, and near Torre Gennaro.

Between Brindisi and Barletta the main Brindisi-Rome road (16) and the Adriatic coast railway keep for most of the way close to the coast. Road 16, with the railway on its seaward side, runs 2-5 miles from the shore between Brindisi and Monopoli, usually at the foot of the steep, scarp-like edge of the Murge plateau. Lanes and tracks lead from the coast to this road from Point Penne, Posticeddu, Castello Villanuova, Monticelli, Torre S. Leonardo, Torre Canne, S. Velletri, and Torre Egnaxia. Between Monopoli and Barletta the main road and railway keep close to the coast, though they are mostly inaccessible from the sea. Main roads and railways radiate inland from Brindisi (7), Bari (96, 98, 100), and Barletta (93), to join a fairly dense network both of roads and railways on the Murge plateau. Numerous good roads also leave the coast and go inland from Monopoli, Polignano a Mare, Mola di Bari, S. Giorgio, S. Spirito, Giovinazzo, Molfetta, Bisceglie, and Trani, whilst many second-class roads and local roads lead inland from road 16 to join the main road network.

#### *Barletta to Torre Mileto (Figs. 24, 25)*

The gulf of Manfredonia extends between Barletta and Testa del Gargano, a rocky headland which forms the eastern extremity of the Gargano peninsula. The shores of the gulf from Barletta to near Manfredonia, a distance of 28 miles, are beach-fringed and backed by the low-lying and featureless plain of Tavoliere, or Foggia (p. 382). The beach is interrupted  $3\frac{1}{2}$  miles north-west of Barletta by the delta of F. Ofanto, which is the longest river flowing across the plain and the only one with a summer flow of water. Salt-pans with an area of 5 square miles, including the now drained Lake Salpi, line the landward side of the beach between the port of Margherita di Savoia and Foce Aloisa. Thence to Manfredonia (Plate 30) the beach is immediately bounded by low dunes and farther inland by marshes and lagoons, the largest of which, Lake Salso, lies 5 miles south of Manfredonia. The alluvial plain of the Tavoliere slopes gently inland



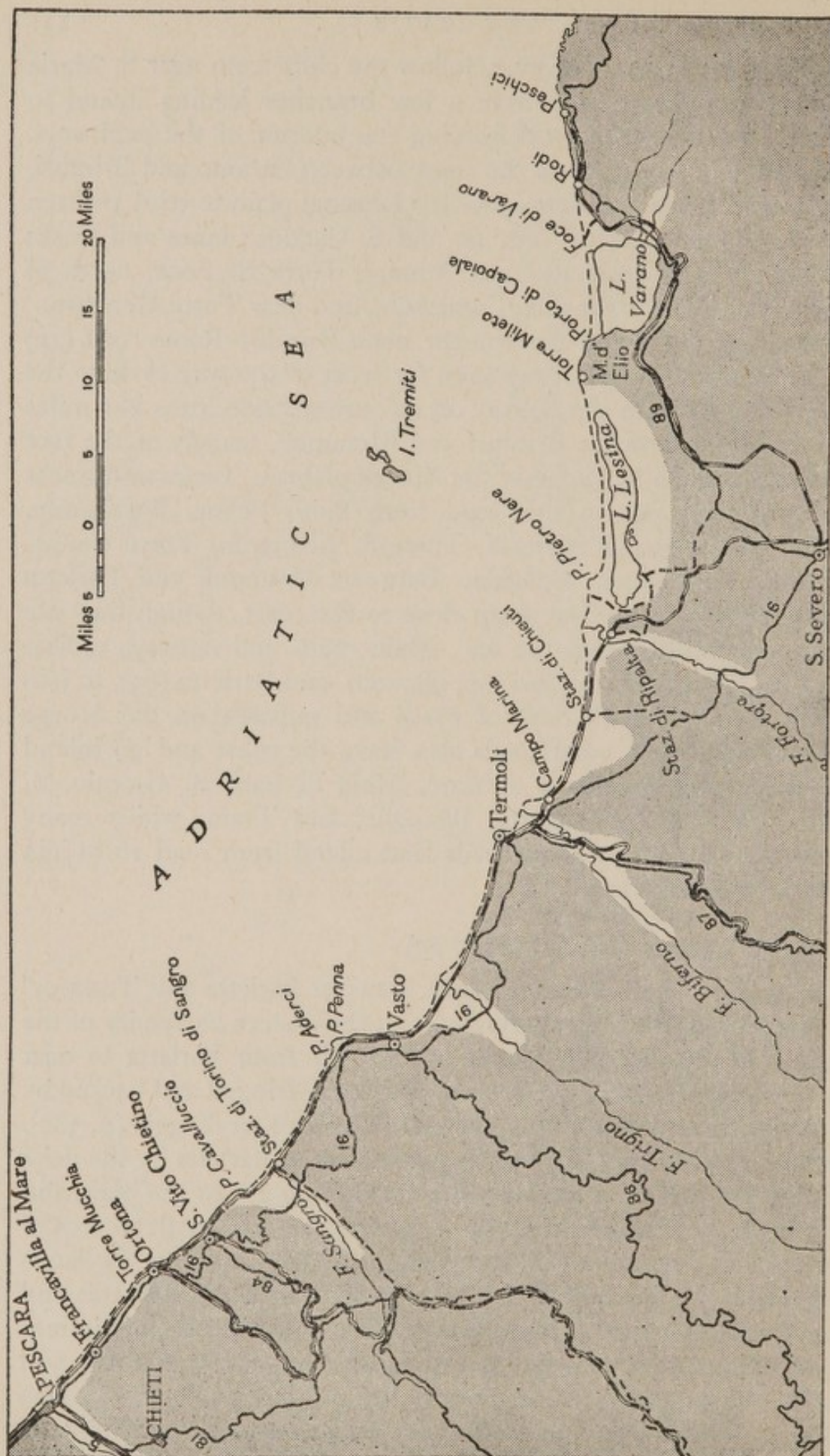


FIG. 25. The coast: Rodi to Pescara. (For Key see p. 54)



in the south to the platform of Cernignola (about 1,000 ft.; p. 382), in the west to the sand-and-gravel M. della Daunia (p. 382), and in the north to the steep, scree-covered scarps of the mountains of the Gargano peninsula. The streams of the Tavoliere plain, other than the Ofanto, which is liable to flood considerably, are small and generally lose their mouths in the coastal marshes and lagoons.

The southern slopes of the mountainous, limestone Gargano peninsula (p. 383), which extends east-north-east from the mainland, forms the northern shore of the gulf of Manfredonia. The steep, rocky mountains of the peninsula (M. Calvo 3,465 ft.; M. Spigno 3,314 ft.) rise much more precipitously on its southern than on its northern side. Consequently the gorge-like ravines incising the southern side are shorter and deeper than those on the north. The south shore of the peninsula from Manfredonia to Testa del Gargano is very irregular and edged with steep cliffs rising inland in a series of terraces. The eastern and northern shores as far as Rodi, though equally indented, are generally lower and sometimes interrupted by beaches backed by small, gently sloping coastal plains which are often cultivated with vines and olives. The most important of these are (1) immediately south of the small port of Vieste, a beach about 3 miles long divided in two by a rocky headland; the southern section is backed by rugged country, while the northern, known as the Spiaggia del Castello, is sandy with low-lying country immediately inland; (2) immediately north of the headland on which Vieste perches, a sandy beach about one mile long; (3) between Torre Porticello and Torre la Chianca, a beach about  $1\frac{3}{4}$  miles long known as the Spiaggia del Scialmarino; and (4) immediately west of the small port of Peschici, a sandy beach half a mile long (Plate 31). From Rodi to Porto di Capoiale, a distance of  $7\frac{1}{2}$  miles, there is a beach with dunes backed by Lake Varano, which lies in an amphitheatre of terraced limestone hills. Beyond Porto di Capoiale the coast is rocky as far as Torre Mileto, where it rises steeply inland to M. d'Elio (827 ft.).

*Communications.* The main Brindisi-Rome road (16) and the Adriatic coast railway run inland from Barletta to Foggia, the meeting-place of several main roads, two of which cross the Apennines. Between the mouth of the Ofanto and Manfredonia the coast is followed, behind the dunes and lagoons, by a series of first- and second-class roads. Roads, usually poor, lead inland across the plain of Tavoliere from Margherita di Savoia, Zapponeta, Torre di Rivoli, and from near Sciale lo Riso. Between Manfredonia and Rodi the



Foggia-S. Severo road (89) runs round the peninsula, only coming close to the coast at Vieste, and between Peschici and Rodi. Lanes or tracks lead inland from the Spiaggia del Castello, Foce di Varano, and Porto di Capoiale. Branch railway lines go inland to join the main Adriatic coast railway from Margherita di Savoia to Ofantino, from Manfredonia to Foggia, and from Peschici to S. Severo.

### *Vegetation*

Inland between S. Maria di Leuca and Otranto the most highly cultivated areas are the fertile depressions, where there are arable and pasture land, olive and fig orchards, and some vineyards, all enclosed by white stone walls. The more open limestone regions are usually rough, stony, and barren, though near the coast, where the cliffs are lower, there are small walled patches of cultivation even in rugged limestone areas. Between Otranto and Monopoli the coastal plain, though often covered with infertile soil, is generally pasture, cornland, or olives. Despite reclamation the cultivation of this coastal region is still interrupted by patches of low bush and scrub. Round Otranto there is a magnificent olive plantation, whilst near Brindisi extends a zone of treeless arable land with vineyards and scattered farms. Farther inland are extensive olive and fig groves with agave hedges, more vineyards, and tobacco fields.

The gently sloping terraces rising from the sea between Monopoli and Barletta are generally fertile, though the rapid changes and extremes in weather, and the aridity of the summer, tends to limit cultivation to fruit trees. Olives are predominant, but round the ports between Bari and Barletta there are almond and cherry orchards, carob trees and market gardens, as well as fields of cereals. On the higher, terraced slopes inland extend treeless arable fields, almond orchards, and vineyards, all usually enclosed by dry walls.

The plain of Tavoliere until comparatively recently was grazing land. Now, reclamation is progressing and fields of wheat, oats, barley, and pot-herbs alternate with small patches of pasture. Few trees grow on the plain, though olives and vines are cultivated on some of the lower surrounding hills, especially near Trinitapoli. The dunes and marshy coastlands have the usual cover of bushes, rushes, and shrubs. Near Manfredonia, where reclamation has been completed, there are fertile gardens.

The steep south side of the Gargano peninsula has, on the whole, a sparse vegetation. East of Manfredonia, however, olives grow on the lower hill-slopes and patches of *macchia* higher up. The eastern



and more gently sloping northern sides of the peninsula are fertile and comparatively well watered. Olives and almonds grow in the coastal strip, whilst there are citrus groves around Vieste and Rodi. Farther inland beach and oak trees spread up the lower slopes of the mountains.

### *Population*

On the plateau above the cliffs between Cape S. Maria di Leuca and Otranto there are numerous villages and a few isolated farms, all interconnected by lanes and roads which are bordered by stone walls. Between Otranto and Monopoli, with the exception of the port of Brindisi, there are few houses near the shore, only the ruins of desolate watch-towers. A mile inland, scattered farms and small villages become increasingly numerous until the chain of towns, along the outer edge of the plateau slope, is reached.

A line of towns, generally with small harbours, extends along the coast between Monopoli and Barletta. These include Monopoli, Polignano, Mola di Bari, Bari, Giovinazzo, Molfetta, Bisceglie, Trani, and Barletta, all of which have a population of about 20,000–50,000. They exist chiefly to export the oil, soap, wine, figs, and nuts produced in the neighbourhood and round the market towns which parallel the coast 4–8 miles inland. The population is town-dwelling, and there are few scattered farms or small villages.

Between Barletta and the ancient town of Manfredonia many isolated buildings are scattered along the coastal strip of the plain of Tavoliere. These are most numerous near the ever-growing town of Margherita di Savoia and in front of the salt-pans, which are of great importance in providing salt for the Italian chemical industry. Inland there are some scattered settlements on the plain, and considerable market towns at Foggia, Lucera, and S. Severo. Along the cliff coast between Manfredonia and Testa del Gargano, there are few settlements except for isolated houses. Monte S. Angelo (alt. 2,736 ft.), a notable place of pilgrimage, is a town of local importance near this coast. The east and north coasts of the Gargano peninsula are comparatively well populated. The town of Vieste has scattered houses on either side, whilst behind the sea-side resorts of Peschici and Rodi the hill-slopes and valleys are dotted with scattered habitations. West of Rodi there are settlements along the coast itself.

### *Ports*

Between Cape S. Maria di Leuca and Cape Otranto the only ports suitable even for very light craft are Porto di Tricase, Porto di Castro,



and Porto di Badisco. From Otranto\* to Monopoli the small harbours of Porto S. Cataldo and of Torre Villanuova are only artificial landing-places, with the notable exception of Brindisi\*, which is the principal port on the Adriatic coast. The ports which line the coast from Monopoli to Barletta generally provide unsatisfactory anchorages, since they lack protected bays, besides being subject to constant silting. The more important are: Monopoli, Polignano, Mola di Bari, Bari\*, Giovinazzo, Molfetta, Bisceglie, Trani, and Barletta\*.

Between Barletta and Torre Mileto the main harbours are: Margherita di Savoia, Manfredonia, Vieste, and Rodi. The anchorage in Manfredonia roadstead is the best along the exposed Adriatic coast of Italy.

#### ADRIATIC COAST: TORRE MILETO-ORTONA-RIMINI

The coast trends west from Torre Mileto to Vasto and then sweeps north-north-west to Ancona and finally north-west to Rimini. It is fronted by a long beach extending with few interruptions for 250 miles from Torre Mileto to Rimini. Low hills rise, often immediately, from the narrow coastal strip, in crumbling cliffs, and then slope gently inland for 10-20 miles to the foot of the steep Apennines (p. 300) which are generally more than 5,000 feet high.

##### *Torre Mileto to Rimini (Figs. 25, 26, 27)*

From Torre Mileto to Vasto Marina the coast is fringed by a sandy beach lined intermittently with dunes. Between Torre Mileto and the cliffs of Point Pietro Nere a narrow bush-covered strip separates this beach from Lake Lesina which is backed by low, though fairly steep, hills (p. 385). From Point Pietro Nere to the cliffed promontory on which Termoli is built, a narrow, though rather marshy, level strip of lowland bounds the beach and only widens at the deltas of the F. Fortore and F. Biferno. These rivers cut steep-sided valleys through the low Pliocene hills behind the coastal strip. The olive-clad hills between Termoli and Vasto rise more steeply from the beach except near the mouth of the F. Trigno, which has a wide patch of lowland near its mouth.

From Vasto, which is built about 470 feet above the sea on a steep olive- and vine-clad slope, a cliffed and rocky coast trends northwards to Point Penna, and then west to Point Aderci. From here a beach extends to Point Cavalluccio and is bounded by cliffs and



steep terraced hills, except at the mouths of the F. Sangro and of several other torrents, where there are level patches. Between Point Cavalluccio and Torre Mucchia steep cliffs, often fronted by a narrow beach, rise to terraced hills, which are slashed with small, deep ravines. At Ortona the cliffs, however, are fringed by broader, sandy bathing beaches.

A continuous beach extends about 91 miles from Torre Mucchia to Numana (south of M. Conero) and is usually bounded by a narrow coastal plain backed by steep hills. This beach, generally 30-100 yards wide, is sandy except at the mouths of rivers, where it becomes pebbly and usually broadens considerably. The Pliocene hills (p. 386) rise for the most part from a narrow coastal plain, usually in yellow or whitish bluffs to heights of 300-600 feet, and then slope gradually to the foot of the Apennines (p. 352). Numerous, wide, flat-bottomed valleys, sometimes with steep crumbling sides, cut through the hills and widen the plain considerably at the coast. Their rivers have great seasonal variations of flow. The coastal plain is narrowest north of Torre Mucchia, at Francavilla al Mare, where the greater part of the town is on a steep hill, near Silvi Marina, from near Cupra Marittima (Marano) to Porto S. Giorgio, and at Porto di Potenza Picena.

From Numana to Ancona precipitous cliffs rise, generally from a narrow beach, to the limestone massif of M. Conero (1,876 ft. high; p. 386). A beach, usually sandy and 50-60 yards wide and backed by a coastal strip a few yards wide, extends from Ancona to Pesaro. Clay and marl hills with crumbling and broken slopes rise from the beach to heights of 150-300 feet. This fertile coastal strip only broadens between Senigallia and Fano and at the mouths of the wide river valleys, where there is a series of large and important sea-side resorts, surrounded by fertile gardens and vineyards. A rugged section of coast separates Pesaro from the sea-side and fishing-town of Cattolica. Thence to Rimini there extends a sandy beach usually about 100 yards wide, but about 200 yards wide at the large sea-side resort of Riccione. The Apennines and their foothills begin to retreat inland at Cattolica, where the fertile coastal lowland gradually becomes wider.

### *Communications*

The main Brindisi-Padua road (16) winds amongst the hills 2-5 miles from the coast between Campomarino and S. Vito Chietino, and then onwards to Rimini follows the narrow coastal plain, except



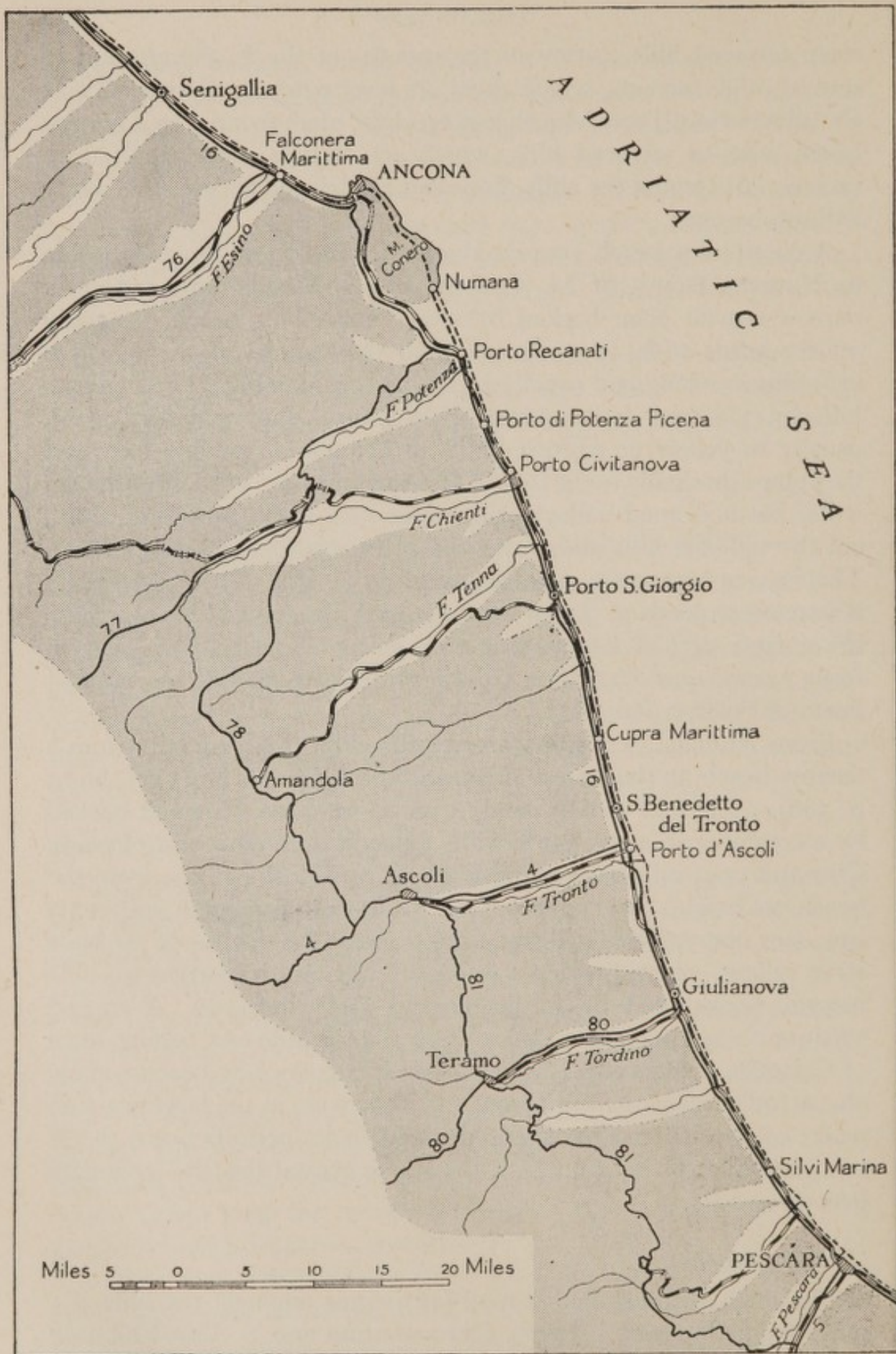


FIG. 26. *The coast: Pescara to Ancona.* (For Key see p. 54)



between Porto Recanati and Ancona, where it goes inland to avoid the M. Conero massif, and between Pesaro and Cattolica. No road follows the coast between Torre Mileto and Campomarino. Lanes, however, lead inland to the main roads from Point Pietro Nere, Staz. di Ripalta and Staz. di Chieuti. A second-class road runs close to the cliffed coast between Porto Recanati and Ancona.



FIG. 27. *The coast: Ancona to Ravenna*  
(For Key see p. 54)

The hill towns are served by a fairly dense network of roads, many of which come from the coast. The majority of roads across the Apennines follow the wide river valleys. The most important of the trans-Apennine roads commence from Termoli (87), Vasto (86), Staz. di Torino di Sangro, S. Vito Chietino Marina (84), Ortona, Pescara (5), Giulianova (80), Porto d'Ascoli (4), Porto S. Giorgio, Porto Civitanova, Porto Recanati (77), near Falconera (76), Fano (Via Flaminia) (73), Pesaro and Rimini (9, 72).

The main Brindisi-Foggia-Ancona-Bologna railway from Foggia



joins the coast near Staz. di Ripalta and then keeps close to it as far as Rimini, usually seaward of the main road. Between Porto Recanati and Ancona it goes inland to avoid the M. Conero massif, and between Pesaro and Cattolica cuts across a hill-spur about  $1\frac{1}{2}$  miles inland. Branch-lines lead to the hill towns, whilst others cross the peninsula, commencing from Termoli, S. Vito, Ortona, Pescara, Porto Civitanova, Falconera Marittima, Fano, and Rimini.

### *Vegetation*

The undulating country between Torre Mileto and Vasto usually consists of rough grazing for sheep, with scattered woods and patches of *macchia* near the coast.

North of Vasto the coastal strip and lower river valleys are intensively cultivated near the towns and villages, with vineyards, mulberry orchards, and fields of corn, maize, and sugar-beet. Walled arable fields generally predominate on the level spurs immediately above the coastal strip. Large trees are rare, but there are some scattered oaks and elms usually lining fields, olive groves north of Vasto, and a large pinewood west of Pescara. Tamarisks, oleanders, and pines often occur along a narrow strip behind the beach, whilst there is *macchia* on the limestone headland of M. Conero.

### *Population*

The population of this region is predominantly agricultural, though there are some local industries such as the manufacture of cement, bricks, and tiles. Since the coastal strip is narrow, the chief centres of population tend to be inland on the more fertile hill-slopes where there are numerous walled towns, villages, and farms linked together by winding hill roads. The population of this region is one of the most scattered in Italy, and isolated farms are numerous.

Between Torre Mileto and Vasto the coastal population is sparse, the only village of any size being Campomarino, near the mouth of the F. Biferno. The towns on the hills are rare, and small. From Ortona\* to Ancona\* there is a line of towns on the hill crests 2 or 3 miles inland, some of which have their fishing-haven or outports at the mouths of the numerous rivers. These outports have the same name as their parent town preceded by 'porto di' or 'marina' and are at once sea-side and fishing-havens. Between Ancona and Rimini the coastal settlements, which are considerable bathing resorts, are larger and more numerous than the inland towns.



*Ports*

Except for Ortona\* and Ancona\*, the harbours along this coast provide little shelter and are only suitable for small craft. Some of the larger rivers are navigable by fishing-craft, for a short distance, and at certain times of the year.

The most important havens are: S. Vito Chietino, Pescara, Giulianova, S. Benedetto del Tronto, Porto Civitanova, Numana, Porto Senigallia, Porto Fano, Pesaro, Porti di Cattolica, and Rimini.

## THE NORTHERN PLAIN: RIMINI-SBOCCO DEL TIMAVO

This coast, over 250 miles long, is sandy throughout, and backed by the flat Northern Plain which is fringed by a series of lagoons and deltas, except from Rimini to north of Ravenna. The largest delta is that of the river Po, which flows across the middle of the plain and is its longest river. Other important rivers watering the plain include the F. Adige, F. Piave, F. Tagliamento, and F. Isonzo, which, being Alpine rivers (p. 50), are in flood in summer. The Apennines limit the plain in the south and the Alps in the north. The lagoon-delta zone (p. 34) forms a rather deserted area lying either just above sea-level or even well below it. A sandbar or strip, often dune-crowned, cuts off the sea from some of the lagoons, which are called *lagune* or *valli*. The open lagoons (*laguna viva*, p. 264) are affected by tides (c. 3 ft. at Venice), the ebb and flow of which keep open the passages (*porti*) connecting with the open sea as well as an intricate series of branching channels (*canali*) within the lagoons. The tidal influence spreads, although with rapidly diminishing force, into the remoter parts of the open lagoons and even into the closed lagoons (*laguna morta*), where the water is, however, only brackish. Between the channels the lagoons are covered with banks of mud (*velme*), dry at low tide and sometimes covered with grass in their higher parts (*barene*). The lagoons are separated from each other by the deltas which are formed by the large rivers.

The greater part of this coast is fringed by off-shore banks which increase in size at the river mouths. These banks often make approach to the shore difficult even for fishing-boats.

*Rimini to Sbocco del Timavo (Figs. 27, 28, 29, 30)*

The coast from Rimini to Foce del Reno sweeps northwards and is bordered by a sandy, gently sloping beach never less than 20-30 yards



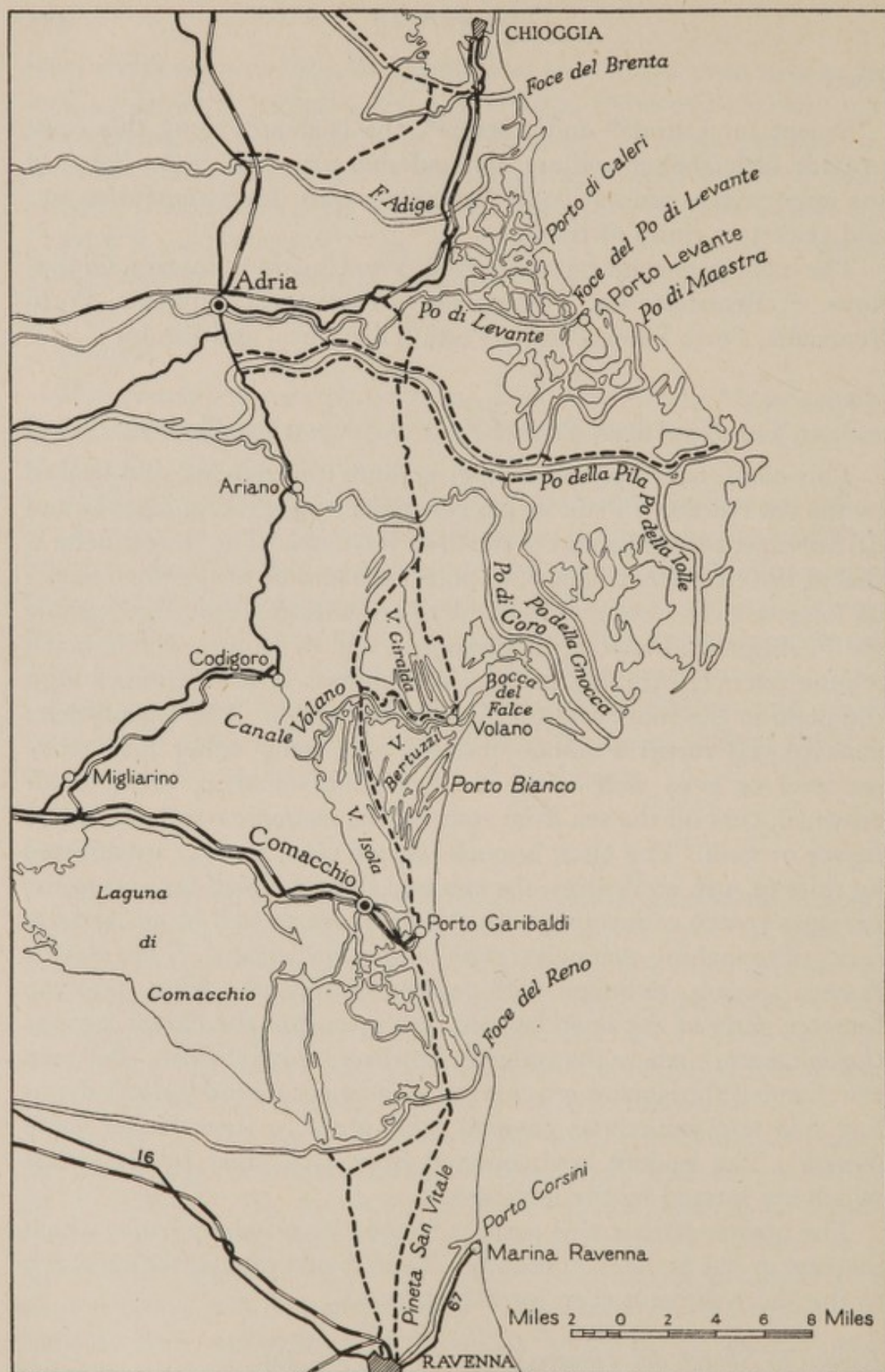


FIG. 28. *The coast: Ravenna to Chioggia*  
(For Key see p. 54)



wide. The beach is in places bounded by pine-clad dunes 10–20 feet high, and elsewhere, especially near Cesenatico and Cervia, merges into the plain behind it. A series of sea-side resorts of varying size line the beach closely between Rimini and Cervia, and the houses are sometimes built on levelled dunes. From Rimini the Apennines retreat inland and give way to the southern part of the Po plain. This is very flat and fertile, especially south of Cervia, being intersected by numerous short, meandering rivers and irrigation channels and chequered by small fields. North of Cervia the plain becomes more wooded, has more artificial drainage, and is fairly desolate and sparsely populated except for Ravenna and its port and marina.

The coast from Foce del Reno to Bocca del Falce is limited by a bar, which separates the sea from a series of lagoons. The bar, which generally consists of a beach, a flat ridge of low dunes, a string of small pools, and then a strip of cultivation, is about  $1\frac{1}{4}$ –2 miles wide as far as Bocca del Bianco and narrows northwards to about 200 yards. The Laguna di Comacchio lies behind this bar between Foce del Reno and Porto Garibaldi, a distance of about 6 miles: the Valle Isola, Valle Bertuzzi, and Valle Giralda extend between Porto Garibaldi and Volano. Some parts of the Laguna di Comacchio, which has an area of about 150 square miles and an average depth of  $1\frac{1}{2}$  feet, are being drained and reclaimed, especially in the south. The numerous sandy spits projecting into this lagoon are either remains of old dunes, which mark the position of former coastlines, or part of the reclamation scheme. The sand-bar north of Laguna di Comacchio fans out landwards in a number of tongues of sand and dunes, one of which joins the mainland and separates Valle Isola from Valle Bertuzzi. Two narrow sand-spits enclose the Canale Volano (Po di Volano) as it meanders between the Valle Bertuzzi and Valle Giralda to the sea at Volano. These two valli, like the other lagoons, are crossed by numerous sandy spits and islands. Bocca del Bianco is the natural outlet of Valle Bertuzzi and Bocca del Falce of Valle Giralda.

The modern delta of the Po extends between Bocca del Falce and Foce di Po di Levante. This delta is extremely complex because the river has flowed into the sea along many courses, some of which are followed to-day by parts of the river. Islands and bars, subject to constant change, are still being built up at the river mouths, especially at the mouth of the Po della Pila, which is now the main exit. The delta, which is usually marshy, is composed of very low, and generally flat areas of fine alluvium, though beaches and dunes of coarser material are found along the coast. Sediment transported by these



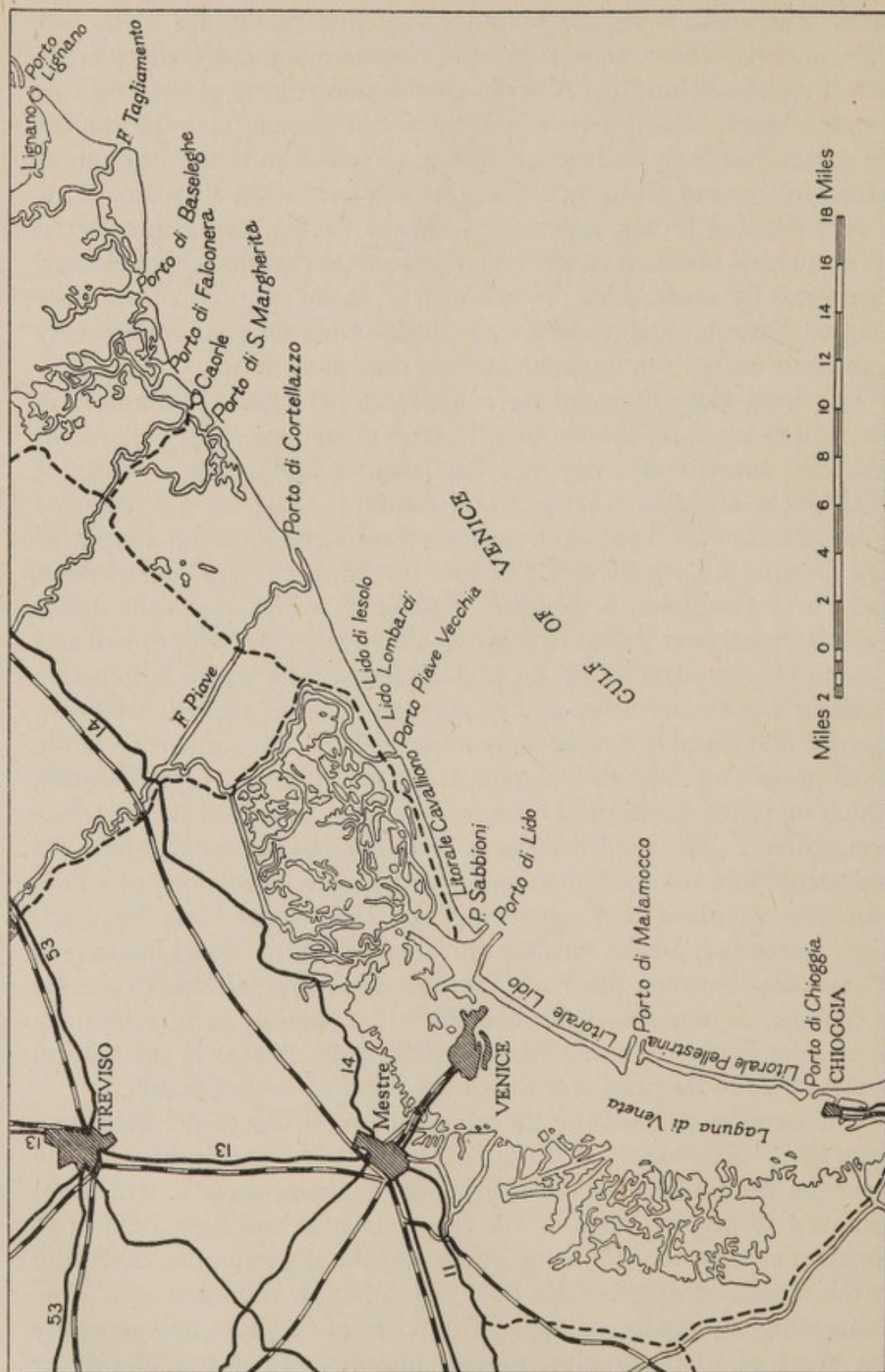


FIG. 29. The coast: Chioggia to the F. Tagliamento. (For Key see p. 54)



ivers has formed marine banks and has silted the Adriatic coast as far south as the Gargano peninsula. The principal mouths in the delta are, from south to north, Po di Goro, Po della Gnocca, Po delle Tolle, Po della Pila, Po di Maestra, and Po di Levante. The rivers are canalized and embanked in such a way that they frequently flow above the level of the plain and of the delta.

Between the mouths of the Po di Levante and of the F. Adige there are a series of small, irregularly shaped lagoons or *valli* fronted by a sand-bar. The bar, which is often dune-crowned, is broken by the mouth of a small canal a short distance north of Foce del Po di Levante, and by Porto di Caleri.

North of the F. Adige, the Laguna Veneta, which is bounded seaward by a discontinuous line of bars or islands separated from each other by exit channels or *porti*, extends from Foce del Brenta to Lido di Iesolo. The lagoon has three main entrances (Porto di Chioggia, Porto di Malamocco, and Porto di Lido) through the islands. The most important islands are the Litorale di Pellestrina, which is embanked seawards, the sandy Litorale di Lido (Plate 32), which is  $7\frac{1}{2}$  miles long, 900 yards wide, and well populated in the north, and another between Point Sabbioni and Cortellazzo. The last, which is made up of the Litorale del Cavallion, Lido di Lombardi, and Lido di Iesolo, is only cut by the canal of the Piave Vecchia. The whole of this bar consists of a wide, sandy beach sloping gently from the sea to grassy dunes, and lined in places by a series of bathing-huts. The Laguna Veneta, the largest along the Adriatic coast, is about 35 miles long and is dotted with a multitude of small, often grassy, islands which become more numerous near the mainland where they sometimes join together and form swampy peninsulas. Attempts have been made to reclaim the swampy areas near the mainland. Venice (Venezia) stands on a large number of small islands near the middle of the lagoon and is connected with the mainland by causeways for road and railway.

From Porto di Cortellazzo, at the mouth of the F. Piave, to Porto di Baseleghe the coast continues low, sandy, and dune-crowned, and interrupted by the mouths of several rivers. Clusters of small lagoons lie inland, the largest being north of Porto di Baseleghe. The marshy and partly pine-clad delta of the F. Tagliamento extends between Porto di Baseleghe and Porto Lignano. Thence to Bocca di Primero the sea merges into the interconnecting Laguna di Marano and Laguna di Grado, both of which are open lagoons and are fronted by a series of low, sandy spits. Those fronting Laguna di Marano,



which contains comparatively few islands, are longer and form a more continuous line than those fronting Laguna di Grado. In the latter, islands are more numerous, especially near the mainland. The small port and bathing resort of Grado is on one of the larger islands

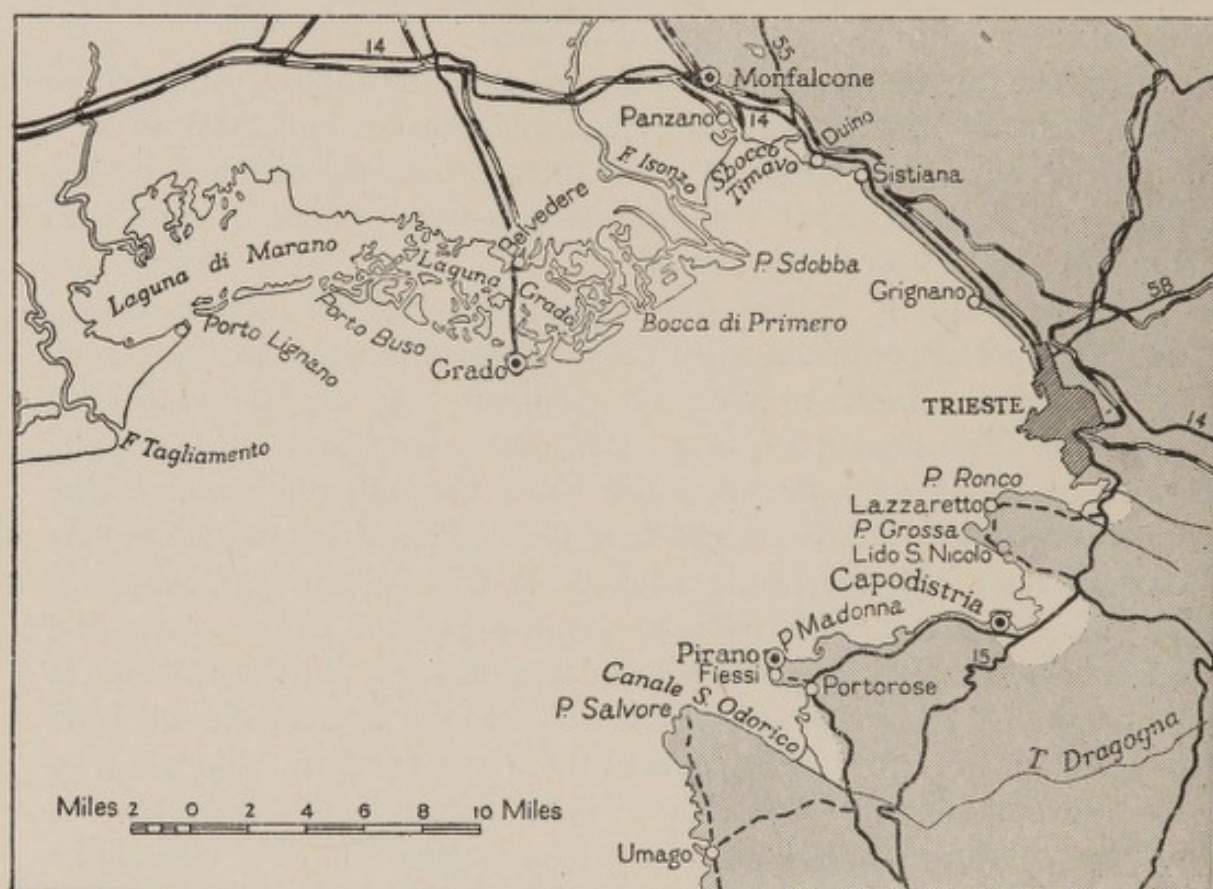


FIG. 30. *The coast: the F. Tagliamento to Point Salvore*  
(For Key see p. 54)

forming part of the bar of Laguna di Grado. About  $1\frac{1}{2}$  miles north-east of Bocca di Primero the narrow delta of the F. Isonzo projects into the sea for a mile. This river has two main mouths, the more prominent of which terminates in Point Sdobba. The bay of Panzano curves between Point Sdobba and Duino (about half a mile east of Sbocco del Timavo). Its coast is low and sandy, and bordered by a shoal off shore between Point Sdobba and the mouth of the F. Timavo, which flows into the sea through an extensive shifting bank. At the head of the bay on the shores of the Panzano lagoon are the naval shipbuilding yards of Porti Rosega and Panzano, which adjoin inland the manufacturing town of Monfalcone.



*Communications*

The main Brindisi-Padua-Trieste road (16, 11, 14) keeps fairly close to the coast between Rimini and Ravenna and then runs about 30 miles inland between Ravenna and Padua, and 10 miles inland between Padua and Monfalcone. A first-class road between Migliarino and Padua runs parallel to the coast more than 10 miles inland. Although no major road skirts the coast between Ravenna and Chioggia, a series of indifferent roads follow the sandbars limiting the lagoons and valli, and run behind the Po delta.

Except for Rimini (9, 72) and Ravenna (67) the great route centres in the east of the plain are mostly along the Brindisi-Trieste road and farther inland. Between Rimini and Ravenna a fairly dense network of narrow roads and lanes covers the coastal fringe of the plain; the region east of the Laguna Veneta has a more open network. Most of the outports have at least poor road connexion with the main roads.

The main Rimini-Ferrara-Trieste railway (double track between Ferrara and Trieste) follows a similar route to the main road.

Railways join the main line from Porto Garibaldi, Chioggia, Venice, and Belvedere (north of Grado on the mainland). At Rimini and Ravenna main lines lead inland across the Northern plain.

*Vegetation*

Though the landward edges of the lagoons are being reclaimed, much of the coast still consists of swamp dotted with islands covered with rough grass.

On the fertile plain inland between Rimini and Cervia cultivation is intensive. There are numerous small fields of vines, mulberries and other fruit trees, and tomatoes, and larger fields of cereals, chiefly for fodder, and sugar-beet, whilst the sea-side resorts of the region are often surrounded with shady parks and gardens. The area near the delta of the Po usually consists of meadow land, with large patches of reed-grass and tall sedges, birch, and willows near the sea. All this country is intersected with canals and rivers, often bounded by rows of poplars, aspens, or mulberries with vines trained up them. The meadow land and grassland present a general appearance of greenness, which, because the country is well watered, is frequently maintained even in summer. Cereals alternating with meadow grass are cultivated on the fertile alluvium and around the lagoons, the landward edges of which are often lined by oak trees. Rice is grown in the most marshy regions near the lagoons of Comacchio and



Venice. The region east of Venice is less intensively cultivated, being frequently put down to grass and vegetables. Considerable remains of the famous pine forest of Ravenna extend about 2 miles inland between Cervia and Foce del Reno, and reappear again for a short distance north of Volano. There are other pinewoods near Rimini and east of Venice, especially on the delta of the F. Tagliamento.

### *Population*

Most settlements near the coast of the plain are agricultural, since agriculture forms the basis of the economy of the region. There is, however, seasonal fishing in the valli, and this has given rise to some coastal villages.

Between Rimini and Cervia a string of small sea-side resorts lines the coast, which north of Cervia is more desolate with the exception of Ravenna (about  $3\frac{1}{2}$  miles inland) and its marina and port. Along the rest of the coast the few existing coastal settlements are outports at the mouths of rivers or artificial passages leading to the lagoons and are usually small fishing-villages. Many of these have recently been depopulated and reduced to small hamlets. The coastal towns on the Laguna Veneta are larger, and include Chioggia and the city of Venice (Venezia) with its island suburbs and the famous Lido, or Litorale di Lido. Farther east, the sea-side resort and small port of Grado is the largest coastal settlement, though there are also small bathing resorts.

A line of small agricultural towns generally occurs about 6 miles from the coast, whilst another of larger and more important towns such as Ferrara, Rovigo, Padua, and Treviso, is 20–30 miles inland. Numerous scattered farms and hamlets are found chiefly at river crossings around Ravenna, while villages form clusters north of the Marano and Grado lagoons.

The harbours along most of this coast, except Venice, are not very good, generally being subject to silting and suitable only for vessels of light draught and the fishing-craft used in the valli.

### *Ports*

The larger ports in the region are Porto Cosini, the port of Ravenna\*, Porto di Chioggia\*, Venice with Porto di Lido\*, Grado, and Porti Rosega and Panzano, the harbours of Monfalcone. The principal small harbours are Bellaria, Porto Cesenatico, Cervia, Porto Garibaldi, Porto Bianco, Porto Volano, Porto Levante, Porto di Malamocco, Porto di Piave Vecchia, Porto di Cortellazzo, Porto di S. Margherita,



Caorle, Porto di Falconera, Porto di Baseleghe, Porto Lignano, and Porto Buso.

#### ISTRIA; SBOCCO DEL TIMAVO TO FIUME

The large triangular promontory of Istria, which consists mainly of limestone plateaux, juts out at the head of the Adriatic between the gulf of Venice and the Quarnero (Carnaro) channel. Its coast is peculiar since it has been deeply submerged; hence it is very indented and steep, and the sea is deep and often studded with islands, rocks and shoals. The coast of the gulf of Trieste curving between Sbocco del Timavo and Point Salvore has a length of 60 miles. At Point Salvore the coast trends southwards for about 125 miles to Cape Promontore and then turns abruptly northwards for 110 miles to the head of the gulf of Fiume, so forming a triangle with its apex in Cape Promontore.

#### *Sbocco del Timavo to Point Salvore (Figs. 30, 31)*

The coast from Sbocco del Timavo to Trieste trends south-south-east and is generally very steep and almost inaccessible. Rugged white limestone hills rise almost sheer from the sea to 650-1,200 feet and then more gradually to greater heights farther inland. The only major irregularities are the small bay at Sistiana with a beach at its head, and a small, flat, wooded promontory with low shores at Grignano.

Between Trieste and Point Salvore the general trend of the coast is west-south-west and it is cut into three similar, sheltered bays, Baia di Muggia, Baia di Capodistria, and Baia di Pirano, all of which are edged by shallow banks off shore. The land backing the three bays is made up of rugged sandstone hills about 900-1,400 feet high, which are eroded into countless steep-sided valleys by numerous short streams. The Baia di Muggia, which forms part of the port of Trieste, has level and cultivated beach-fringed patches at its head near the mouths of the T. Reka and T. Rosandra. A fertile wooded promontory (alt. 646 ft.), terminating in three headlands (Point Ronco Point Sottile, and Point Grossa) and having rugged shores, separates Baia di Muggia from Baia di Capodistria, which lies between Point Grossa and Point Madonna. The latter bay has a short beach on its north shore between the two moles of Lido S. Nicolo. The land at its head, notably at the mouth of the T. Risano and south of the town of Capodistria, is flat, beach-fringed, and intersected by canals and



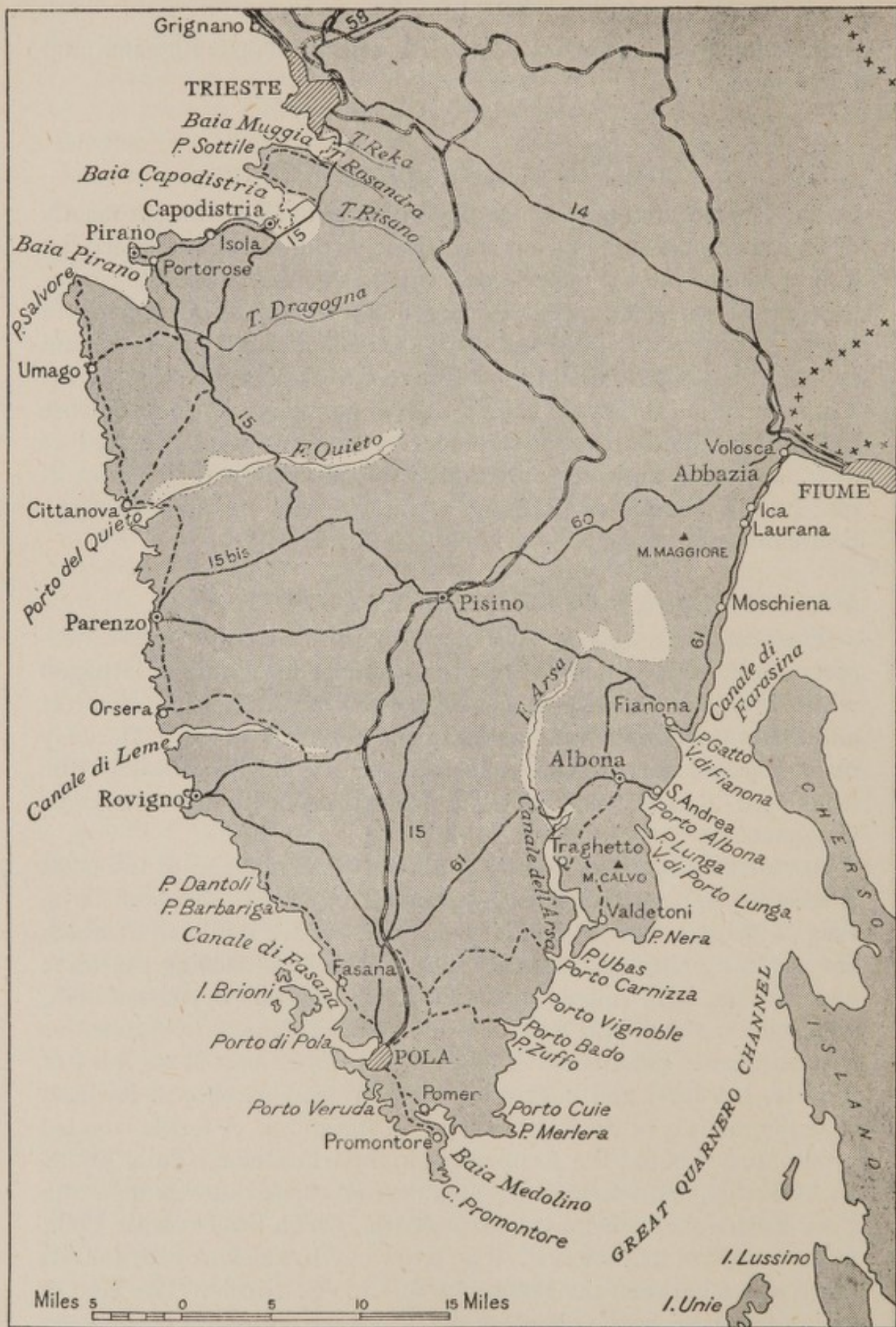


FIG. 31. The coast: Istria  
(For Key see p. 54)



by many salt-pans. The south shore, extending west from the Capodistria headland, is rugged except at the mouths of rivers and streams, and is backed by low, rounded hills. The town of Isola d'Istria stands on a small, flat, and partly beach-fringed peninsula projecting from this coast, and Pirano, which has a rocky bathing beach, is on the Point Madonna headland. The Baia di Pirano affords one of the best anchorages on the coast of Istria for sailing-vessels, and extends between Point Madonna and the wedge-shaped Point Salvore promontory. The fishing-port and sea-side resort of Portorose lines the north shore of the bay and is fronted by a sandy beach, with low, fertile, rounded hills rising inland. A flat, partially beach-fringed plain about 3 miles wide, mainly occupied by salt-pans, extends inland at the head of the bay between the mouths of the T. Dragogna and Canale S. Odorico. The south-west shore consists of low fertile hills.

*Communications.* Road 14 between Duino and Trieste closely follows the coast usually more than 100 feet above it, with the main Venice-Trieste railway farther up the hill-side. South of Trieste, road 15 reaches the coast only at the head of the Muggia and Capodistria bays, whilst a poor road skirts the shores of the Point Ronco promontory; a first-class road runs close to, though often above, the coast between Capodistria and Portorose, only going inland to avoid Point Madonna headland. A second-class road follows the coast between Pirano and Portorose. Roads go inland from Trieste to Fiume and Yugoslavia, and from the head of the Baia di Capodistria and from Portorose to the main road system of the peninsula.

*Point Salvore to Cape Promontore (Fig. 31)*

The coast between Point Salvore and Cape Promontore is cut into many small inlets of which Porto del Quietto, Canale di Leme, and Porto di Pola are the most notable. The incursion of the sea into the limestone hills has formed numerous small, semicircular inlets, which are backed by dry valleys and separated from each other by short, pointed promontories frequently edged by low cliffs. No coastal plain exists along the shore, and the coast is generally rugged and rocky, or fronted by low cliffs above which a low plateau slopes gently inland. The inlets, however, sometimes have small beaches at their heads, the most notable being at Umago, Cittanova, and Parenzo. Between Umago and Parenzo and between Point Barbariga and Pola the hills slope gently and evenly from cliffs or rocks about 10-30 feet high, whilst along the rest of this coast the cliffs are



somewhat higher (30-70 ft.), though the rise above them is equally gradual.

Porto Quieto, Canale di Leme, and Porto di Pola, the largest of the inlets, are all different in shape and in character. Porto Quieto and Canale di Leme are submerged valleys and each of them is continued inland by a flat-bottomed canyon. Porto Quieto is about  $1\frac{1}{4}$  miles long with a similar breadth; its coast slopes fairly gradually inland except at its head, where there is a small, level, beach-fringed patch across which the F. Quieto flows through marsh and salt-pans. The Canale di Leme,  $7\frac{1}{2}$  miles long and half a mile wide, winds between flat-topped, white limestone hills, mottled with bush and scrub, which rise steeply on either side to heights of over 500 feet on the south and over 300 feet on the north. Porto di Pola, which forms Pola harbour, is a crescent-shaped bay 4 miles long and up to 1 mile wide.

Along this coast Point Salvore and Cape Promontore are the most outstanding of the numerous headlands. The low and wedge-shaped Point Salvore, which is cut into three short headlands with small bays between, forms the north-west extremity of the Istrian peninsula. Cape Promontore, a long, narrow, serrated headland, extends in a southerly direction and constitutes the southernmost point of the Istria. The whole coast is fringed by small, steep islands, rocks, and shoals. These become particularly numerous south of Parenzo, and sometimes extend for 2 miles off shore. The largest group are the Brioni islands, which are separated from the mainland by Canale di Fasana. The islands are mostly uninhabited and macchia-covered, the smaller being bare and rounded. The Brioni group off Pola are, however, luxuriantly wooded with palms, bamboos, agaves, magnolias, oranges, laurels, and pine trees and are popular seaside resorts. The sea bordering the coast and the islands is usually deep.

*Communications.* The main roads of the Istrian peninsula are inland, and no major road or railway follows this coast closely or continuously. A series of lanes and secondary roads usually runs near the coast, cutting across the necks of headlands sometimes a few miles inland and passing through all the larger coastal towns. No coastal road exists between Orsera and Point Dantoli. Between Rovigno and Pola a first-class road runs 3-5 miles inland; south of Pola, where the coast is more indented, interconnecting roads are few. The coastal roads usually have connexion with the road system of the peninsula. The most important connecting roads go inland from Umago, Cittanova, Parenzo, Rovigno, and Pola, which is linked with Trieste by railway.



*Cape Promontore to Fiume (Fig. 31)*

The Great Quarnero (Carnaro) channel is formed by the east coast of Istria and by the limestone islands of Cherso, Lussino, Unie, and Sansego. This channel communicates at its northern end through the narrow Canale della Farasina with the gulf of Fiume. The currents are rapid in the narrowest parts of the Great Quarnero, where the *bora* wind (p. 414) is often very violent and dangerous.

Between Cape Promontore and Point Nera the eastern coast of Istria is similar to the western, but the land behind it is generally higher, the wooded hills less rounded, and the inlets longer. The Baia di Medolino, one of the largest inlets, extends north-east of Cape Promontore, the termination of a long, narrow peninsula. The bay has very irregular, though low and gently sloping shores, and is studded with numerous small islands. The largest inlets between this bay and Canale dell' Arsa are about  $\frac{1}{2}$ –1 mile long and include Porto Cuie, Porto Bado, Porto Vignoble, and Porto Carnizza. These usually have several small branches with tiny beaches at their heads, whilst the rest of the coast is generally edged with low cliffs. Inland the limestone hills rise immediately to about 200 feet between Point Merlera and Point Zuffo, and to about 500 feet north of Point Zuffo; Canale dell' Arsa, another submerged valley, extending in a northerly direction for about  $7\frac{1}{2}$  miles, is bounded on the west by steep hills about 800 feet high, and on the east by the mountainous M. Calvo (1,765 ft.) peninsula. A hilly and wooded projection of this ends in Point Ubas and protects the inlet from the sea. At the head of the inlet there is a small level beach-fringed patch of marshland at the junction of two flat-bottomed canyons, separated farther north by a hill-spur; F. Arsa (30 miles long), the longest river along this coast, flows in the western valley, and Lake Carpano, fed by a mountain stream, lies in the eastern.

The coast between Point Nera and Point Gatto (Pax Tecum) is precipitous, rising immediately to hills of between 1,000 and 1,650 feet, and is cut by three steep-sided inlets, Valle di Porto Lunga (Longa), Porto Albona, and Vallone di Fianona, all of which extend inland in a north-north-westerly direction, and are about 1 mile long. Porto Albona, which affords the best shelter of these inlets, has small beaches at both of its heads.

Between Point Gatto and Volosca a limestone mountain wall, about 2,000–3,000 feet high, culminating in M. Maggiore (4,580 ft.), usually rises directly from the sea and is interrupted by only a few



minor indentations. Between Laurana and Abbazia, where the slope is not so sheer, there is a line of sea-side resorts and villas along the rocky coast, which is about 15-30 feet high (Plate 33). Beyond Volosca the coast, still backed by wooded mountains, trends east-south-east to the town and port of Fiume\*, where there is a short beach.

*Communications.* The coast between Cape Promontore and Point Gatto is not served by any continuous road. Poor roads lead inland from Promontore and Pomer, both on the Baia di Medolino, and from Porto Bado, Porto Carnizza, Traghetto, and Valdetoni on other inlets. A first-class road leads inland from S. Andrea di Albona on Porto Albona. All these tracks and roads are indirectly connected with the road from Pola to Abbazia (61). Between Point Gatto and Moschiena this road runs along the mountain-side generally over 1,000 feet above the sea, gradually descends almost to the water's edge near Laurana, and continues generally close to the coast as it rounds the head of the gulf of Fiume. Main roads go inland to the route system of the peninsula from north of Abbazia and into Yugoslavia from Fiume.

The east coast of Istria is not served by any railway, except at the head of the gulf of Fiume where the Trieste-Fiume railway runs not far from the coast.

### *Vegetation*

South of Duino the limestone hills are covered with dark patches of *macchia*, or pine-trees and other conifers; immediately north of Trieste the lower slopes are often terraced for vines, which are also intensively cultivated along the south side of the gulf of Trieste. The shores of the bays to the south-west of Trieste are fertile and extensively cultivated. Vines, almonds, and olive trees mixed with dark cypresses grow up the hill-slopes, which are sometimes terraced, whilst gardens fragrant with jasmine, damask roses, and wistaria line the coast.

Vines, one of the chief crops of Istria, are grown together with olives along the west coast as far south as the Canale di Leme. Their cultivation is particularly intensive round the towns, where there are also arable fields. Large tracts of *macchia* interrupt the cultivation in the less populated areas near the coast but give way to arable land or forest farther inland. South of Canale di Leme pinewoods and *macchia* tend to predominate, and cultivation is confined to small areas round the towns.



The limestone hills of the east coast between Cape Promontore and Point Lunga are generally overgrown with thick dark *macchia*, whilst the sandstone hills round Porto Albona have patches of arable land. The lower slopes of the coastal hills north of Point Andrea are covered with rough grazing land, forests of beech, chestnuts, and oaks, and thick *macchia*, which here is often made up of laurels and stunted oaks. Near the health resorts at the head of the gulf of Fiume there is more cultivation, whilst many of the villas have attractive gardens of palms, cypresses, and fruit trees.

### *Population*

The steep coast between Duino and Trieste is thinly populated, but numerous villas, farms, and towns line the coast south of Trieste. Most of the towns have a close historical connexion with Venice, whose seafaring tradition they have inherited, and have to-day flourishing fishing industries.

The west coast is generally well populated, except south of Rovigno where Fasana and Pola are the only large settlements. A series of compact fishing-villages and small towns line the shore intermittently, whilst numerous small villages and towns are scattered on the hills farther inland. The most important coastal towns include Umago, Cittanova, Rovigno—which exports bauxite and tobacco, has a large fishing-fleet, and contains the Italo-German Institute of Marine Biology—and Pola.

The east coast is sparsely populated, except at the head of the gulf of Fiume. Between Cape Promontore and Point Gatto there are several small villages on the hills above the sea, the most important of which are all near the Baia di Medolino, but Fianona is the only coastal village of any size. North of Point Gatto houses and villages follow the coastal road (1,000 ft. above the sea), and from near Moschiena to Fiume the coast is lined by a series of villas and sea-side and health resorts, the most important of which are Laurana, Abbazia, and Volosca.

### *Ports*

North of Trieste\* there are no safe anchorages or harbours. The three bays south of Trieste, though unprotected from the bora (p. 414), have good anchorages and small harbours or landing-places at Lazzaretto, Lido S. Nicolò, Capodistria, Isola d'Istria, Porto Pirano, Portorose, and Fiessi.

There are good anchorages along the south coast of Point Salvore; their security, however, varies considerably with the direction of the



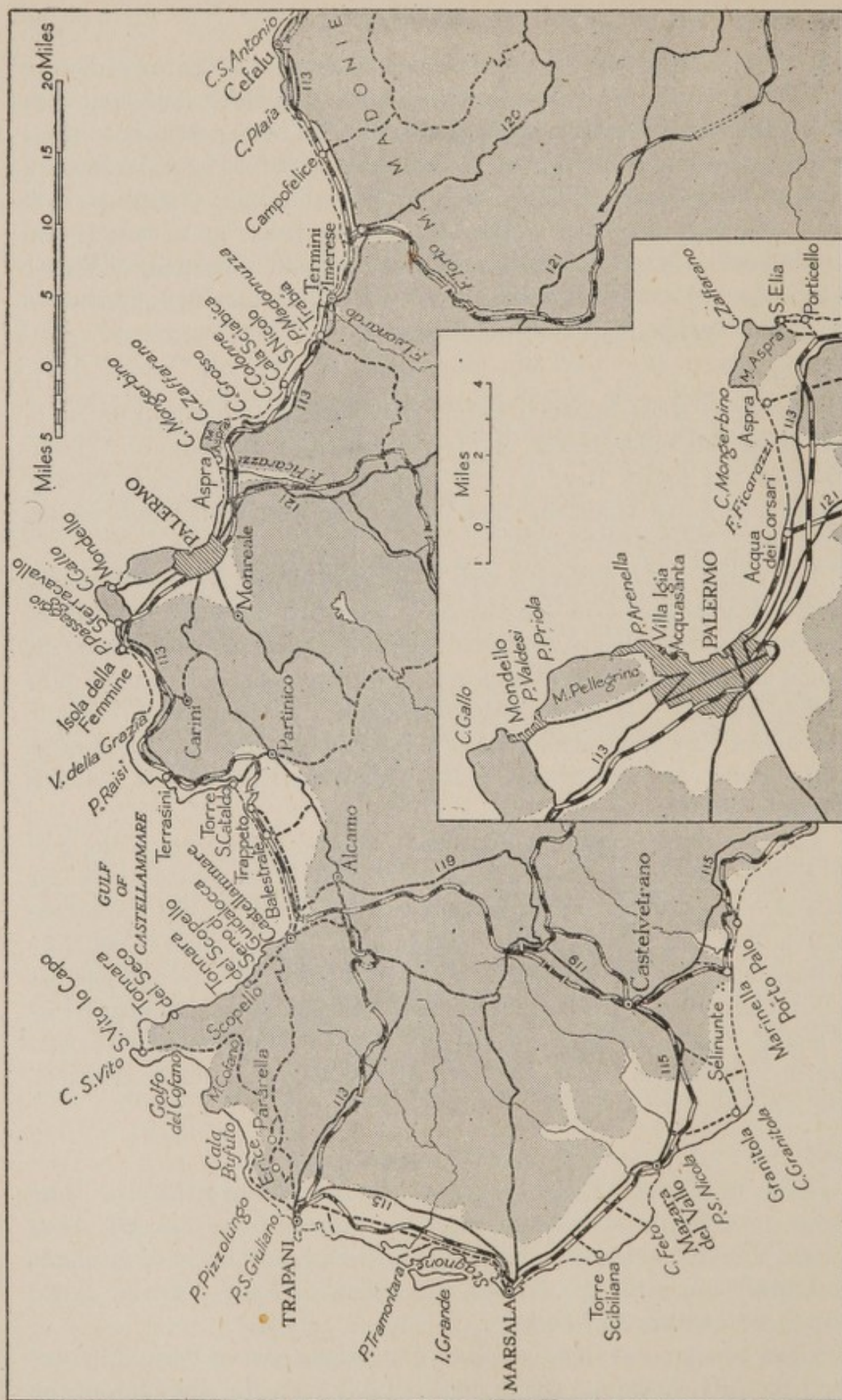


FIG. 32. The coast: western and north-western Sicily. (For Key see p. 54)



wind. Almost every coastal village has its own little harbour or landing-place. Most of these ports have daily steamship connexion with each other and with Trieste and Fiume. The most important are: Porto di Umago, Porto di Cittanova d'Istria, Porto Parenzo which affords the best shelter on the Istrian coast for vessels drawing not more than 15 feet, Porto di Orsera, Porto Rovigno, Fasana, Pola,\* and Porto Veruda.

Between Cape Promontore and Point Gatto (Pax Tecum) the best shelter for small and moderate-sized vessels is found in the coastal inlets and deep bays, such as Baia di Medolino, Porto Cuie, Canale dell' Arsa, Porto Albona, and Vallone di Fianona. No small harbours and few safe anchorages exist between Point Gatto and Laurana. Between the small harbour of Laurana and Fiume\* there are only a few shallow creeks and small harbours at Ica, Abbazia, Porto Preluca, and Volosca.

## SICILY

### THE WEST COAST; CAPE S. VITO TO CAPE GRANITOLA

THE west coast of Sicily extends between Cape S. Vito and Cape Granitola, a distance of only about 70 miles. Cape S. Vito is almost due north of Cape Granitola, but the coast trends south-west from Cape S. Vito to Trapani, then south-south-west to Marsala, and finally south-east to Cape Granitola. To the north of Trapani rugged limestone mountains closely approach the coast, but to the south a narrow coastal plain rises gradually inland to low plateaux.

#### *Cape S. Vito to Cape Granitola (Fig. 32)*

The coast between Cape S. Vito and Point Pizzolungo consists of two bays, the Golfo del Cofano (Vermia bay) and the bay of Cala Bufuto, which are separated from each other by the rugged and steep limestone mass of M. Cofano (alt. 2,162 ft.). The shores of these bays are mostly rough, steep, and fringed by off-lying rocks. Hills, which are predominantly limestone and often as high as 2,000 feet, rise steeply inland except at the heads of the bays, where there are narrow level strips of land and a few small beaches. The shore between Point Pizzolungo and the port of Trapani is mostly low and either rocky or sandy with a narrow belt of dunes, but is only approachable with safety for a mile on either side of the flat, rocky



Point S. Giuliano, which is immediately north of Trapani. Few streams flow to this coast.

From Trapani to Marsala the coast is low, being either rocky or sandy, and faced by extensive areas of shallow water and fringing rocks, and is nowhere easily accessible. Salt-pans line the greater part of the coast between Trapani and Point Tramontana, beyond which lies Isola Grande (or Isola dello Stagnone). For  $3\frac{3}{4}$  miles this island parallels the mainland and almost encloses Stagnone, an extensive area of shallow water interspersed with islets and numerous rocks. The west coast of the island, which contains numerous salt-pans, is fringed with shoal. The mainland between Trapani and Marsala consists of a broad, well-cultivated coastal plain rising gradually inland. The seaward margins of the plain are lined with intermittent salt-pans, mounds of dazzling white salt, and windmills for grinding it (Plate 34).

The coast is low, sometimes sandy and fringed with rocks from the port of Marsala to Mazara del Vallo, beyond which it rises slightly to the low headland of Cape Granitola. There are three accessible beaches: (1) about a mile long south of Marsala, and of fine sand; (2) about a mile long north of Torre Scibiliana, and (3) about  $2\frac{1}{2}$  miles long, including minor interruptions, between Cape Feto and Mazara del Vallo. The fertile country inland is either flat or gently rolling and tends to be marshy near the coast.

### *Communications*

No major road follows the coast closely between Cape S. Vito and Trapani. A second-class road from S. Vito lo Capo to Trapani skirts the shore of the Golfo del Cofano for a short distance, and then turns inland through mountainous country to Trapani. At Paparella a poor alternative road to Trapani branches off this route to follow the shore at the foot of M. Erice to Trapani. From Trapani to Point S. Nicola, south-east of Mazara del Vallo, the main Trapani-Syracuse road (115) runs 2-6 miles inland. More accessible from the sea than the main road is the main coastal railway on its embankment. This is followed closely by a poor motorable road which is linked with the coast by several lanes. The main road and railway between Marsala and Point S. Nicola are fairly accessible from the coast with which the road is connected by several lanes, including two leading inland from the beaches near Torre Scibiliana and Cape Feto. South of Mazara a poor track to the village of Granitola branches from the main road at Point S. Nicola.



Numerous good roads radiate inland to join the main road system of the islands from Trapani, Marsala, and Mazara.

### *Vegetation*

The region north of Trapani has little vegetation and is rarely cultivated, although there are scattered olive groves, almond orchards, and small pinewoods on some of the hill-slopes near Trapani. South of Trapani almost to Marsala the country inland from the salt-pans is fertile and is interspersed with melon plantations, almond orchards, olive groves, and vineyards. One of the great vine-growing areas of Sicily extends from north of Marsala to Mazara del Vallo. The vineyards here produce the grapes from which Marsala wine is made. South of Mazara, vineyards gradually become rarer and give place to olive groves.

### *Population*

The region north of Trapani is very sparsely populated and the few buildings that occur along the coast are connected with tunny fishing. Even towns on the hills are small and rare. The only one of any size is the ancient town of Erice (Eryx) with the ruins of the temple of Venus Erycina, which was famed for its beautiful prostitutes, descendants of the Phoenician worshippers of Astarte. South of the important town and port of Trapani and around Marsala and Mazara, houses and farms, connected by small lanes and tracks, are numerous close to the coast and a short distance inland. Marsala and Mazara are large towns; the chief livelihood of their population is fishing and wine making. Villages on the plateaux behind the coastal plain are few, compared with the numerous hill-towns of the northern and southern coasts.

### *Ports*

The only natural harbours on this coast are at Trapani\* and Marsala\*, both very inferior to those of the north and east coasts. At Mazara del Vallo there is also a small harbour, subject to silting, in the estuary of T. Mazara, the mouth of which is protected by moles. At Scogliera di Tramontana there is a small jetty and at Torre Bonagia a quay.

## THE SOUTH COAST; CAPE GRANITOLA TO CAPE PASSERO

The south coast of Sicily, which extends in a general south-easterly direction for 180 miles, is irregular but has no major indentations or



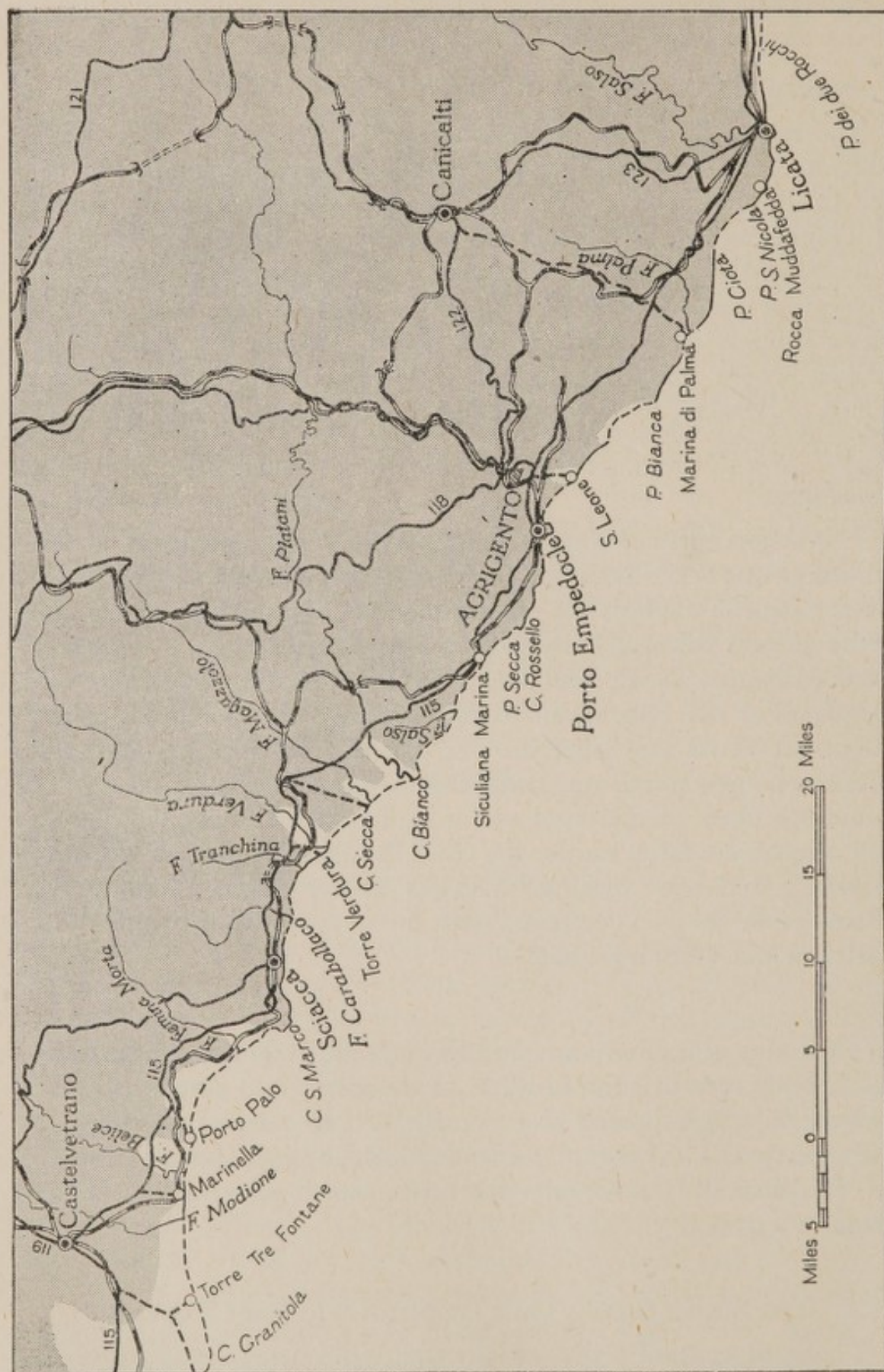


FIG. 33. The coast: Cape Granitola to Licata. (For Key see p. 54)



bays. It is edged with shallows and has no natural harbours or anchorages sheltered from all winds. The slope from the south coast to the mountains of the interior is usually more gentle than from the north coast. This is mainly due to the extensive occurrence along the south coast of terraces rising gradually inland in tiers. The coastland tends to be hot, dusty, and unhealthy. Settlement tends to be repelled so that it is the least densely populated region of the island.

*Cape Granitola to Licata (Figs. 32, 33)*

An outstanding feature of this section of coast is the series of coastal terraces rising inland in tiers to a height of about 300 feet. The first terrace often rises steeply from the shore to a height of about 100 feet, and may form a considerable barrier to movement inland, especially as it is frequently succeeded by another steep slope leading to a further terrace up to 200 feet high. The extent and development of these and higher terraces, and bluffs varies greatly from one locality to another.

A broad open bay, fringed with a sandy beach, extends from Cape Granitola to Cape S. Marco. The beach, however, is interrupted by low cliffs fronted by off-shore rocks at the mouth of the F. Modione, Marinella, Porto Palo (Menfi), the mouth of the F. Femina Morta and for 3 miles east of Cape S. Marco, and is lined with a belt of sand-dunes about a mile wide between Cape Granitola and Marinella. The dunes are being reclaimed and planted with vines. The coast slopes gently inland in wide terrace-like steps to limestone plateaux about 1,000 feet high. The F. Belice is the longest river crossing the beach.

Between Cape S. Marco and the port of Sciacca the coast is fairly steep, though sometimes fronted by small rocky beaches. East of Sciacca the coast is low and rocky as far as the mouth of the F. Carabollaco, where there are three small beaches. Onwards to Torre Verdura the cliffs are only interrupted by a beach half a mile long at the mouth of the F. Tranchina. A sandy beach extends from Torre Verdura to Cape Bianco and is lined with scrub-covered dunes at the mouths of the F. Verdura, F. Magazzalo, and F. Platani. The latter is the longest south coast river and for the most part flows in a gorge, the mouth of which is thickly wooded. The beach, except for the marshland at the mouth of the F. Verdura and the small gently sloping plain immediately north of the mouth of the F. Platani, is backed either by steep cliffs about 70 feet high or by a sharp rise to a broken terrace at about 200 feet. Further steep-sided terraces,



often cultivated with vines and olives, lead inland to bleak, scarped limestone mountains about 3,000 feet high. The seaward approaches to this beach are also difficult.

Beyond the cliffs of Cape Bianco another beach, usually sand or shingle, trends south-eastwards to near Point Secca, and is often fronted by rocks and reefs off shore. The beach is widest immediately east of Cape Bianco, where it is bounded by a wide belt of sand-dunes, and is narrowest and boulder-strewn near Siculiana Marina. Cliffs, 130–260 feet high, succeeded inland by terraces, rise almost directly from the beach, except for the low-lying marshland along the valley of the F. Salso. Beyond the cliffs near Point Secca another rock-fringed beach leads to Cape Rossello and is backed by a steep rise inland. The coast between Cape Rossello and the harbour of Porto Empedocle is high, rocky, and often fringed with off-shore rocks, but there are several small shingle coves and bays, the longest (about  $1\frac{3}{4}$  miles) of which is west of Porto Empedocle and is clear of off-shore dangers. A sandy beach interrupted here and there by cliffs and headlands extends from east of Porto Empedocle to north-west of Point Bianca. This beach is fronted by some off-lying shoals and rocks and is backed in places by the steep rise to the coastal terrace here between 140 and 240 feet high, above which hills slope gradually inland. The small hamlet of S. Leone is near the mouth of one of the numerous torrents, which have built up small deltas along this stretch. The most accessible stretches of beach are near Porto Empedocle and at the torrent mouths where there is often a narrow strip of lowland fronted by vine-covered dunes. The coast in this area is sometimes lined with concrete blocks to prevent marine erosion. Between Point Bianca and Point Ciota the coast is high and inaccessible with the exception of a small beach about three-quarters of a mile long at Marina di Palma. The beach is rock-bound except for 180 yards west of F. Palma. From near Point Ciota to Point S. Nicola (alt. 60 ft.), there extends a narrow beach about  $2\frac{1}{2}$  miles long above which cliffs 30–60 feet high rise to a small vine-clad plain at the foot of high hills. East of Point S. Nicola to Licata the coast is again rocky with the hills coming down close to the sea, except for the sandy vine-clad isthmus which joins Rocca Muddafedda (Mollarella) to the mainland. Between Sciacca and Licata the hills rising above the coastal terraces are intensively worked for sulphur and have a scarred yellow appearance. The surface is unstable and landslips are frequent. Except for the Platani, which is over 30 miles long, the other rivers are usually mountain torrents





PLATE 33. *Laurana*

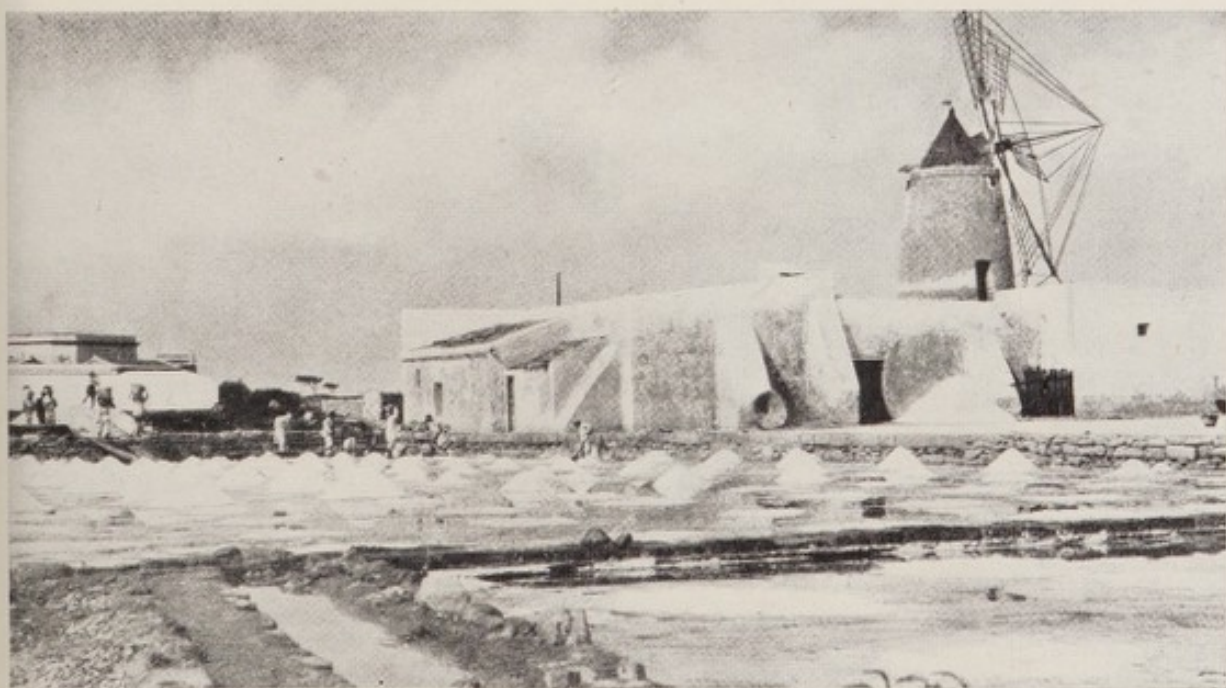


PLATE 34. *Salt-pans near Marsala*



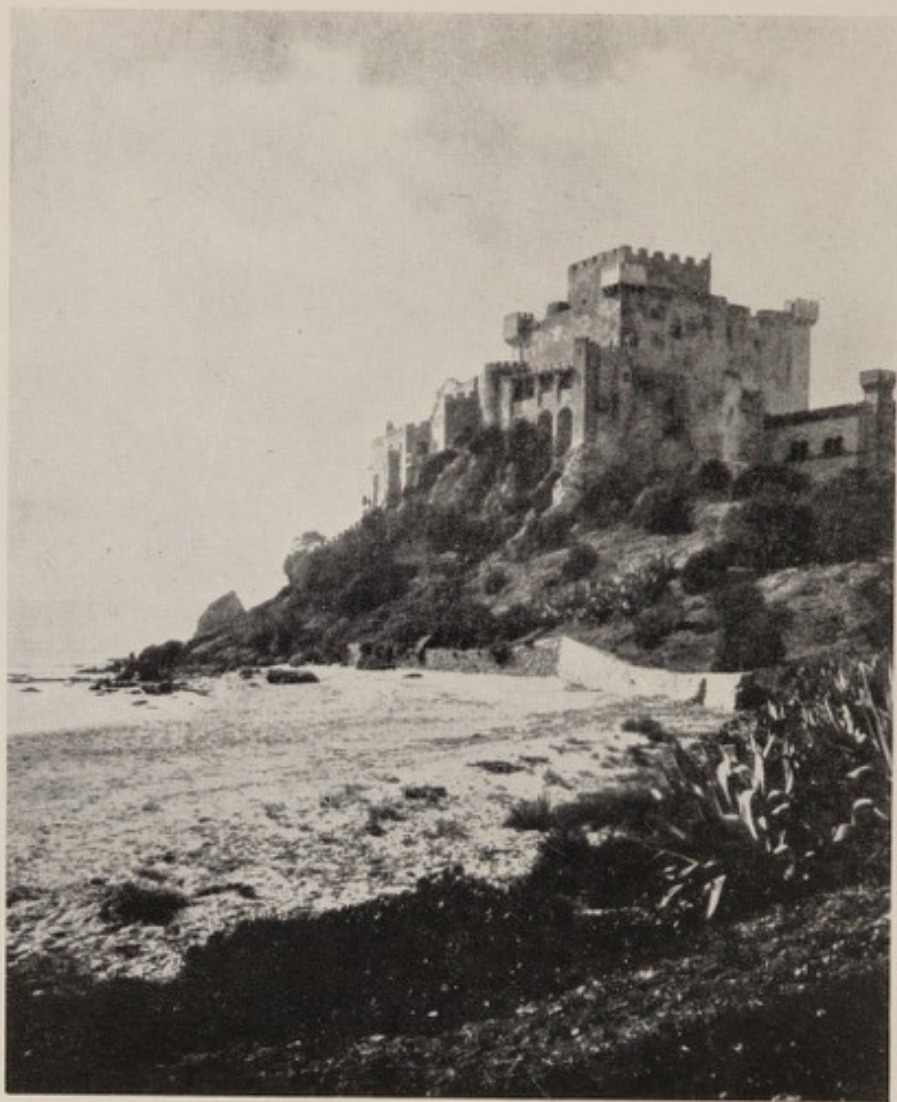


PLATE 35. *Castello di Falconara*



PLATE 36. *Mondello*



and, like most other streams flowing to the south coast, dry up in summer and leave pebbly beds resembling mountain paths.

*Communications.* This section of coast is followed throughout, but often at some distance from the shore, by the main Trapani-Syracuse road (115) and narrow-gauge railways. The steep rise of the coastal terraces effectively prevents easy contact with either the road or railways, except where interrupted by river valleys, or where the routes run close to the shore itself.

The main road for much of its distance is about  $4\frac{1}{2}$  miles inland, but approaches the coast closely on either side of Sciacca, Siculiana Marina, Porto Empedocle, and in the lowland west of Licata. It is connected with the coast by second-class roads and lanes from Torre Tre Fontane, Marinella, Porto Palo, Torre Verdura (track), Cape Secca (track), Siculiana Marina, S. Leone, and Marina di Palma. The coast is linked inland to the main road system of the island by good roads from Sciacca, Porto Empedocle, and Licata.

The normal-gauge railway between Mazara del Vallo and Castelvetro runs from 4 to 8 miles inland between Cape Granitola and Marinella. A narrow-gauge line from Castelvetro reaches the coast at Marinella and keeps close to the shore almost to Porto Palo (Menfi). It then turns inland and rejoins the coast for short stretches near Sciacca, Torre Verdura, and Porto Empedocle. From the latter a normal-gauge railway turns inland to Agrigento. The lowland west of Licata is served by the Agrigento-Licata narrow-gauge railway, which terminates at Licata. The coastal line at Castelvetro is joined to Palermo by both normal- and narrow-gauge lines.

#### *Licata to Cape Passero (Fig. 34)*

From Licata, at the mouth of the wide Salso river, to Cape Scalambri (Scaramia) the coast sweeps to the south-east in a wide curve to form the gulf of Gela, and is for the most part fronted by a beach of yellow sand. Between Licata and Gela the beach is fringed by off-shore rocks at Punta dei due Rocchi, Castello di Falconara (Plate 35), and Cape Soprano. The land backing the section of the beach between Licata and Punta dei due Rocchi tends to be low, but from near Castello di Falconara to Gela is usually bounded by consolidated, scrub-covered dunes and low bluffs rising to terraces at heights of 175 feet and 325 feet.

Cape Soprano interrupts this stretch of beach immediately west of the town of Gela. From Gela to Point Zafaglione the beach is bordered by a girdle of dunes 40-100 feet high and sometimes a mile



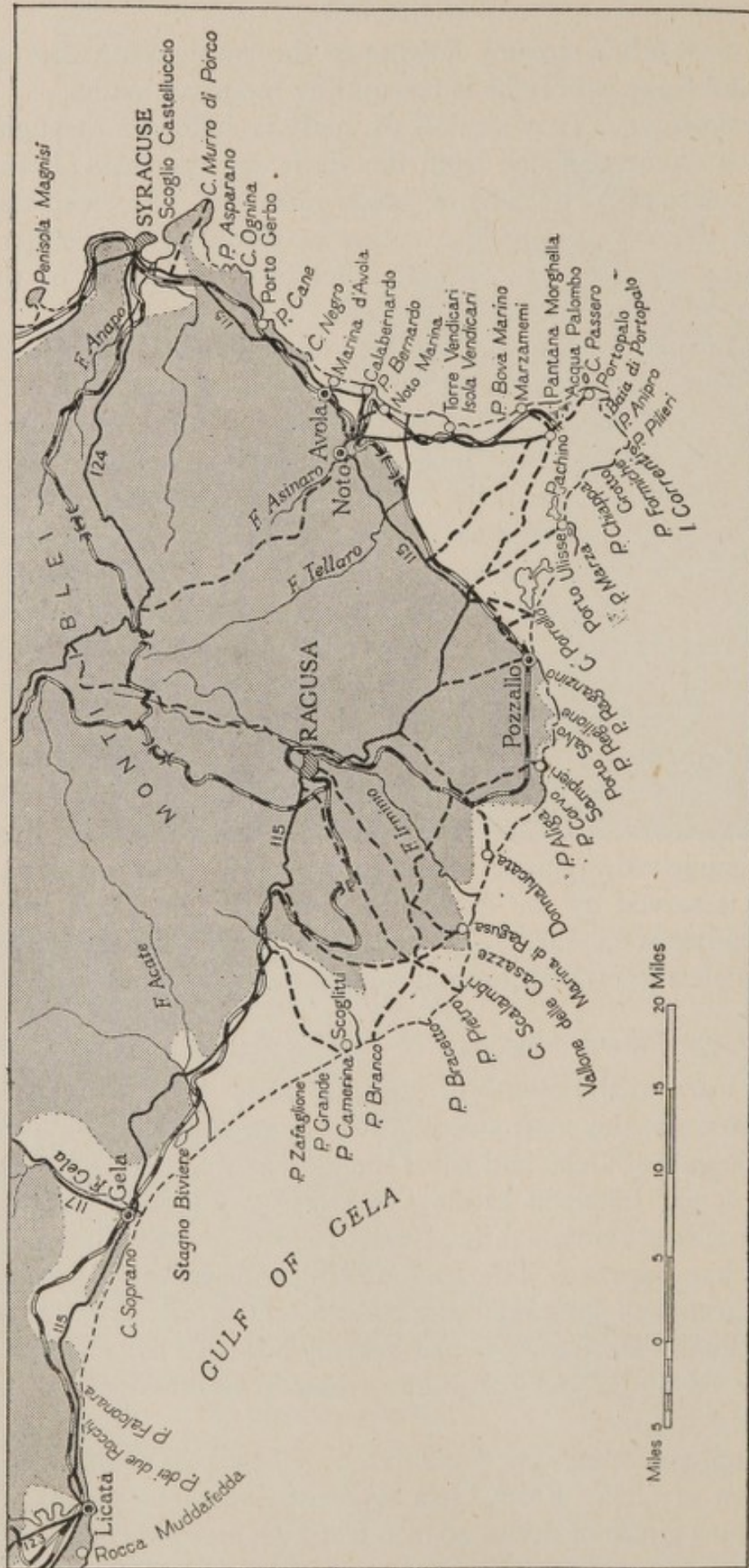


FIG. 34. *The coast: south-eastern Sicily. (For Key see p. 54)*



wide, behind which slopes the gently shelving plain of Gela. The plain is watered by F. Gela and F. Acate to which the swamp of Stagno Biviere drains. Between Point Zafaglione and Cape Scalambri (Scaramia) the girdle of dunes varies greatly in width, and the even line of the beach is broken by a series of low rocky headlands. The latter include Point Zafaglione, Point Grande, Point Camerina, Point Branco, Point Bracetto, and Point Pietro. The dunes are being consolidated and come to the shore in ridges. The gulf of Gela is enclosed by rolling hills, which usually rise gently from a low coastal plain, partially cultivated with vines, olives, and cotton.

From Cape Scalambri (Scaramia) to Marina di Ragusa the coast is low, indented, sometimes sandy, and bordered by off-shore rocks. The most accessible beach is at the mouth of Vallone delle Casazze. East of Marina di Ragusa there is a 200-yard long beach which is not immediately faced by rocks. This beach is separated by rocks and cliffs from another, about  $6\frac{1}{2}$  miles long, which extends from west of the mouth of the F. Irminio to half a mile north of Point Aliga. This sandy beach, backed by low vine-clad dunes, is interrupted to the east of the mouth of the F. Irminio by several small rock-fringed headlands, on the largest of which is the village of Donnalucata. The country inland is cultivated with orchards and vineyards. Between Point Aliga and Point Corvo steep cliffs line the rock-fringed shore. From Point Corvo to Pozzallo the coast is made up of at least four small bays, separated from each other by craggy headlands, the most outstanding being Point Regilione and Point Raganzino. Each of these bays has at its head a dune-crowned beach, the largest of which, over  $1\frac{1}{2}$  miles long, stretches to the east of the rocky headland of Sampieri, whilst the others are only about half a mile long. From Pozzallo, on a low rocky coast, to Point Marza there is a sandy beach, about  $6\frac{1}{2}$  miles long, which is backed by a belt of vine-clad dunes and marshes and often interrupted by small rocky headlands. The cliffs 2 miles east of Pozzallo constitute the most notable interruption. From Point Marza to the Correnti islets there extends a small bay, for the most part fringed by a beach; the most notable interruptions of cliff and rock occur between Point Marza and Porto Ulisse and between Grotto and Point Formiche. The longest stretch of beach extends from Porto Ulisse to Point Chiappa and is backed first by cultivated dunes and then farther inland by two marshy lagoons surrounded by vineyards. The irregular coast between the Correnti islets and Cape Passero is fringed by off-shore rocks and shoals and edged by sandy beaches, which are only



interrupted by Point Pilieri, Point Anipro, and by the cliffs near the village of Portopalo. The longest stretch of rock-free beach is round the shores of the semicircular Baia di Portopalo. Cape Passero, a small, low-lying island bordered by low cliffs, lies a short distance to the east of Portopalo on the mainland.

The coast between Cape Scalambri and Pozzallo rises, in most places, steeply inland through a narrow band of coastal terraces below 300 feet to limestone hills, which are cut into narrow, evenly graded ridges by a series of parallel rivers and torrents. Many of these flow in steep-sided valleys and at their mouths lose their waters in the sand-dunes and beaches along the coast. The F. Irminio, which has its source some distance inland in the M. Iblei,<sup>1</sup> is the longest of the rivers watering this region. East of Pozzallo the hills retreat farther inland and the coastal area consists of an undulating plain, less than 300 feet high, formed of limestone and of volcanic rocks. Much of this lowland is badly drained, and there are many small marshes to landward of the beaches.

*Communications.* The main Trapani-Syracuse road (115) runs between Licata and Gela at a distance varying from 100 yards to 2 miles from the shore, from which it is generally accessible. The railway follows a similar route, but is generally farther inland. East of Gela the road does not again rejoin the coast. The railway comes close to the coast near Point Aliga and continues within  $1\frac{1}{2}$  miles of the shore as far as Pozzallo, whence the line goes inland to Noto, near the east coast. Between Scoglitti and Cape Passero an intricate network of lanes and tracks link the main road to the coast at Scoglitti, Cape Scalambri (Cape Scaramia, Punta Secca), Marina di Ragusa, Donnalucata, Sampieri, Pozzallo, near Cape Porrello, near Point Porto Ulisse, and Portopalo. From Gela a main road (117) leads inland to the main road system of the island.

### *Vegetation*

Much of the south coast of Sicily appears arid and desolate, especially during summer when most of the vegetation is scorched up. The dunes along this coast are being consolidated and are now often planted with vines. Between Cape Granitola and Cape S. Marco the rolling country rises gently inland, and is mainly given over to sheep grazing, although the vineyards of the Marsala region continue east of Mazara. Wild celery, bush palms, and mastic trees grow along the more deserted parts of this coast, whilst round the hamlets and

<sup>1</sup> M. Iblei or the Hyblaean hills.



villages there are vineyards, olive groves, and tomato beds in season. Vines and olives are intensively cultivated on the limestone hills and cliffs between Cape S. Marco and Sciacca. From the mouth of the F. Platani to near Cape Scalambri the hill-slopes near the coast are mostly given over to corn-growing or to pastures. The coastal belt between Cape Scalambri and Cape Passero is for the most part well cultivated with vines. The fields in this area are often walled. Olives are the only trees in any numbers along this coast, largely because they can best survive the strong winds which sweep inland. Myriads of these trees are distributed amongst the fields and afford the only shade from the summer sun, while their dark, green colour gives the coastal landscape its peculiar tone. Small almond orchards and carob trees are sometimes found in the more sheltered spots, especially near Pozzallo, and the courses of the torrents are often marked by belts of green vegetation. Cotton is grown on the plain of Gela. The zones of most intensive agriculture are generally confined to the areas around the coastal towns, where irrigation is possible. Here there are usually numerous vines and olive trees with mixed vegetable cultivation in their shade.

### *Population*

Between Cape Granitola and Porto Palo there are, near the coast, numerous scattered farms, usually linked together by a network of small lanes and tracks. The only two coastal settlements of any size are the fishing and bathing village of Marinella and the fishing hamlet of Porto Palo (Menfi). From Porto Palo to Cape S. Marco coastal habitations are rare, but a short distance to the east of the cape is the ancient town and port of Sciacca flanked by isolated farms. Between Sciacca and Licata there are few settlements near the coast, especially where it is low. All the principal towns are either on the hill-slopes or hill-crests, largely because of the danger of malaria. Porto Empedocle, which is the port for Agrigento and exports sulphur, and Licata are the only coastal towns of any size, and Siculiana Marina, S. Leone, and Marina di Palma the only villages. The inland towns, which are picturesque and generally dusty, are fairly numerous and sometimes are only a mile or two from the coast.

East of Licata as far as Cape Scalambri the coast is desolate and unpopulated except for the town of Gela; even the hill towns become smaller and retreat farther inland. Onwards to Cape Passero the country is dotted with numerous scattered farms, hamlets, and villages, both inland and coastal, which are linked together by lanes



and tracks. The more important hamlets or villages near the coast include Marina di Ragusa, Donnalucata, Sampieri, Pozzallo, and Portopalo (Pozzallo).

### *Ports*

Rada di Punta Secca, a tiny port suitable only for small craft, is the sole natural harbour along this coast, which was inaccessible to shipping during southerly gales until the construction of the artificial harbours of Sciacca, Porto Empedocle\*, and Licata. Except at Porto Palo (Menfi), other landing facilities are rare between Cape Granitola and Cape S. Marco; east of Licata, Gela has a concrete pier and good anchorages off the town, Pozzallo a stone jetty and wooden piers, and Marina di Ragusa a small wooden pier used for shipping asphalt.

### THE NORTH COAST; CAPE S. VITO TO CAPE PELORO

The north coast of Sicily extends from Cape S. Vito to Cape Peloro (or Punta del Faro), a distance of about 250 miles including indentations. The general direction of the coast is from west to east, but between Cape S. Vito and Cape Zaffarano its even trend is interrupted by the gulfs of Castellammare and Palermo. Between Cape Zaffarano and Cape Orlando the coastline is more regular than between Cape Orlando and Cape Peloro, where the gulfs of Patti and Milazzo extend on either side of the narrow Milazzo peninsula. The coast is backed throughout by lofty mountains, but at least round the heads of the gulfs there are usually stretches of lowland accessible from the sea. The coast is comparatively free from off-lying dangers, and is bordered by deep water, the 100-fathom contour seldom being more than 2 miles off shore.

The Isola di Ustica lies about 36 miles north-east of Cape S. Vito, and the Lipari (or Eolie) group of islands 35 miles off the eastern part of the north coast.

### *Cape S. Vito to Cape Zaffarano (Fig. 32)*

This section of the coast is made up of the gulfs of Castellammare and Palermo which are separated from each other by a lofty mountain mass. The hills encircling the gulfs are mostly of limestone, which form short, serrated promontories at the coast and steep scarps inland. The south coasts of the gulfs, which are beach-fringed and low, slope gently inland to the mountains of western Sicily (p. 394).



The gulf of Castellammare lies between the low marshy headland of Cape S. Vito and Point Raisi. The west shore of the gulf from Cape S. Vito to Castellammare del Golfo is indented and very steep, and generally rises abruptly to mountains 2,000 feet high and more. Here the only landing-places are a small sandy beach, about three-quarters of a mile long, at the village of S. Vito lo Capo, and a small bay at Seno di Guidalocca which is bordered by a sandy beach, 900 yards long, at its head. There is a small cove with a sandy beach at its head on either side of the headland on which Castellammare is built. A sand and shingle beach fringes the south coast for about 10 miles from Castellammare del Golfo to Torre S. Cataldo, and is lined with dunes as far as Balestrate. This beach, which is interrupted by cliffs at Balestrate and rocks at Trappeto, is bounded by a plain, highly terraced for agriculture. The plain slopes gently inland for 2 or 3 miles, except east of Trappeto, where it rises more steeply. The east shore of the gulf between Torre S. Cataldo and Point Raisi is either rock-bound or rises in low cliffs to the narrow coastal plain, above which tower the mountains separating the two gulfs; only at Terrasini is there a small narrow beach backed by steep ground.

Between Point Raisi and Cape Gallo the coast is generally indented and either steep or rocky, except for two small bays. The first of these, the Baia di Carini, has a gently sloping and rather rocky and discontinuous beach, about 4 miles long, extending between Vallone della Grazia and Point Passaggio. The second, in front of the village of Sferracavallo, is a cove with a rocky beach at its head. Both of these bays give access to narrow strips of lowland.

The gulf of Palermo has for the most part a rocky coast, and extends from Cape Gallo to Cape Mongerbino. The rugged limestone heights of M. Gallo and M. Pellegrino rise precipitously from the rocky west coast and are separated from each other by Mondello bay, which is fringed by a wide sandy beach about 1,600 yards long. This fronts the villas of Mondello (Plate 36) and a small gently sloping plain which continues inland behind M. Pellegrino to join the Conca d'Oro. The important port of Palermo (Plate 37) on the southwestern shore of the gulf is surrounded by the fertile Conca d'Oro, which slopes gradually up to the encircling ring of hills about 3 miles inland. North of the town there is a small, sandy and rocky bathing beach at Acquasanta. East of the port the hills once again come closer to the shore, so that the plain narrows to about a mile before ending at M. d'Aspra (1,227 ft.), a limestone mass similar to M. Pellegrino, the seaward spurs of which form the rocky Cape Mongerbino



and the dome-like headland of Zaffarano (Plate 38). The shore between Palermo and M. d'Aspra is generally low and rocky, though there are a few beaches and small coves. The sandy beach, 1,300 yards long, on either side of the mouth of the F. Ficarazzi, is the longest and most accessible. The largest coves are west of the F. Ficarazzi and at the village of Aspra.

*Communications.* The gulf of Castellammare is not served by any continuous road along its shores. The west coast is devoid of roads, except for one linking Scopello to Castellammare. Along the south coast between Castellammare and Trappeto a second-class road runs never more than half a mile inland and is easily accessible from the shore; parallel to the road and mainly on the seaward side is the Trapani-Messina railway. The east coast of the gulf is served north of S. Cataldo by the main Trapani-Messina road (113) and the railway, both of which continue eastwards round the lofty headland to Sferracavallo before turning inland to Palermo; along the coast the road and railway often run  $\frac{1}{4}$ – $1\frac{1}{4}$  miles inland, and generally 150–300 feet above the shore from which they are not often easily accessible. The west shore of the gulf of Palermo is served by a series of local roads, but east of Palermo itself the main road (113) and railway to Messina keep close to the coast as far as Aspra, where they turn inland to avoid M. d'Aspra before rejoining the coast at Flavia.

West of Palermo there is access inland by minor roads to road 113 from the following places, S. Vito lo Capo (second class), Puntazza, Castellammare del Golfo (second class), Balestrate (second class). From Acqua dei Corsari route 121 crosses the island to the south coast. Palermo is a centre for many other trans-island routes.

*Cape Zaffarano to Cape Peloro (Figs. 32, 35, 36)*

The gulf of Termini Imerese lies between Cape Zaffarano and Cape Plaia. From Cape Zaffarano to Cape Grosso (Solanto) the coast is either cliffed or rocky, except between S. Elia and Porticello where there are beaches at the head of two small coves. A shingle beach, about 4 miles long and usually backed by cliffs, extends from Cape Grosso to near Torre Colonne. Thence to S. Nicolo l'Arena the coast is bordered by cliffs 30–50 feet high, and is only beach-fringed at Cala Sciabica and near S. Nicolo l'Arena. There is a beach, partly backed by a gently cultivated strip, between S. Nicolo and Point Madonnuzza, whence to west of the F. Leonardo the coast consists of low cliffs which are sometimes fringed by a narrow shingle and rock beach. The most accessible stretch of this beach is west of





PLATE 37. *Palermo from M. Pellegrino*



PLATE 38. *Cape Zaffarano and intensively cultivated coastal strip*





PLATE 39. *Cefalu and Cape S. Antonio*



PLATE 40. *Cefalu*



Trabia, and is 200 yards long. A sandy beach about 900 yards long stretches from the F. Leonardo to Termini Imerese and is backed by a steep rise except at the mouth of the Leonardo valley. From east of the port of Termini Imerese to east of the F. Torto the coast is either rocky or beach-fringed.

Between Cape Zaffarano and Termini Imerese limestone mountains, with lower slopes cultivated with olive and citrus trees, rise from the shore to serrated peaks often as high as 3,900-4,300 feet.

From west of the mouth of the F. Torto the coast curves for 10 miles east-north-east to Cape Plaia and is fringed by a beach and backed by a plain about 1 mile wide. This plain, which is formed of soft marls and river gravels and is planted with vines and lemon groves, is cut into by the numerous gorges of the streams and rivers flowing from the lofty Madonie mountains. The most important of the rivers is the Torto, whose wide, gently sloping olive-clad valley has always formed a route to the south coast through the mountain wall. The coast is cliffed and rock-fringed between Cape Plaia and Cefalu (Plates 39, 40), where there is a shingle beach 1,600 yards long and partly backed by a narrow cultivated strip.

Eastwards to Cape Orlando there are no major coastal projections, except for Cape S. Antonio (at Cefalu) and Cape Raisigelbi which are steep, cliff-fringed, limestone headlands. Between Cefalu and S. Stefano di Camastra the steep rounded Nebrodi mountains rise from the shore in cliffs, and the interior of the country is only accessible at the mouths of the numerous rivers and streams which cut ravines through the mountain wall. The cliffs are generally bordered seaward by a narrow beach of fine shingle which often widens considerably at the river mouths. The most accessible stretches of beach are (1)  $1\frac{1}{4}$  miles, between the T. Carbone and S. Ambrogio; (2) 900 yards, at the mouth of the T. Malpertugio; (3) 1,400 yards, at the mouth of the F. di Pollina; (4) about 2,000 yards, between Castel di Tusa and the mouth of the F. Tusa, backed by a narrow cultivated plain; and (5) 600 yards, east of S. Stefano di Camastra. From the mouth of the S. Stefano river (immediately to the west of the village of S. Stefano) to Cape Orlando the coast, which now trends east-north-east, consists of a beach divided into three long bights by Point Caronia and the deltas of the T. Furiano and T. dell' Inganno. This beach is fine shingle with some dunes inland between S. Stefano and Point Caronia, stony to Torre del Lauro, either sandy or stony from Torre del Lauro to F. Zappulla, and then finally sandy to Cape Orlando. The beach is backed by a narrow, fertile,



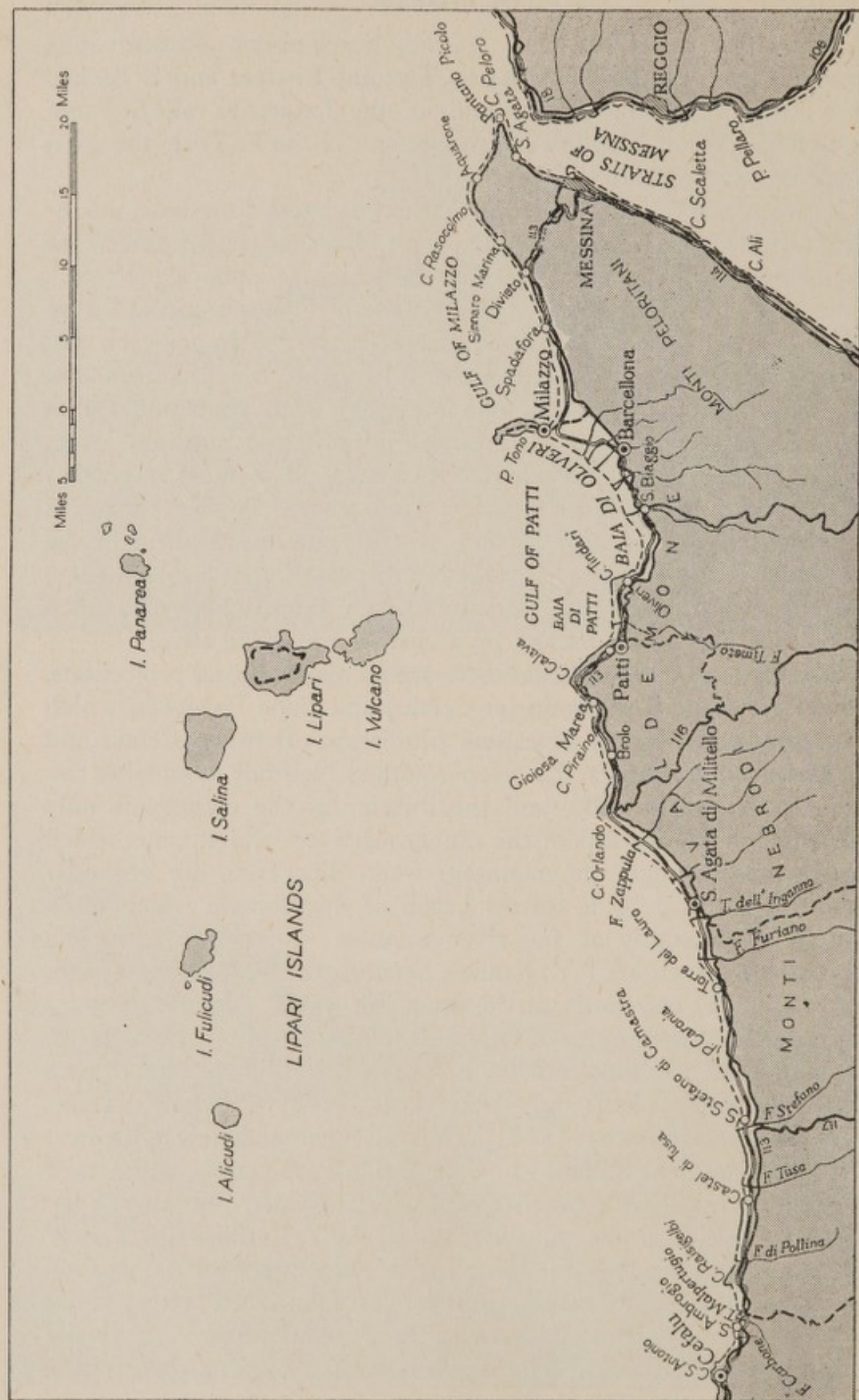


FIG. 35. The coast: Cefalu to the Straits of Messina. (For Key see p. 54)



coastal terrace, which widens at the deltas of the many rivers and streams flowing across it, whilst between S. Agata and Cape Orlando it broadens to three-quarters of a mile wide and is planted with citrus groves. Hills rise above the plain, at first in fertile terraces and then almost vertically in massive sandstone blocks.

Between Cape Orlando and rugged Cape Calava is an open bay, the western shore of which is, for the most part, rocky and dangerous, while the southern and eastern shores consist of two beaches separated from each other by the high and craggy cliffs of Cape Piraino. The western beach is sandy and about 4 miles long and the eastern about 1 mile long. The hinterland here is very steep and rises abruptly to wooded hills 1,600–2,300 feet high, except immediately behind the western beach where there is a narrow cultivated plain.

To the east of rugged Cape Calava lies the gulf of Patti, which is separated from the gulf of Milazzo only by the long, narrow Milazzo peninsula. The gulf of Patti is subdivided by Cape Tindari into two bays, the Baia di Patti in the west and the Baia di Oliveri in the east. The Baia di Patti is either steep or rugged to the west of Marina di Patti, but to the east consists of a wide, pebbly beach  $2\frac{1}{2}$  miles long, terminating near the high cliffs of Cape Tindari. This beach, which is widest at the delta of the F. Timeto, is bounded landward by a low wall with a narrow strip cultivated with vineyards and orchards. The Baia di Oliveri has steep, lofty cliffs south of Cape Tindari (alt. *c.* 215 ft.), but from Oliveri eastwards to Cape Peloro, about 35 miles distant, there is a continuous sand and shingle beach, interrupted only by the long, narrow Milazzo peninsula. This peninsula (alt. 480 ft.), which is rocky and steep between Point Tono and the port of Milazzo, projects northwards for about 4 miles. The beach, which is usually bounded throughout by a fertile coastal plain, is intersected by numerous rivers and streams and edged seaward by a low retaining wall. The plain, varying in width from  $\frac{1}{2}$ –4 miles, is widest round the southern and eastern shores of the Baia di Oliveri where it is cultivated with orchards and vineyards. To the east of Milazzo, where it is crossed by numerous irrigation ditches and sometimes bounded seaward with sand-dunes, the plain narrows until it disappears between Sinnaro Marina and Aquarone (Acqualadrone), and then again widens to about a quarter of a mile at the neck of the low sandy spit of Cape Peloro. About three-quarters of a mile west of Cape Peloro, Pantano Picolo, a lake 82 feet deep, lies a few hundred yards from the beach. Between Sinnaro Marina and Aquarone steep cliffs rise about 300 feet sheer from the beach except



around rugged Cape Rasocolmo where blown-sand is piled up high. The whole beach is easily accessible from the sea, and especially along the southern shores of the two gulfs. Inland, however, the sandstone Valdemone hills rise, often in broken terraces, to heights of over 1,600 feet behind the Baia di Patti, and the Mi. Peloritani back the coastal plain extending round the Baia di Oliveri and the gulf of Milazzo. These rugged mountains are less steep than along the eastern coast, but near the north coast are cut into low, narrow spurs by numerous rivers and streams.

*Communications.* This section of coast is closely served by roads. From Flavia to Divieto the main Trapani-Messina road (113) is never more than 3 miles inland and usually much less. As a rule it runs along the level coastal stretch at the foot of the hills. Where, however, the coast is cliff-fringed and rocky the road usually runs high above the shore, and is, therefore, frequently inaccessible except from the steep pebbly beds of torrents. At Divieto the main road turns inland to Messina, and the coast from Divieto to Messina is followed by a first-class road round Cape Peloro. This road is often difficult to reach from the shore as it frequently runs above cliffs 300 feet high. About 6 miles east of Termini Imerese road 120 branches south-east to Masseria Xireni and thence runs east to Fiumefreddo on the east coast, at a distance of 30 miles from the coastal road. The two main roads are connected by a number of local roads of which the most important leave the coast at Trabia (second class), Cerda railway station (120), Campofelice (second class), S. Ambrogio (second class), S. Stefano di Camastra (117), west of S. Agata (second class), Cape Orlando (116), Patti (second class), and S. Biaggio (first class). Milazzo on its peninsula is linked to the coast road (113) by two branch roads.

The Palermo-Messina railway follows the coast from Flavia to Divieto. It usually runs nearer the sea than the main road, crossing the plains on an embankment, and often tunnelling through the rocky headlands and promontories. At Castella a branch railway leads inland along the Torto valley and crosses the island to the south coast.

### *Vegetation*

The plains around the southern shores of the gulfs of Castellammare and Palermo are cultivated in a somewhat similar fashion, though that of Palermo (called the Conca d'Oro) is the more fertile of the two. The Conca d'Oro, or golden shell, resembles a fruitful





PLATE 41. *Cape S. Alessio*



PLATE 42. *Taormina: Isola Bella*



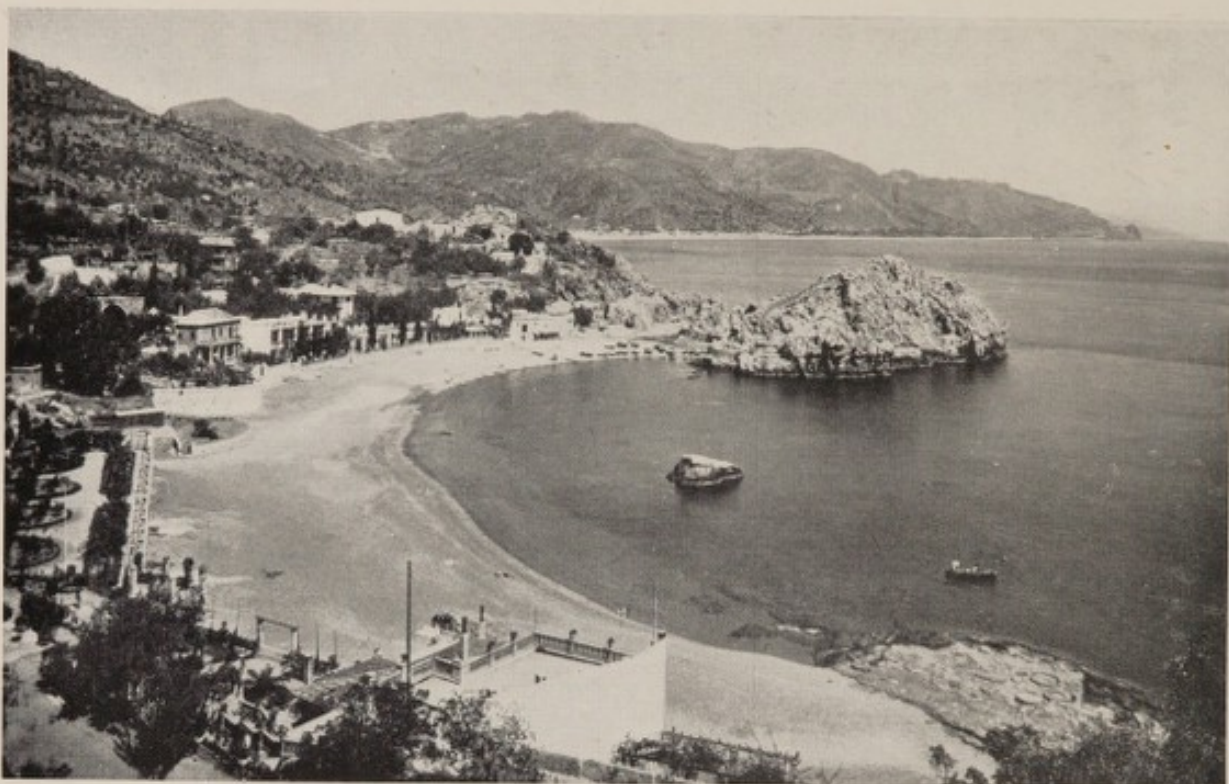


PLATE 43. *Rada di Taormina*



PLATE 44. *Cape Taormina*



garden, and is irrigated for the cultivation of oranges and lemons, which often form dense groves. Vines, however, are more numerous than citrus trees on the plain of Castellammare, and there are arable fields and almond orchards on the small plain of Carini. Vines and olives grow on the lower slopes of the hills encircling all of these plains. Dwarf palm, fennel, shrubs, tall grasses, prickly pear, and acanthus often grow on the limestone cliffs, but where the latter are more accessible, vines and olives are cultivated.

The low-lying and narrow coastal strips edging the gulfs and bays east of Cape Zaffarano are intensively cultivated and abound with orange and lemon groves, with vineyards and with fields of corn. Olives grow on the lower slopes of the hills, especially near the towns, whilst the hill-sides east of Milazzo are extensively terraced for vineyards. Near the villages and towns there are scattered orchards of almonds and medlars. Aloes, fig trees, cacti, prickly pears, dwarf palms and shrubs grow on the more rugged and hilly stretches of the coast, and on the craggy capes. Some distance inland extensive forests of oak, ash, elm and pine clothe the northern slopes of the Mi. Nebrodi and Mi. Peloritani.

### *Population*

The hilly sections of the west and east coasts of the gulfs of Castellammare and Palermo are sparsely inhabited. In contrast, the low-lying land at the heads of the gulfs and small bays are generally well cultivated and more densely populated, mainly by agricultural workers, but also by a small number of fisherfolk. The towns and larger villages, whether coastal or inland, are generally built near the foot of the hills. The most important towns and villages on the gulf of Castellammare are S. Vito lo Capo, Castellammare del Golfo, Balestrate, Trappeto, and Terrasini. Palermo, the largest town on the northern coast of Sicily, together with its suburbs and sea-side resorts of which Mondello is the most important, extends round the shores of the gulf of Palermo. The largest of the towns inland from these gulfs are Alcamo, Partinico, Carini, and Monreale.

East of Cape Zaffarano there are, however, few towns of any size along the coast. The towns which do exist are mostly old in origin, and to-day are frequently health or holiday resorts, as well as agricultural centres. Fishing plays only a small part in the lives of these towns, with the exception of Termini Imerese and Milazzo. The more important towns are Cefalu, which is famous for its Norman cathedral, S. Stefano di Camastra, S. Agata di Militello, and Milazzo.



There is generally a line of small towns perched on hill summits not far distant from the coast. These are most numerous on the hills between Cape Orlando and Divieto and include Patti and Barcellona Pozzo di Gotto. The only coastal villages of any size are Brolo, Gioiosa Marea, Oliveri, and Sinnaro. Isolated habitations are limited to the level strips near Cape Orlando, Milazzo, and Spadafora, and the lower slopes of the hills behind Cefalu.

### *Ports*

There are no natural harbours along the north coast. Palermo\*, however, is a considerable town and port, and Milazzo\* and Termini Imerese\* are the only others of any size. West of Palermo there are a number of moles and piers and harbours mainly connected with tunny fishing. These include primitive landing facilities at the fishing-village of S. Vito lo Capo, a jetty at Tonnara del Secco, two jetties at Tonnara di Scopello, a mole and a quay at Castellammare del Golfo, a jetty and mole at Isola delle Femmine, a boat jetty at Sferracavallo, a quarry quay south of Cape Gallo, a pleasure pier and mole at Mondello, a yacht pier at Point Valdesi, a quay and mole at Point Priola, a small fishing harbour at Point Arenella, a landing-place at Villa Igia, and a small artificial harbour at Porticello. At Cefalu, east of Palermo, there is a mole.

### EAST COAST OF SICILY; CAPE PELORO TO CAPE PASSERO

The east coast of Sicily between Cape Peloro and Cape Passero extends in a southerly direction for approximately 180 miles. The northernmost part of this coast forms the west shore of the Straits of Messina. Between Cape Peloro and Cape Schiso there are no major indentations, and the Peloritani mountains rise steeply inland from a very narrow coastal strip, often called the 'riviera'. The coast between Cape Schiso and Catania retains the same general direction, but is more irregular and rugged and is dominated by M. Etna.

At Catania the regular trend of the coast ceases. Cape Passero is almost due south of Catania, but the coast between is very irregular. The shore of the gulf of Catania as far as Agnone is almost straight and runs due south, but becomes rugged as it trends south-east to Cape S. Croce. Onwards to Cape Murro di Porco the general trend is south-south-east, but the coast is cut into by the bays of Augusta, Panagia, and Syracuse, the first and last of which afford the best natural harbours in Sicily. Finally a broad bay, with many minor



indentations and headlands, curves southwards to Cape Passero. Except for the plains of Catania and Syracuse and the lowlands south of Avola, the coast is generally backed by the rugged limestones of the Mi. Iblei.

*Cape Peloro to Cape Schiso (Fig. 36)*

The east coast of Sicily between Cape Peloro and Cape S. Andrea extends south-south-west for 37 miles; the northern part of this between Cape Peloro and Cape Ali forms the western shore of the turbulent Straits of Messina (Stretto di Messina). The coast between the low sandy Cape Peloro and the limestone headland of Cape S. Andrea has, except for the harbour of Messina, no major indentations. This is because the spurs between the short torrents which cut into the precipitous coast have long ago been blunted by heavy seas. The whole coast is fringed by a narrow beach, which is generally sandy and steep-to and often backed by a low retaining wall. This fronts a coastal terrace from which the precipitous Peloritani mountains rise steeply inland. The terrace, which is generally accessible from the beach, consists mainly of level and well-cultivated land of varying width. It is one-quarter to three-quarters of a mile wide between Cape Peloro and S. Agata, where it is partly occupied by Pantano Grande (25 ft. deep), hardly exists between S. Agata and Messina, but broadens to about 500–600 yards south of Messina, and again disappears between Cape Scaletta and Cape Ali and near Cape S. Alessio (Plate 41). Round these capes the rugged coast and hinterland are both very steep and inaccessible from the shore. Both the littoral terrace and the beach widen at the mouths of the numerous torrents which dry up in summer and leave pebbly beds suitable for foot-paths. These torrents south of Cape Scaletta increase in length as the main watershed of the Peloritani mountains retreats farther inland. The longest of them, F. di Pagliara, F. di Savoca, and F. d'Agro, have extensive deltas, which increase the width of both the terrace and beach. The Peloritani mountains, which consist of crystalline schists and sandstone outliers, rise steeply to ridges 1,600–2,000 feet high and sometimes to craggy and barren summits over 3,000 feet. This range forms a considerable barrier to internal communications.

From Cape S. Andrea almost to Cape Schiso the nature of the coast changes. Limestone hills, on one of which the town of Taormina perches, fall precipitously to the sea in steep headlands separated from each other by rocky coves and small bays. The bay between the



twin headlands of Cape S. Andrea and Cape Taormina has a shingle beach to the north of the small rocky island of Isola Bella, but is foul with rocks to the south (Plate 42). The Rada di Taormina (Plates 43, 44), which extends between Cape Taormina and Cape Schiso, is fringed by a pebble beach north of the rocks in front of Giardini, and by shingle to the south. Except for a stretch of 1,200 yards, north of Cape Schiso, the beach is fronted with rocks.

*Communications.* This section of the coast is followed closely by a first-class road, easily accessible from the beach, between Cape Peloro and Messina, and thence by the main Messina-Syracuse road (114). The Messina-Syracuse railway closely follows the coastal terrace, generally on its landward side. Since the railway frequently runs along embankments and the road sometimes on sea-walls, a certain amount of scrambling is necessary before either can be reached from the shore. The road and railway are difficult of access where the hills rise steeply from the coast, especially at Cape Scaletta, and other craggy headlands between Cape S. Andrea and Cape Taormina and north of Giardini. At these and other places the railway usually tunnels through the headlands. The only roads leading inland to cross the steep Peloritani mountains are the Trapani-Messina road (113) between Messina and Divieto, and a first-class road from Cape Schiso to S. Biaggio on the north coast.

*Cape Schiso to Agnone (Fig. 36)*

The whole coast between Cape Schiso and Catania is dominated by M. Etna, which towers 10,700 feet above the sea (Plate 150). Its lower slopes, roughly ridged with lava flows, fall steeply but evenly to the shore. A coastal plain extends between Cape Schiso and Riposto to the north-east of Etna, and the plain of Catania to the south of it.

Between Cape Schiso and Riposto a steep-to shingle beach over 6 miles long fringes the fertile, orchard-covered plain, which is about a mile wide and rises gradually to lava hills (1,600 ft. high) at the foot of Etna. The plain is intersected by the Alcantara, one of the longest rivers on the east coast of the island, together with torrential streams (often dry in the summer) fed by numerous tributaries flowing from Etna, and by irrigation ditches. Between Riposto and Catania the coast is generally steep-to and rugged, being made up of low, dark, lava cliffs with sea-grottoes, and sometimes fronted by basaltic reefs and off-shore rocks. The rugged cliffs become higher and the coast more indented south of S. Tecla. Cape Molini is the greatest of the headlands, and the islands of the Cyclops the largest of the off-shore



rocks. Local legends maintain that these are the petrified bodies of the Cyclops flung by Ulysses into the sea. Small coves afford the best landing-places between Riposto and the large port of Catania. The most accessible of these are (1) at Pozzillo, stony beach; (2) at Stazzo, stony beach, protected by a small breakwater; (3) at S. Maria la Scala; (4) south of Cape Molini, and (5) at Aci Trezza, where there is a small shingle beach fronted by the basaltic I. Ciclopi, and (6) the small stony cove of Ognina.

The fertile plain of Catania is fringed by a sandy beach 11 miles long, which extends southwards from Catania to Agnone. The beach is divided in two by the shifting mouth of the river Simeto, and is backed by a belt of low scrub- or vine-covered sandhills. Near the coast there are small lagoons and marshes around the mouth of the Simeto. The gently sloping plain of Catania, which extends about 18 miles inland, is intersected by irrigation channels and is planted inland from the dunes, with citrus trees, pines, and vines with belts of trees as a wind break. Inland the plain is edged by hills over 650 feet high and in the south is broken by a spur which almost reaches the coast just to the south of the mouth of the Simeto. To the south of the spur the small plain of Lentini forms a southerly continuation of the larger plain of Catania, and is crossed by the S. Leonardo river. The large swamp on this plain is being drained and planted with vines.

*Communications.* From Cape Schiso to Catania the main Messina-Syracuse road (114) and railway run generally not more than 2 miles from the coast although they are not always accessible from it. Between Cape Schiso and Acireale they run about  $1-1\frac{1}{2}$  miles inland while skirting the lower slopes of M. Etna. Between Acireale and Catania, however, they are usually closer to the shore, though by no means easily accessible from it. South of Catania the main road cuts across the plain of Catania about  $1\frac{1}{2}-3$  miles from the coast with the railway  $2\frac{1}{2}-3$  miles farther inland. Between Cape Schiso and Riposto lanes and tracks lead inland from Torre Archirafi, Pozzillo, Stazzo, and S. Tecla. Between Catania and the mouth of the S. Leonardo there are lanes and tracks, which for short stretches run behind the coastal dunes and near to the shore. The lower slopes of Etna inland from the main road, particularly on the south-east, are intersected by numerous motorable roads. A main road leads inland along the north flank of Etna from the main coastal road at Fiumefreddo di Sicilia (120) and another along the south flank from Catania (121). Both of these roads link up with the main road-system of the island and are joined



together west of the mountain by a first-class road from Randazzo to Adrano.

The circum-Etna railway leaves the coast at Riposto, crosses the main Messina-Syracuse railway at Giarre, and rejoins it at Catania, the centre for other lines leading inland to the north and south coasts.

*Agnone to Cape Passero (Figs. 36, 34)*

From Agnone to Point Izzo the coast trends south-east and consists of cliffs often fringed with rocks. There are some coves with small stony beaches in the lava cliffs between Agnone and Point Bonico. The most important of these is immediately west of Point Bonico, where there is a stony beach with difficult exits. From Point Bonico to Cape S. Croce the cliffs are of white limestone, which beyond the low, flat-topped headland of Cape Campolato are generally high and rugged. The easiest landing-place here is at the head of the fishing-cove of Brucoli, where a small, cultivated valley leads inland. The bay of Augusta, now totally enclosed by moles, lies between Point Izzo and Point Vognoli. The latter is separated by a short stretch of low coast from Penisola Magnisi (alt. *c.* 50 ft.), which is a rocky cliff-fringed headland joined to the mainland by a sandy isthmus enclosing salt-pans. The coast curves south-south-east from Penisola Magnisi to Cape S. Panagia and so forms Panagia bay. The shore of this bay consists of sandy beach for 2 miles south of the isthmus, but thence to Cape S. Panagia is either rocky or with cliffs and a few scattered sandy coves. This bay is backed by a narrow marshy plain, fringed seaward by scrub and crossed by numerous short streams which have their source in the limestone hills rising gradually inland. Between Cape S. Panagia and the port of Syracuse the limestone coast is high and fringed with cliffs. Much of the land-locked bay of Syracuse is edged by a beach which gives access to the plain of Syracuse. The F. Anapo, after rising in the nearby Mi. Iblei, crosses the fertile plain, where it is joined by numerous tributaries.

From Scoglio Castelluccio to Cape Ognina the coast is very irregular. The peninsula of Cape Murro di Porco (Penisola della Maddalena) and the bay to its south are backed by steep and rocky cliffs, usually cliffed, except for two small beaches north of Point Asparano. From Cape Ognina to Cape Negro the coast is usually bordered by steep, low cliffs, though there are accessible beaches, at (1) Porto Gerbo, north of Point Cane, sandy and half a mile long; (2) south of



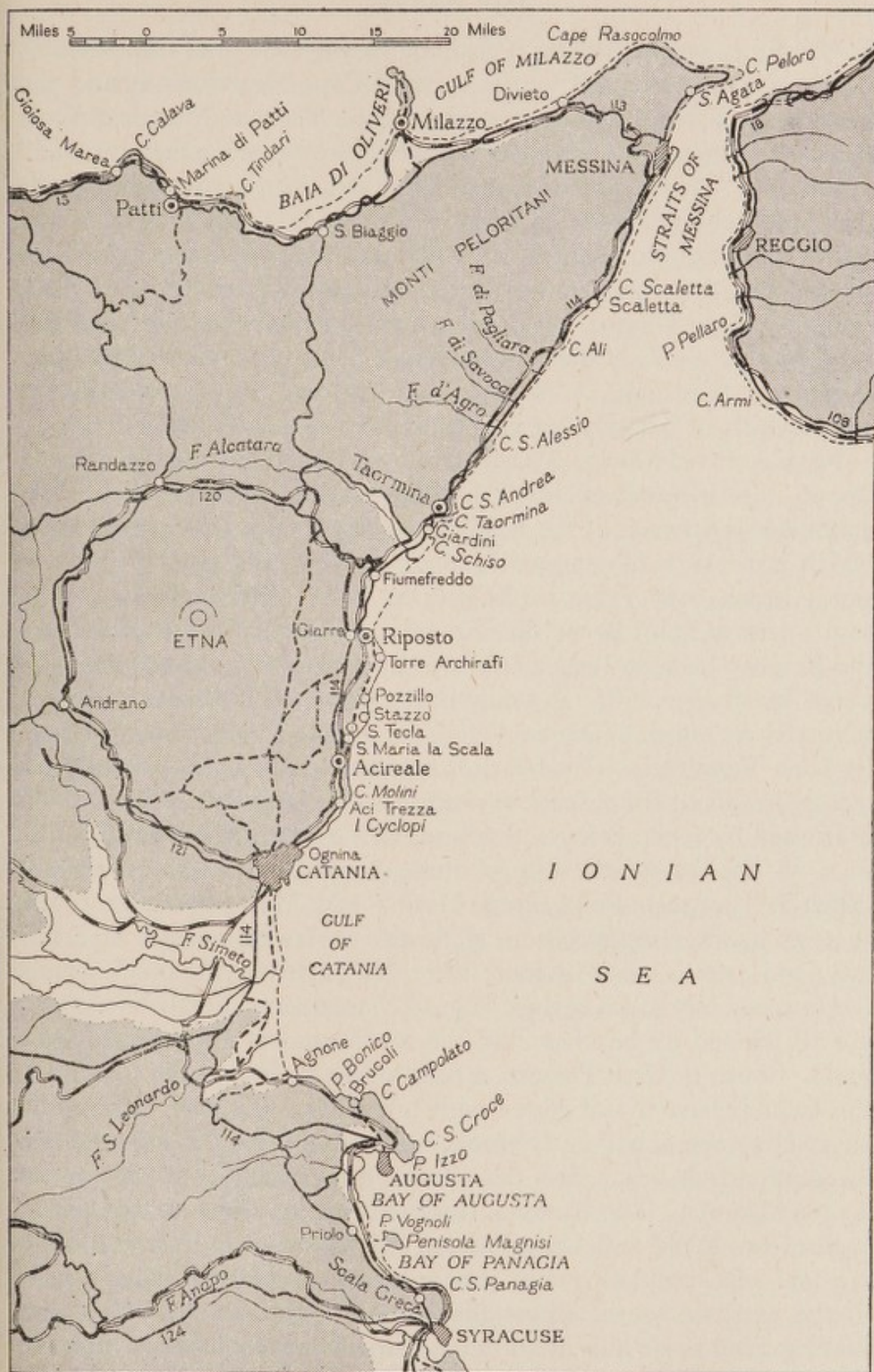


FIG. 36. The coast: north-eastern Sicily. (For Key see p. 54)



F. Cassibile, 450 yards long; (3) about  $1\frac{1}{2}$  miles north of Cape Negro, short; and (4) about half a mile north of Cape Negro, sandy and 700 yards long. From 1 mile south-west of Cape Negro to Marina d'Avola there are three sandy beaches separated from each other by small headlands. The northernmost of these beaches is about 750 yards long, the central (south of Lido d'Avola) 600 yards long, and the southernmost at Marina d'Avola. Inland the country between Scoglio Castelluccio and Avola consists of an undulating coastal strip backed, south of Cape Ognina, by limestone mountains which rise precipitously within a mile of the coast, to a steep-sided plateau with summits over 1,600 feet high. A few small streams cut deep valleys in the steeper hills before flowing gently across the coastal plain.

From south of Marina d'Avola to Torre Vendicari the coast is made up of a succession of small headlands and beaches. The most accessible is a beach at the head of the small cove of Calabernardo, which is protected by a small jetty. There is also a discontinuous sandy beach over 1,000 yards long at Noto Marina, about 1 mile south-west of Point Bernardo. From Torre Vendicari to Marzamemi the beaches become longer, and the intervening headlands are bordered by steeper cliffs. A sandy beach about  $1\frac{1}{2}$  miles long extends immediately south of Torre Vendicari, and is divided into two bays by Isola Vendicari. This beach is separated at its southern end by a craggy headland from another sandy beach about 1 mile long which is fronted by rock patches. Scattered scrub-covered dunes and salt-ings on the landward side of these beaches make access inland difficult. Between Point Bova Marina and Marzamemi, however, there is another sandy beach, along the shores of a small bay; this has good exits. A bay divided into three parts by two small islands lies immediately south of the village of Marzamemi; the three sections are all fringed by beaches, and the southernmost is protected by a mole. South to Cape Passero, a rugged island close to the mainland, the coast is barren and edged with low cliffs, which are only interrupted by a few small sandy beaches with some salt-pans inland. The most important beach, less than half a mile long, lies north-west of Acqua Palomba. The Pantana Morghella marsh drains to this beach.

Between Avola and Cape Passero the hills inland from the coast are low and undulating and generally consist of limestone, except in the extreme south, where they are of basalt. The short rivers flowing from these hills are often marshy near their mouths, and like the majority of the east coast rivers have a swift flow in winter and spring, but dry up in summer and autumn. The F. Asinaro and T.



Tellaro, the longest of these, have deep, narrow valleys, which open out in the plain south of Avola.

*Communications.* The coast is not followed by any main roads between Agnone and the small town of Priolo. First-class roads lead inland from the coast at Agnone, Brucoli, and Augusta, all of which are linked with the main Messina-Syracuse road (114). The main road runs close to the shores of the bays of Augusta and Panagia between Priolo and Scala Greca, whence it cuts across a headland to Syracuse. North of Augusta the main coastal railway, though often close to the coast, is not easily accessible from it except at Agnone. South of Augusta, however, this line follows the shores of the bays of Augusta and Panagia to Scala Greca and then runs above the cliff-bordered coast to Syracuse.

Between Syracuse and Avola the main Syracuse-Trapani road and the main coastal railway run usually  $\frac{1}{2}$ -4 miles from the coast, with which they are linked by numerous lanes and tracks. The most important of these lead inland from Murro di Porco lighthouse, the bay north of Cape Ognina, the bay north of Lido d'Avola, and Marina d'Avola. At Avola the main road and railway turn away from the coast. A first-class road, however, runs close to the shore from Avola to Calabernardo, where it goes inland and, before reaching Noto, is joined by a road and lanes from Noto Marina. A first-class road from Noto to Portopalo leads south and parallels the coast, from which it is  $\frac{3}{4}$ -2 miles distant. This road is also connected with the coast and beaches by numerous lanes and tracks, the chief of which start from Torre Vendicari, Marzamemi, and Acqua Palomba. To the landward side of this first-class road there is a network of lanes and tracks which lead inland to the main Syracuse-Trapani road (115). A branch railway from Noto to Pachino usually keeps nearer to the shore than the road.

### *Vegetation*

The narrow coastal terrace or 'riviera' and the gentle seaward slopes of the Monti Peloritani have a luxuriant vegetation of oranges, lemons, olives, almond and carob trees, and some vines. Citrus trees thrive up to a height of 1,600 feet because of the numerous streams watering the northern part of the coast. The more craggy hills and limestone cliffs have a wild appearance, being generally covered by heath, broom, and prickly pear. On the terraced limestone hills round Taormina, which are famous for their beauty and fertility, small fields of corn, shaded by olive trees, alternate with



dark green citrus trees. The lower slopes of Etna (0 to 2-3,000 ft.) are particularly fertile and are covered with gardens and orchards, similar to those along the 'riviera'. The cornfields are surrounded by olive trees, and the orange groves are enclosed by dark walls of lava which criss-cross the mountain side and limit visibility. The higher slopes of the mountain (4,000-6,600 ft.) are clothed with a belt of forest, composed of chestnuts, deciduous oaks, plane, beech, birch, and pine trees. Above the forest rises the bare cinder cone with its snow cap and smoking crater. The plain of Catania, which is one of the most potentially fertile areas of the island, interrupts the garden-like cultivation of the coast. The plain is irrigated and is largely down to pasture and cereal crops, though near the coast vines and citrus trees are sometimes intensively grown immediately behind the scrub-covered dunes.

The vegetation of the coastal region south of the plain of Catania is less luxuriant than that of the north-eastern 'riviera', though vineyards, almond orchards, olive groves, and arable fields are numerous, especially near Augusta and Syracuse. The fields are often lined with trees. Dwarf palms are common round Syracuse, whilst tall reed-like papyrus grows along the banks of the F. Anapo. Farther inland, where the country is less fertile, bare pasture and scrub, made up of terebinths, oleasters, and asphodels, predominate. In the lowlands south of Avola vines are intensively cultivated, especially in the valley of the Noto, while the undulating hills inland are covered with moorland, alternating with olive groves and clusters of carob trees.

### *Population*

To the north of Catania the coast is, for the most part, densely populated, whilst to the south coastal settlements are much rarer, with the notable exceptions of the towns of Augusta and Syracuse.

From Cape Peloro to Cape Schiso the 'riviera' is lined by an almost continuous string of villages, hamlets, and scattered whitewashed houses. Inland the villages on the hill-slopes and crests become more numerous and picturesque south of Messina. The most spectacular of the hill towns is Taormina, with its fertile terraced gardens, winding roads and paths, and impressive Greek theatre.

The seaward slopes of Etna are thick with towns and villages as well as with farms and houses scattered amongst the citrus groves. These settlements are all linked together by a network of roads which become closer as the density of population and the size of the towns



increase with proximity to Catania. It is notable that, with the exception of Riposto, towns do not closely approach the coast north of Pozzillo, but are about 2 miles inland. Immediately south of Pozzillo, however, scattered houses and villages become more numerous. The wide, agricultural plain of Catania is worked mainly by farmers who live on the slopes of Etna because of the danger from malaria in the lowland. As a result there are near the coast of the plain few permanently inhabited dwellings.

Few settlements, or even isolated houses, are built on the coast between Agnone and Cape Negro, except for the towns of Augusta, Syracuse, and their suburbs. The southern end of the east coast from Cape Negro to Cape Passero is more densely populated; settlements are within a quarter of a mile of the shore, especially in the vicinity of the towns of Avola and Noto. Here the population does not live in villages so much as in scattered houses, served by an intricate network of small roads and lanes. Marina d'Avola, Calabernardo, Marzamemi, and Portopalo are the only sizeable hamlets on the coast itself, and Pachino, which is  $1\frac{1}{4}$  miles inland, is the only town of any size south of Noto. Houses are fewer and more scattered where marshes extend close to the shore. The inhabitants of this part of the coast are principally employed in agriculture and viticulture and in fishing for tunny, anchovies, and sardines, all of which are consumed locally.

### *Ports*

The four large ports of Messina\*, Catania\*, Augusta\*, and Syracuse\* are the principal places of disembarkation along this coast. Small harbours or ports are rare, the majority being along the rocky shore between Riposto and Catania. These fishing havens include Riposto, Stazzo, Santa Tecla, S. Maria la Scala, Aci Trezza, Aci Castello, and Ognina. South of Catania there are Brucoli, Porte Xiffonio, Marina d'Avola, Calabernardo, Lido di Noto, Marzamemi.



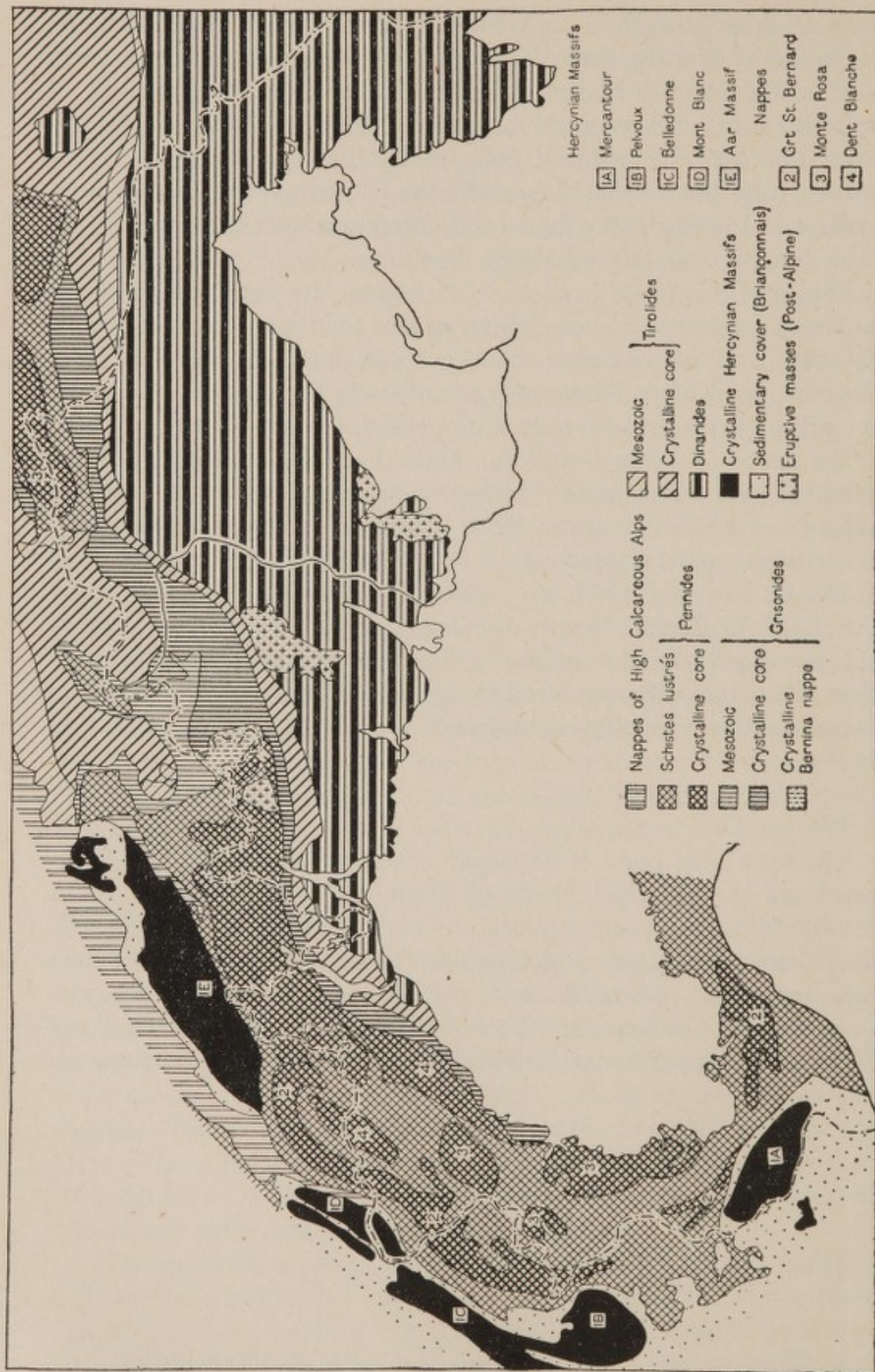


FIG. 37. The structure of the Alps (after Staub)



## CHAPTER IV

### REGIONAL TOPOGRAPHY

#### THE ALPS

**S**TRUCTURAL and Physical Features. The Italian Alps have already been described as a region where rocks of very diverse ages and types have been highly folded, displaced, and distorted (p. 27). The resulting structure is exceedingly complicated, and its interpretation a task of great difficulty (Fig. 37).

The majority of the rocks, now so contorted, are presumed to have been laid down originally in horizontal, or almost horizontal, strata or beds. These have been intensively rucked up and the resultant folds thrust forward, one on top of the other, to form overfolds. The pressure causing the folding is believed to have come predominantly from the south, so that the loops of the overfolds for the most part point towards the north. The arc-like arrangement of the Alps has been imposed by crystalline Hercynian massifs, which consist of Primary and earlier rocks so resistant that they escaped folding, but yielded to faulting and fracturing. Some of these massifs are beyond the Alps, but others are included. All, however, like breakwaters, barred or moderated the thrusting forward of the folds.

The above outline presents the main processes leading to the formation of the Alps. The folds, and especially the overfolds, are, however, often more complicated than has already been indicated. The younger rocks, now folded, of Secondary and early Tertiary age were laid down on a floor of older and tougher Primary rocks. Parts of this underlying floor were caught up in the folding of the younger and more pliable rocks and incorporated in the cores of the overfolds. These overfolds are by far the most complicated structural feature of the Alps, and to them the technical term of 'nappe' is applied. A nappe may be a major overfold with a comprehensive name, or a minor overfold forming a subdivision with a name of its own. In Italy, where not all the elements of the Alps are represented, the major nappes are the Pennine, overlaid in turn by the Grisonid and Tirolid, the last two together often being known as the Austrides. Another major nappe, the Dinarid, which in places overrides the Tirolid, has, unlike the others, its main overfold pointing to the south. The minor nappes are too numerous to mention by name. The



displacement of the nappes has often been so great that they have been rent and torn away from their roots in the root zone; sometimes they have been detached from their roots by subsequent erosion. The former connexion can, however, be ascertained from the similarity of the rocks.

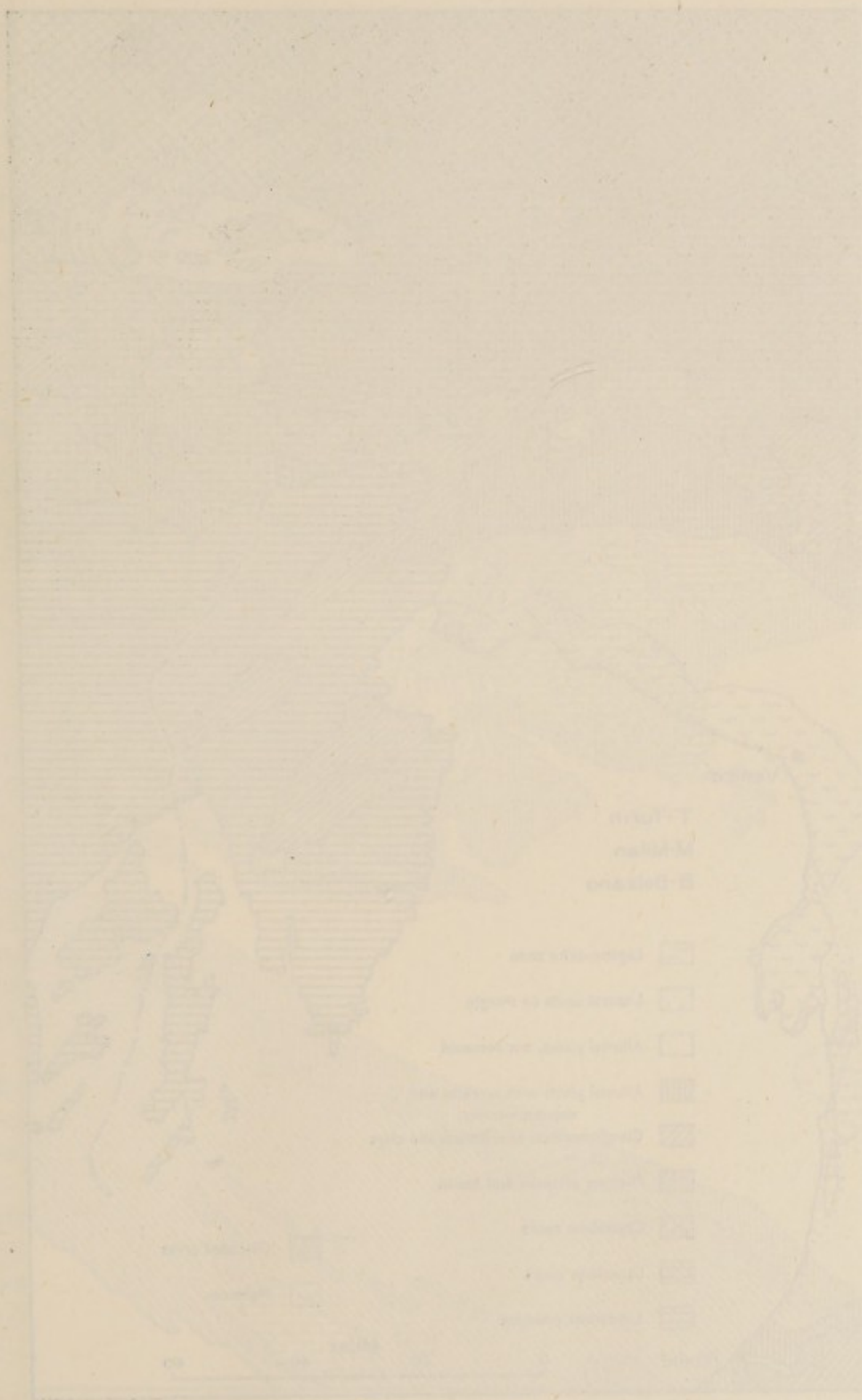
Other principal features of the Alps, the metamorphism of many of the rocks due to the enormous pressures exerted by the folding (p. 25), the accompanying intrusion of igneous rocks (p. 28), and the subsequent intensive glaciation (p. 31), have already been described. The net result of all these influences has been to produce a mountain region of tremendous grandeur and beauty, but of the utmost topographical complexity. The following pages attempt to describe in broad terms the main regional features and differences, which have already been outlined under the three main headings of the (1) Western Alps, (2) Central Alps, and (3) Eastern Alps (p. 193).

*Vegetation.* The vegetation of the Italian Alps, as of any other mountain region, is arranged in altitudinal zones (Fig. 79), although the width and limits of these vary in different parts of the chain. In the higher zones there are considerable floristic differences between the eastern, central, and western sectors, but the broad vegetational types (p. 440) are throughout very similar in appearance. In general, it is true to say that the greater the height, the more closely the plant cover approaches the original, natural vegetation.

The Alpine pastures of the high mountain zone (p. 457) have substantially retained their original composition in spite of their use for grazing. They extend to the limit of permanent ice and snow except where rock and scree restrict the vegetation to a more open type. Their mean lower limit, which is the upper limit of trees, is higher towards the interior than near the margin of the chain (Val d'Aosta, 7,500–7,900 ft.; the region of the great lakes, 5,600 ft.), but on the whole becomes lower towards the east (Ortles, 6,900 ft.; Julian and Carnic Alps, 4,900–5,200 ft.). These pastures are covered with snow in winter, but are used in summer by cattle and sheep brought up from the valleys or neighbouring plains. Meadows cut for hay occur in places in the lower part of the high mountain zone.

Below the tree-line, forest, mainly coniferous but with some beech, would, under natural conditions, clothe the slopes except where these are too steep or rocky. Many of the forests have been cut and even completely cleared, especially on sunny and gentle slopes and







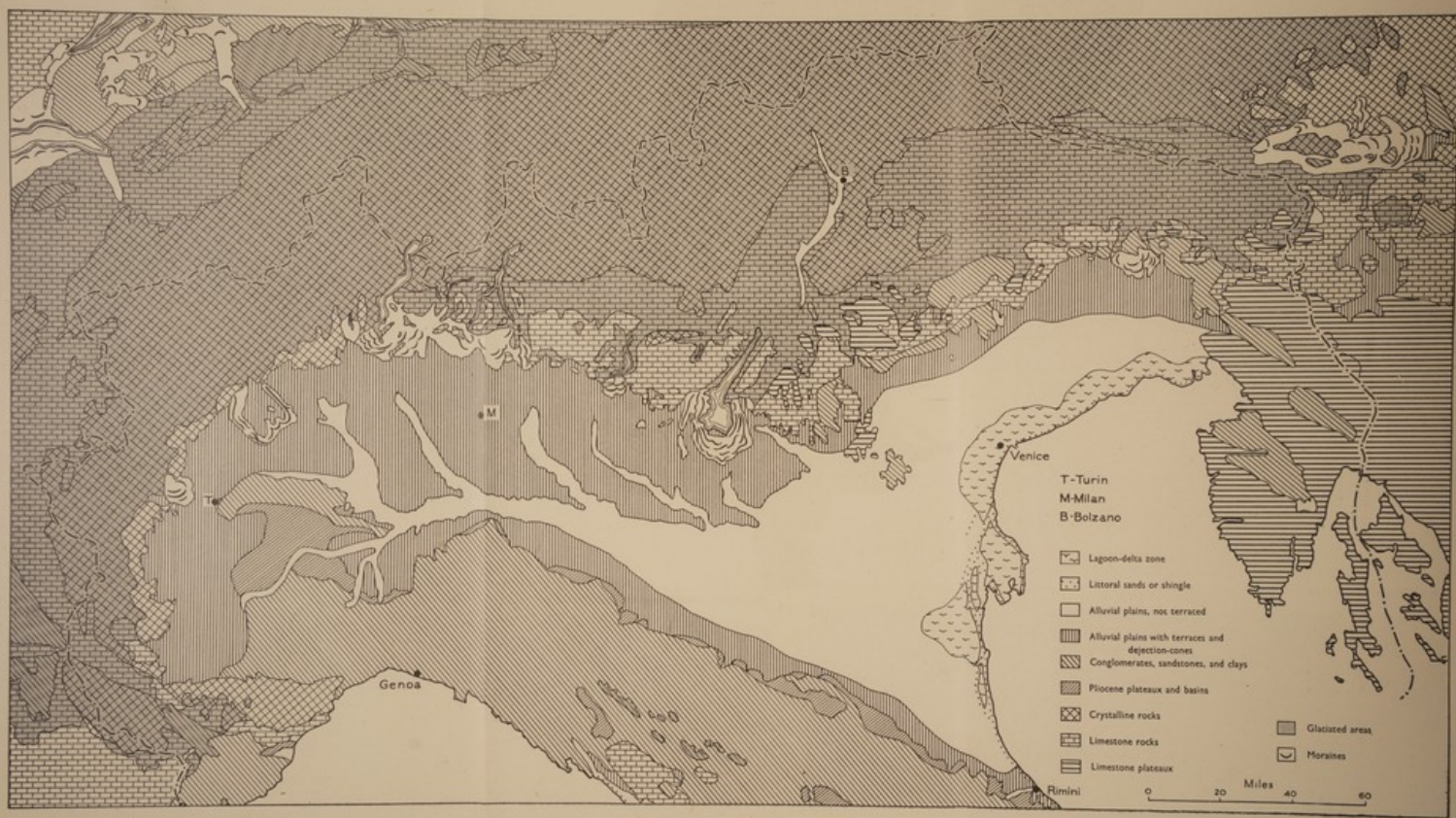


FIG. 38. Landform types: Northern Italy



at lower levels, although at the same time there has been a certain amount of reafforestation. The most common conifers are larch (especially in the east), spruce, and black and Scots pine, with other pines and white fir locally. The beech is found up to an altitude of 6,000 feet. The trees may grow in pure or almost pure communities of considerable extent, but are often mixed together in varying proportions.

This forest belt was originally succeeded at an average altitude of about 3,000 feet by oak forests, but these have now largely been replaced by chestnut woods, meadows, and arable land. There has even been some extension of chestnut woods to higher altitudes (to 3,600 ft. and to over 4,300 ft. in the Val d'Aosta), and cultivation also extends in places into the higher forest belt (up to about 4,300 ft., and in extreme cases in the Val d'Aosta, 6,900 ft.). Hay meadows are found at all altitudes in the montane zone (p. 446), but especially on the valley floors, where they are often irrigated. The cornfields are usually either intermingled with them or immediately above, while chestnuts occupy the steeper slopes. The arrangement of the vegetation and agricultural zones in an Alpine valley is shown on the map of the east side of the Dora Baltea valley (Fig. 41). In this rather dry part of the chain limits are perhaps rather higher than the average, but otherwise the arrangement shown is fairly typical. The upper limits of cultivation of both vine and maize occur within this oak and chestnut zone. The vine penetrates from the plain into all the larger transverse valleys, and on sunny slopes rises to 2,000–2,300 feet in the Maritime Alps and around the great lakes, and to 1,300–1,600 feet in the extreme east. In the Val d'Aosta grapes ripen at 4,000 feet, a level higher than any reached even in Sicily or Spain. Vines and fruit trees are grown in specialized plots, the vines often being raised off the ground, sometimes, as in the Trentino, on pergolas formed by intertwining their stems.

Exceptional climatic conditions are found around the shores of the great lakes, and have caused the development of Mediterranean vegetation, particularly round Lake Garda. In these 'oases' are found *macchia* and such crops as olives (up to 1,300 ft.) and lemons, as well as gardens with decorative palms and a wealth of subtropical plants. This luxuriant vegetation is restricted to the immediate vicinity of the lakes. It is, however, also found in a few localities on the south-east slopes of the limestone *Mi. Lessini* (olives up to 1,600 ft.).

*Settlements.* Towns and villages are naturally attracted to the



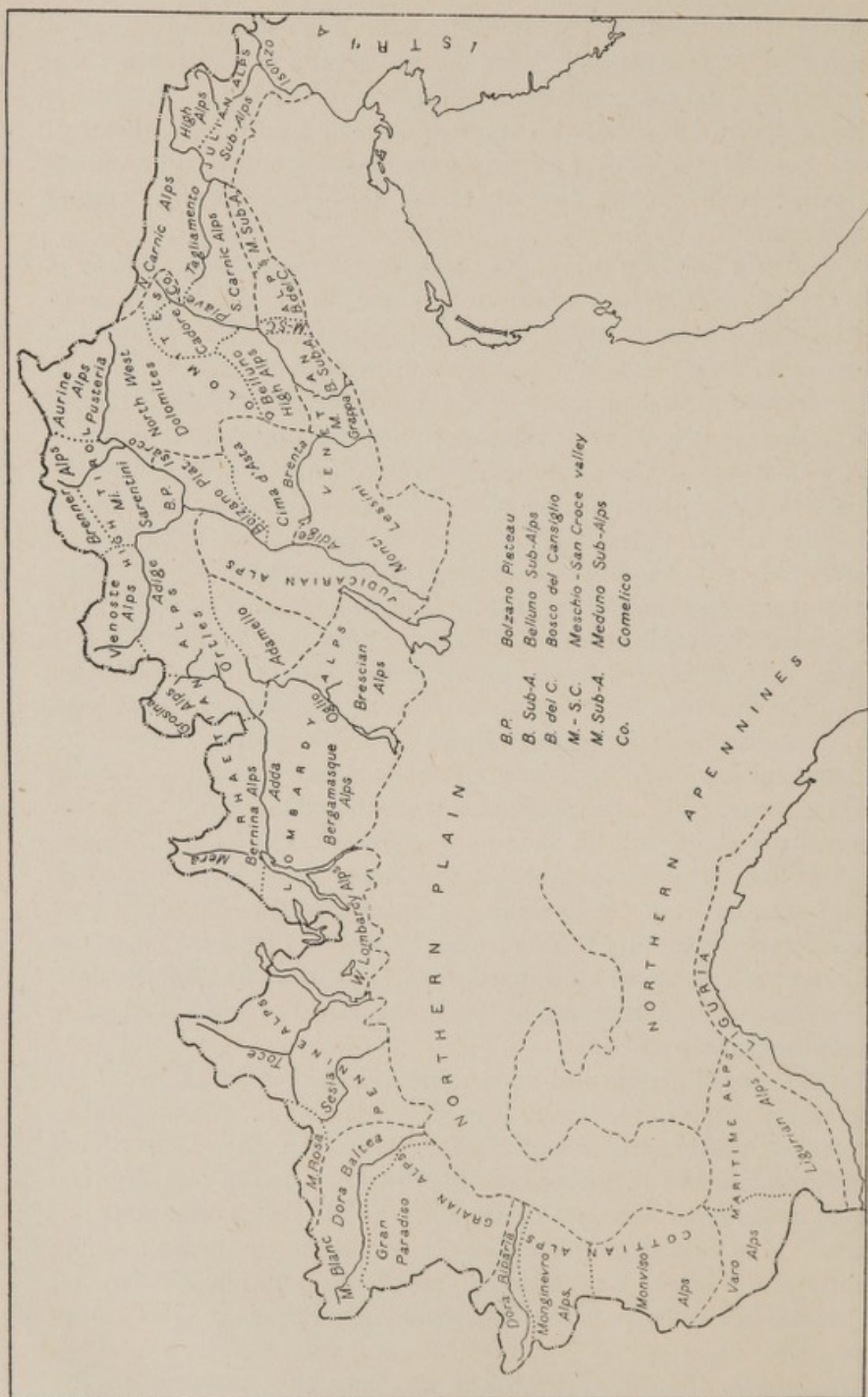


FIG. 39. The Subdivisions of the Alps



valleys, and particularly to the larger valleys where more extensive areas of fertile land, better power and factory sites, and routes are all available. Agricultural settlements are, however, much more scattered than industrial and route centres and often spread to considerable heights up the mountain-sides. At high altitudes there are communities of huts used by shepherds during the seasonal migration of their flocks to the summer pastures. Some of the highest settlements of all are tourist or health resorts.

Although the Alps as a whole are not densely populated and there may be extensive areas without any settlements at all, high densities occur in the larger valleys and in the foothills, particularly between Turin and Vicenza, where the textile industry is most widespread. In the Western Alps the Dora Riparia and Dora Baltea valleys are the most closely settled. The Central Alps include the greater part of the textile regions and the concentrations of settlements, agricultural, industrial, and tourist, along the lake shores. The Adige valley is notable for the important route-centres of Trento and Bolzano. In the Eastern Alps, where industrial development is much less advanced and population is still mainly of the scattered agricultural type, the largest settlements are in the major valleys, the Piave, Tagliamento, and Isonzo. Elsewhere settlement is only close along the junction of the Alps and the Northern Plain.

*Communications.* Although not an impenetrable barrier, the Alps present a great obstacle to communications. Routes are naturally confined to the valleys, and in order to pass from one to another have to cross saddles or cols, or even to tunnel through the intervening ridges. The valleys of the Italian Alps are mostly transverse (p. 20) and thus encourage routes between the Northern Plain and adjacent countries or local route-centres within the Alps themselves. As a result the major route-centres for the Alps have grown up in the Northern Plain at the dominant cities of Turin and Milan. Other, but less important centres are Cuneo, Novara, Bergamo, Brescia, Verona, Vicenza, Treviso, Udine, and Gorizia. Nodal centres within the Alps themselves are few owing to the comparative lack of longitudinal (p. 20) routes. In the Western Alps there are no longitudinal routes, but they become increasingly important towards the east. Thus the principal route-centres within the Alps, Trento, Bolzano, and Belluno, are in the eastern half; others elsewhere are chiefly found where a town stands at the junction of main and tributary valleys. The railways, which are almost without exception followed by roads, are confined to the larger and more densely

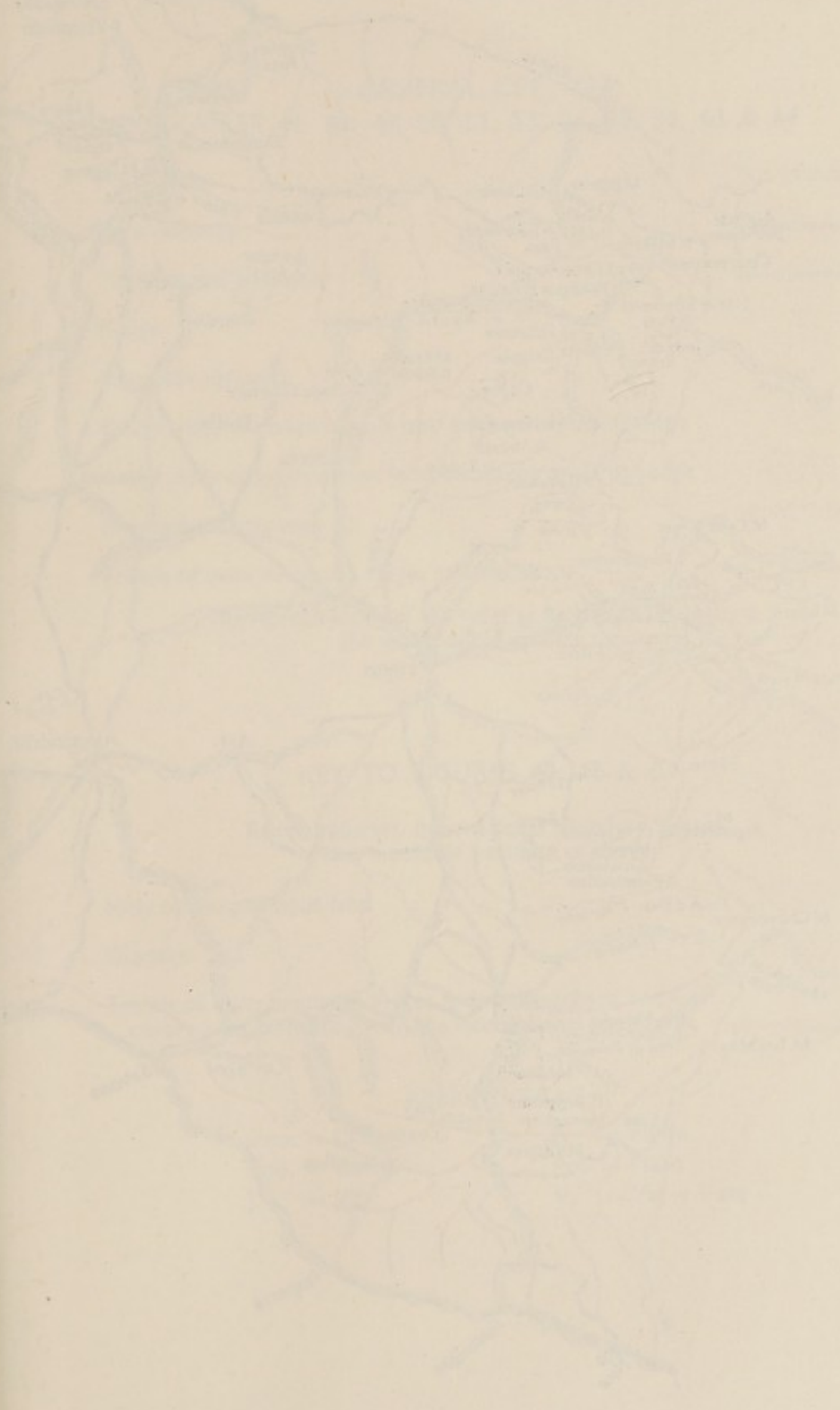


populated valleys. Roads are far more widespread, but the more difficult country is either entirely avoided by routes or served only by mountain tracks and paths.

Eleven railway lines cross the Italian Alps. Most of these follow main valleys leading to some famous pass, which often has to be negotiated by a long tunnel. Amongst the most important of these lines are three diverging from Turin to (1) Savona by the Cadibona pass, (2) Ventimiglia by the Tenda pass and tunnel, and (3) France by the Valle di Susa and Mont Cenis tunnel (4,245 ft.). Between Turin, Milan, and Bergamo numerous branch-lines lead from the Northern Plain into Alpine valleys, but two important international routes cross the Alps from Milan: (4) the Simplon line alongside Lake Maggiore and up the Toce valley to the Simplon tunnel (alt. 4,078 ft.), and (5) the Saint Gotthard line through the town of Como to Bellinzona, in Switzerland. (6) The line from Milan along the Adda valley and over the Bernina pass in Switzerland has a break of gauge at Tirano. (7) The Brenner line from Verona to Innsbruck along the Adige and Isarco valleys, and its important (8) branch to Klagenfurt through Dobbiaco are both noteworthy in that they cross the frontier without any major tunnels. The Brenner pass is crossed at a height of 4,498 feet and the Dobbiaco pass at 4,232 feet. In the Eastern Alps there are few railway routes. The main line from Udine follows the Tagliamento valley, along which there are many tunnels, and then the Canale del Ferro to Tarvisio, where it divides into two: (9) the main line crosses into Austria, and (10) the branch-line into Yugoslavia. (11) The railway from Gorizia along the Isonzo valley enters Yugoslavia through the Piedicolle tunnel at a height of 1,660 feet. The Alpine railways have steep gradients and sharp curves and are, to a large extent, electrified.

The main international roads, although more numerous than the railways, follow very much the same routes. Unlike the latter, the roads do not cross the higher passes by tunnel. Many of them are, accordingly, liable to be blocked by snow for certain periods every year. Most of the passes below 5,000 feet are only blocked intermittently, but at higher elevations they may be closed for considerable periods, usually from November to May or June. Generally speaking, the eastern passes are the less liable to be closed. Many of the Alpine roads are exceedingly spectacular with their steep gradients, hair-pin bends, tunnels, and protective works against snowfall and avalanches.







Main roads	
Main railways	
International boundary	
Passes	
Mountain summits	
Rough, hilly or mountainous land with gently rising edge	
Rough, hilly or mountainous land with steep or abrupt edge	
Principal escarpments	
Trends of main mountain ridges and chains	

KEY TO FIGURES 40, 42 & 43

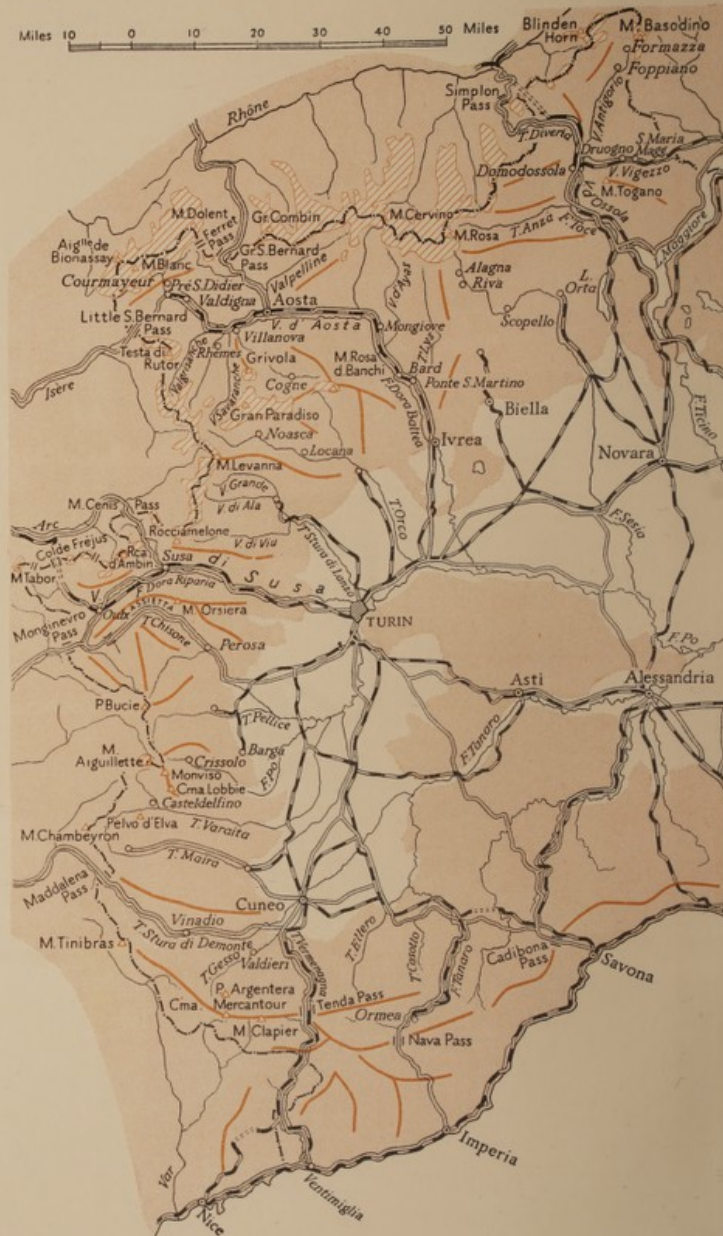
Hilly or mountainous land . . . . .

Glaciers . . . . .

Trends of main mountain ridges and chains where not ice-covered nor coinciding with the international boundary .

Cma. = Cima  
Cno. = Corno  
J. = Jof

P. = Punta  
Pzo. = Pizzo  
V. = Val or Valle

FIG. 40. *The Western Alps*



## THE WESTERN ALPS

The Western Alps extend for about 250 miles from the Cadibona pass in the south, where they continue into the Northern Apennines, to Lake Maggiore in the north, and include some of the most famous peaks and valleys of the whole range. They consist of a great semi-circle of mountains which trend mainly from south to north but have easterly prolongations at either end. Except in the south, where the whole width of the range is Italian, and in the extreme north-east, the frontier follows the main watershed and coincides with the line of the highest peaks.

Compared with the Central and Eastern Alps the Western Alps are narrow and topographically simple, for they consist of a single principal chain, the Italian slopes of which have been dissected into buttresses by deep and fairly straight river valleys converging on the plain of Piedmont. The Alps rise very steeply from the plain without any intervening foothills other than the low morainic hills at the entrance to the Dora Riparia, Dora Baltea, and Ticino valleys. Monviso (12,608 ft.) is only  $12\frac{1}{2}$  miles from Barga, the nearest point on the plain, and although the chain becomes wider farther north, it is only 27 miles from Biella to M. Rosa (15,217 ft.) on the frontier.

The physical pattern of the Western Alps allows them to be divided simply along the transverse lines of the Stura di Demonte, Dora Riparia, and Dora Baltea valleys into four blocks, the Maritime, Cottian, Graian, and Pennine Alps (Fig. 39).

The Western Alps are composed of three main structural belts:

(1) The crystalline Hercynian massifs, including Mercantour (Argentera), Pelvoux, Belledonne, and Mont Blanc. These formed the resistant blocks against which the more pliable beds to their south and east were folded. The massifs themselves were not folded, but were extensively faulted and displaced. Owing to their resistant nature they still form rugged, high mountain regions.

(2) The Pennine nappes, a highly folded region, which is further divisible into (a) the Briançonnais zone, composed of sedimentary rocks, mainly sandstone, and (b) the dominantly crystalline zone of the schistes lustrés, which include calcareous slates, shales, sandstones, breccias, and intercalations of *pietre verdi*, enveloping the cores of the major Pennine nappes formed mainly of rocks of Primary age. The most important of these nappes are: the Great Saint Bernard, which extends from the coast near Savona to the Stura di Demonte valley and appears again in M. Tabor, and in the upper



Dora Baltea and the Saint Bernard passes; the M. Rosa, which stretches from the Maira valley through the Gran Paradiso to the M. Rosa group itself; and the Dent Blanche, which includes much of the Graian Alps (Fig. 37).

(3) A narrow crystalline band along the margin of the Northern Plain between Ivrea and Lake Maggiore which consists of part of the root zones of the Grisonid and Tirolid nappes. A small area to the south of this band near Lake Maggiore consists of the western extremity of the dominantly limestone Dinarid nappe. The first two zones are here topographically indistinguishable from the zone of the Pennine nappes, whilst the Dinarid nappe has been covered almost completely by the later deposits of the Northern Plain. All three, however, widen out farther east in the Central Alps.

### *Subdivisions*

#### *The Maritime Alps*

The Maritime Alps, 1,800 square miles in area, extend about 85 miles from the Cadibona pass (road 29) in the east to the Stura di Demonte valley and Maddalena pass in the north-west. The Tenda pass (5,971 ft.) divides this mountain group into two, the *Ligurian Alps* in the east and the *Varo Alps* in the west. The Ligurian Alps (average height below 6,500 ft.) are really a western extension of the Apennines, and are composed almost entirely of sedimentary rocks (sandstones and marls). Their forested slopes are, for the most part, rounded and gently undulating, but rise abruptly from the coast (p. 57). The Varo Alps (average height 8,000–10,000 ft.), which consist mainly of the Mercantour massif, are predominantly crystalline and are more rugged and considerably higher. Many of their peaks exceed 9,500 feet, such as M. Tinibras, 9,944 feet, M. Clapier, 10,010 feet, Punta Argentera, 10,817 feet, and there are two small glaciers (Maledia and Clapier), the most southerly of all Alpine glaciers. A band of sedimentary rocks flanks the crystalline nucleus on the north along the Stura valley and has given rise to a monotonous, hilly country with wide valleys and gentle slopes, forming part of the Briançonnais zone.

The Italian section of the outer slope of the Maritime Alps rises steeply from the coast (p. 57; Plate 45). The inner face has been dissected by many short, transverse streams all of which eventually flow into the river Po. The most easterly flow from south to north, but the general direction of the streams gradually changes until in the west





PLATE 45. *The Maritime Alps near Finale*



PLATE 46. *The Upper Tanaro valley near Garessio, in winter*





PLATE 47. *The Dora Riparia valley at Susa*



PLATE 48. *The Gran Paradiso Massif*



it is more or less from west to east. These valleys have been of great importance to settlement and communication, and are often the only well-known parts of the mountains. Coniferous forests clothe the upper slopes, while chestnuts predominate on the lower valley-sides. Where the valleys widen out pasture occupies most of the level ground, and settlements occur. East of the Tenda pass, the Tanaro, Casotto, Ellero, and Vermenagna valleys are all very similar. In the west the lower parts of the valleys are wider but the upper stretches in the crystalline rocks become narrow and steep (Plate 46). The Gesso valley below Valdieri is broad and flanked by wooded hills; above Valdieri it becomes narrower and truly Alpine in character, with a twisting, incised course, and steep sides covered with chestnuts on the lower and firs on the higher slopes. The Stura di Demonte, which rises on the Maddalena pass, is the longest river (31 miles) of the Maritime Alps. Up to Vinadio the valley floor has an average width of half a mile; above it wild gorges alternate with wide basins, and majestic peaks rise on both sides.

Roads cross the Maritime Alps, in the east by the Cadibona pass (1,427 ft.; 29), and by the Tanaro valley and Nava pass (3,064 ft.; 28), in the centre by the Vermenagna valley and Tenda pass (2,674 ft.; 20), in the north by the Stura di Demonte valley and the Maddalena pass (Col de Larche, 6,549 ft.; 21). A railway between Cuneo and Ventimiglia or Nice uses the Tenda pass, and another follows the Tanaro as far as Ormea. Apart from these routes the Maritime Alps are poor in communications, since the country is not easy to cross and the population is not sufficient to warrant a more complete network.

### *The Cottian Alps*

The Cottian Alps rise immediately to the north of the Maritime Alps and stretch for 50 miles from the Stura di Demonte and the Maddalena pass to the Mont Cenis (Moncenisio) pass and the F. Dora Riparia on the north. The frontier follows the main watershed which reaches its most westerly point in M. Tabor (10,423 ft.). In the east the Cottian Alps rise abruptly from the Northern Plain (p. 258). The mountains are very variable in width, about 30 miles in the south, 15 miles in the centre, but about 45 miles in the latitude of the Dora Riparia. The Cottian Alps are for the most part formed of the crystalline M. Rosa nappe, and the Briançonnais zone is only a prominent feature in the neighbourhood of M. Chambeyron in the south and in the extreme west between Monginevro and M. Tabor. The relief is lofty and rugged, with the eastern flank of the main



north to south longitudinal ridge cut into short parallel buttresses by powerful rivers. Although there are many high peaks, the average height is lower than that of the Maritime Alps, and consequently there are no important glaciers. Both the Po and the Dora Riparia, one of its most important tributaries, rise on the flank of Monviso.

The Cottian Alps consist of three more or less distinct transverse sub-regions. The most southerly sub-region, the *Monviso Alps*, is made up of parallel east to west ridges south of the T. Pellice. These extend from the main frontier chain to the plain and have an average height of about 8,000 feet, while many peaks are considerably higher, e.g. Pelvo d'Elva (10,052 ft.), Cima Lobbie (9,891 ft.). The principal frontier crest-line reaches 11,119 feet in M. Chambeyron, 10,820 in M. Aiguillette, and 12,602 in Monviso. The conical summit of Monviso, about 1,500 feet higher than any other Cottian peak, towers above the surrounding country. Separating the east to west ridges are deep river valleys such as the Valle Maira, Valle Varaita, and Valle del Po. These valleys vary in size and importance, but all have wide, flat-floored, lower stretches with constricted upper sections, within which are small basins where population has concentrated. The Valle Maira (road 22) has a spacious floor cultivated with vines alternating with pasture, and its lower slopes are covered with chestnut groves and its upper with coniferous forests. The Valle Varaita also has a wide floor, and is flanked by undulating hills in the lower course. Above Casteldelfino the Varaita is fed by two streams: the Bellino flows through wild country and is hemmed in by steep, rugged walls, while the Chianale flows through wide basins and gently undulating hill-land. The river Po in the Alpine part of its course is no more important than any of its tributaries. Below Crissolo the river winds through green, chestnut-covered hills, but above it the valley becomes tortuous and deeply incised.

The central region of the *Monginevro Alps*, which extend northwards to the Dora Riparia, has a fairly low average height. All the highest peaks are along the watershed in the southern half, where chains radiate in all directions from a small central ridge from which Punta Bucie (9,836 ft.) rises on the frontier. These short chains, which extend north and east, are separated by wide valleys occupied by the Pellice and the tributaries of the Chisone. North of the Chisone the landscape changes. Instead of many small ridges there is one main ridge, the Assietta, which extends in a sweeping curve between the Chisone and Dora Riparia valleys and rises very steeply from the former and more gently from the latter. The highest peak is



M. Orsiera (9,442 ft.), but the average height of the ridge is little over 6,500 feet.

The Pellice, like the rivers in the Maritime Alps, has a wide lower valley, well cultivated and flanked by gentle hills, and an upper valley of very deep, narrow stretches alternating with wider picturesque basins. The Chisone valley (road 23), which is very similar but on a larger scale, is wide and cultivated with wooded slopes below Perosa where the Germanasca valley enters from the south-west; above the town it is tortuous and incised, with coniferous forests and pasture on the valley sides, and wonderful Alpine views from the small basins. It communicates over the Sestrières pass (6,670 ft.) with the upper Val di Susa.

The third sub-region to the north of the Assietta ridge consists of the *Dora Riparia* valley or Val di Susa and the *Mont Cenis* (Moncenisio) chain. From Monginevro the frontier and watershed run north-westwards to M. Tabor (10,423 ft.), but thence they follow the Mont Cenis chain almost due east to Rocca d'Ambin (M. Rosa nappe), where the direction changes to north-east. Most of the main peaks are of crystalline schist, but part of the extreme west round M. Tabor, which is of Primary limestone, is within the Briançonnais zone. The chain has been cut through by many passes, such as those of Scala (5,716 ft.), Valle Stretta (8,008 ft.), and Étiache (9,193 ft.), but only the Monginevro (24) and Mont Cenis (25) are used by road; the railway tunnels under the Col de Fréjus. To the south of the main watershed the F. Dora Riparia flows from west to east in one of the most important valleys of the Western Alps, the Val di Susa. It has been heavily glaciated, and consequently has a wide, level floor with occasional constrictions, fairly smooth sides of moderate height, and a morainic amphitheatre where it opens on to the plain. The Val di Susa is far more important than any of the Alpine valleys to the south. Not only the valley floor, but the sides also, are scattered with small agricultural villages, e.g. S. Didero, Bruzolo. The largest town, Susa, which has arisen at the confluence of the Dora Riparia and Cenischia and at the fork of the Monginevro (24) and Mont Cenis roads (25), stands in the midst of cultivated fields and meadows, scattered with trees. The natural terraces on the hill-sides are also cultivated (Plate 47). Above Susa the valley narrows considerably, but it is still fairly wide up to Oulx, where the T. Bardonecchia (Mont Cenis railway) enters the Dora Riparia. Both these streams have typically Alpine courses.

Apart from the main routes (Mont Cenis railway, and roads 23,



24, 25) from Turin along the Chisone and Dora Riparia valleys, the Cottian Alps are poor in communications. There are no other first-class roads or railways.

### *The Graian Alps*

The Graian Alps extend from the Dora Riparia in the south to the Dora Baltea and the Ferret pass in the north, a distance of about 50 miles, and include the great block of Gran Paradiso (13,323 ft.) and the south-eastern face of the Mont Blanc range. They are narrow in the south, but nowhere less than 30 miles wide, and more than 50 miles in the north. Many peaks exceed 10,000 feet and there are several over 13,000 feet, with the result that much of the main chain along the frontier and the Gran Paradiso block are covered with glaciers, in contrast to the lower, almost ice-free Maritime and Cottian groups. The sides of the mountains have been deeply cut by valleys on the lower slopes of which chestnuts flourish, with conifers above.

The valleys, although frequently narrow, steep-sided, and uninhabitable, contain the only settlements and routes. In the south the T. Stura di Lanzo is the master stream which collects the waters from three short valleys, the Val di Viu, Val di Ala, and Val Grande. All three have wooded sides, with cultivated fields and meadows where the floor is sufficiently wide, and all are followed by main roads. The Val di Viu is the narrowest, and the Val Grande the widest, its gentle sides being covered with chestnut groves. At the heads of these valleys towers the great snow-covered frontier chain of Levanna, which extends for about 13 miles from Rocciamelone (11,607 ft.) through Bessanese, a precipitous mountain 11,825 feet high, and Uia di Ciamarella (12,061 ft.) to M. Levanna (11,874 ft.). To the north of M. Levanna, and separating it from the main Gran Paradiso block, is the valley of the T. Orco, the lower part of which is known as the Valle di Locana. Up to Locana the valley is wide and cultivated, but onwards to Noasca it is more alpine, its slopes either forested or bare and stony. Above Noasca the valley is wild and rugged, with many steep-sided gorges, and only occasional widenings. The Soana tributary, which drains the land between Gran Paradiso and M. Rosa dei Banchi, is deeply incised and winding, with high, steep, wooded flanks. These valleys are separated from the north-flowing tributaries of the Dora Baltea by the main ridge of the Gran Paradiso.

The great massif of the *Gran Paradiso*, between the Orco and Dora Baltea valleys, has been deeply dissected by ice and snow, and the



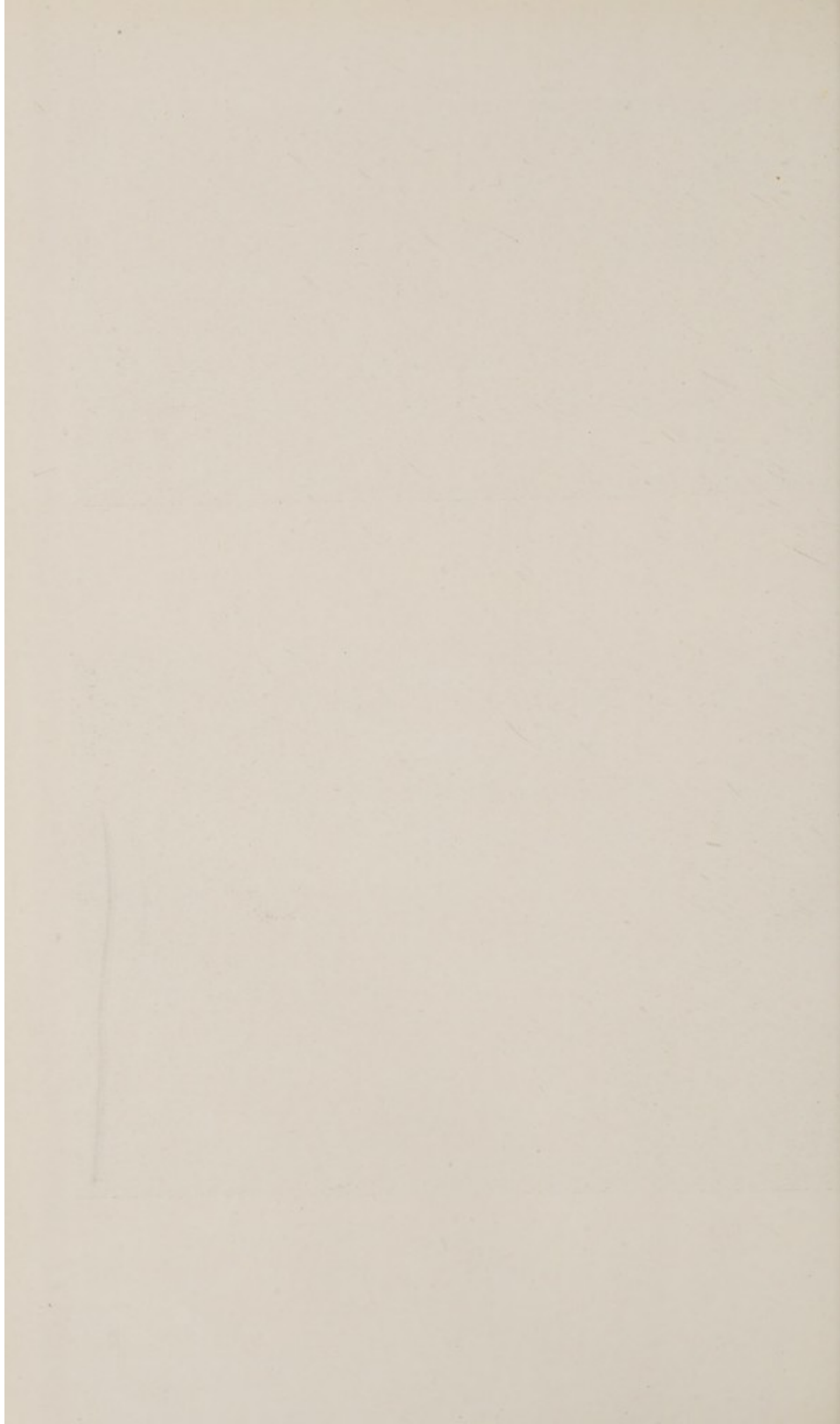


PLATE 49. *Courmayeur and the Mont Blanc chain*



PLATE 50. *The Valle di Gressoney at Gressoney la Trinité*







highest peaks are very sharp and jagged. Below 12,000 feet it is less rugged and debris from the heights has accumulated on the lower slopes, thereby making the surface more uniform. The main axis of the chain is from west to east, from Cima Ciarforon (11,932 ft.) to M. Rosa dei Banchi (10,377 ft.). After Gran Paradiso (13,323 ft.) the highest peak is Grivola (13,022 ft.). The massif is composed predominantly of crystalline rocks, and forms one of the larger remnants of the M. Rosa nappe. Glaciers straddle the ridge, but are far more numerous and larger on the north face than the south. The whole massif is now a national park (Plate 48).

The *Dora Baltea* basin comprises the extensive area, much of which is relatively low (about 8,500 ft.), extending between the Gran Paradiso in the south, Mont Blanc in the west, and the Pennine Alps, culminating in M. Rosa, in the north. It is here that the Western Alps reach their greatest width (55 miles from Mont Blanc to Ivrea). This structurally complex area consists of a great transverse depression, coinciding below Valdigna d'Aosta with the Dora Baltea valley, and the much smaller longitudinal trough of Val Veni and Val Ferret beneath Mont Blanc. The transverse depression has been cut through the M. Rosa, Dent Blanche, and Great Saint Bernard nappes. The M. Rosa nappe appears on either side of the Dora Baltea valley in the blocks of Gran Paradiso and M. Rosa, the Dent Blanche nappe in M. Mary and the outliers of M. Emilius, M. Rafre, and Pillonet, and the Great Saint Bernard nappe in the Valsavaranche region, Testa di Rutor, and on either side of the Great Saint Bernard pass. Much of the depression is floored by schistes lustrés of the Pennine nappes. The valley of the Dora Baltea opens above Pré S. Didier into the longitudinal trough of the Val Veni and Val Ferret. This is a depression in the Briançonnais zone, and is flanked on the west by the Hercynian mass of Mont Blanc and on the east by the Great Saint Bernard nappe.

The valley of the Dora Baltea, like the Valle di Susa, has been heavily glaciated, and consequently is much wider than its neighbours. Between Ponte S. Martino and Pré S. Didier the valley is called the Val d'Aosta, which name also embraces all the tributary valleys such as Valsavaranche, Valle di Rhêmes, Valpelline, Valle d'Ayas. Apart from gorges at Bard, 12 miles north of Ivrea, and at Mongiove on the great bend 8 miles farther north, the valley, as far as the town of Aosta, is wide, with green, well-cultivated slopes, scattered with villages and ruined castles. Wonderful views open up towards the magnificent snow-capped peaks of the Mont Blanc



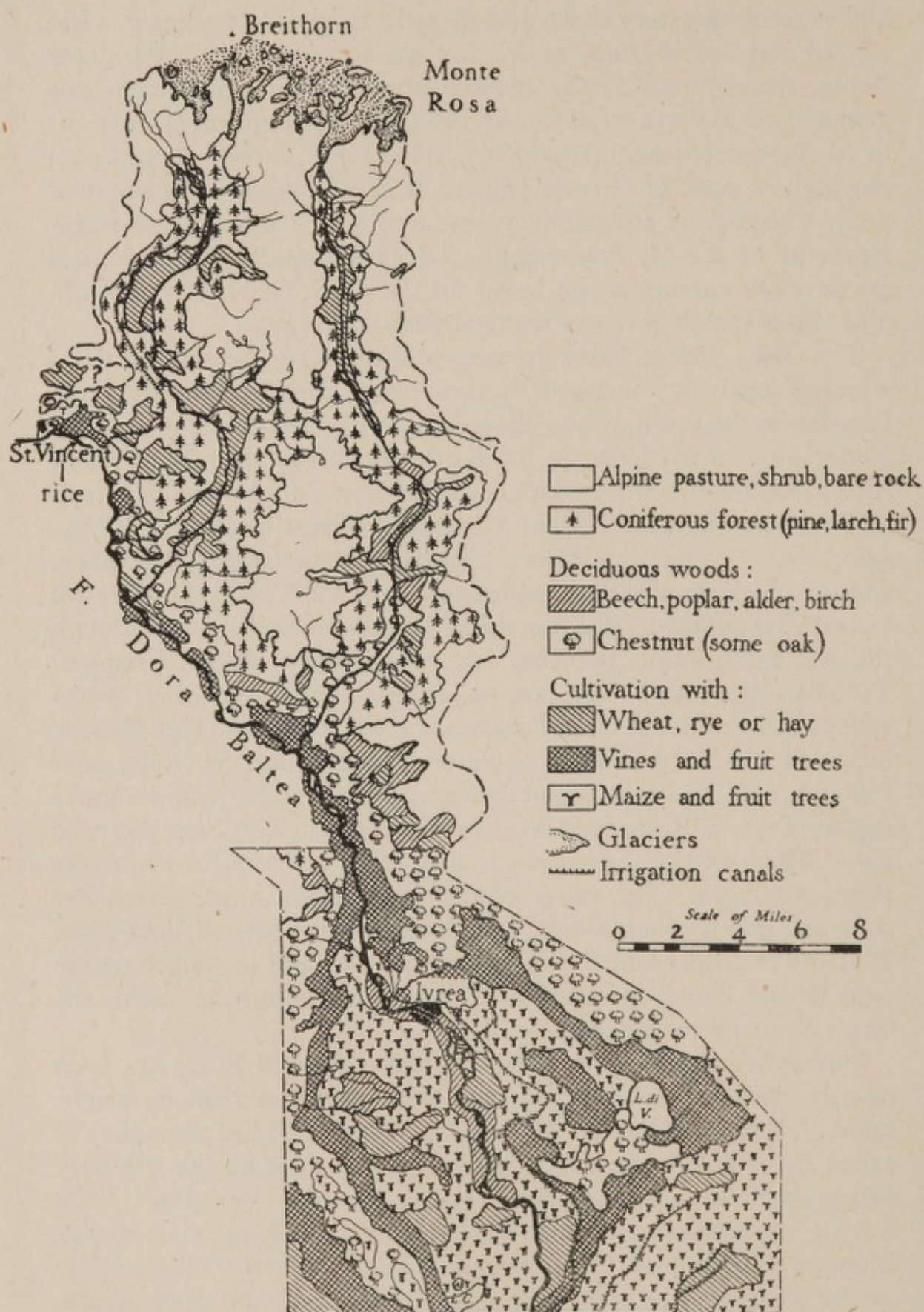


FIG. 41. *The Vegetation of part of the Middle Dora Baltea Basin*



chain. Above Villanova Baltea the valley narrows gradually and becomes twisting; the sides increase in height and are either covered with trees or are bare and rocky; narrow gorges alternate with basins. Magnificent peaks appear, and near Pré S. Didier the Mont Blanc group dominates the head of the valley. Rich vegetation with vines and cereals along the valley-sides contrasts sharply with the snow-covered mountains on either side (Fig. 41). Although it is not so populous as the Val di Susa, the Val d'Aosta has important industries and roads, and attracts far more visitors because of its own beauty and that of many of its tributary valleys, such as the Valle di Gressoney (Plate 50). Road 26 follows the Dora Baltea to Pré S. Didier, and thence by the Little Saint Bernard pass to the Isère valley. A second road (27) branches off at Aosta along the Valle del Artereva (or Artanavaz) to the Great Saint Bernard pass and so to the Rhône valley. There is a railway to Pré S. Didier, but it does not cross the frontier.

The Dora Baltea receives many tributaries from the north and south. The most important of the former flow northwards from the Gran Paradiso and are provided with a steady volume of water from melting ice and snow in addition to rainfall. The best known of these valleys are the Valle di Cogne, where there are iron-mines, Valsavaranche, Valle di Rhêmes, and Valgrisanche. All are picturesque, with steep wooded sides, occasional fertile basins, and magnificent views, and though difficult of access are frequented by tourists. Above Pré S. Didier the Dora Baltea flows through less rugged and lofty country, in the Briançonnais zone of Val Veni and Val Ferret. The Little Saint Bernard pass, Courmayeur, and the Ferret pass also lie within this zone (Plate 49).

The northern tributary valleys of the Val d'Aosta are more easily reached from the main valley. The T. Lys is the longest tributary of the Dora Baltea (25 miles), and its valley, the Valle di Gressoney, is of varying width and is shut in by very steep-sided mountains. The valley floor has few morainic deposits. The slopes are liable to landslides, particularly in the lower reaches. Along the sides of the lower Valle d'Ayas there are natural terraces, on which settlements have developed. The upper valley is rocky and bare, except for coniferous forests. The Valtournanche is the most picturesque of the Aosta valleys. It has several basins, the wide floors of which are covered with pasture and the sides partly cultivated with vines and cereals. The upper valley, at the head of which rises the magnificent peak of the Matterhorn, or M. Cervino, is very wild and rugged.



Although the Valpelline, which enters the Dora Baltea at Aosta, is one of the longest, it is also one of the least densely peopled of the tributary valleys.

The magnificent chain of *Mont Blanc* (average height 10,500 ft.), which rises to the north-west of the Val Veni and Val Ferret, forms the main watershed for 25 miles between the Aiguille de Bionassay (13,149 ft.) and M. Dolent (12,536 ft.) and has an average width of 10 miles. This great Hercynian mass is the highest region of the whole Alpine system, and the hinge on which it turns from a south-to-north to a west-to-east direction. Structurally this is an exceedingly complicated area. The main crest-line is composed of hard crystalline rocks, and these are flanked by softer beds. The chief peak derives its name from the snow and ice which cover it to a considerable depth. Partially snow-covered peaks rise, sharp and pointed, along the crest of the chain, separated and surrounded by glaciers, e.g. Allée Blanche, Miave, Brenva, and Triolet (Plate 51). On the Italian slope the glaciers are shorter and less important than on the northern face. The Dora Baltea and, in France, the Isère, Rhône, and Arve rivers are all fed by the Mont Blanc glaciers. The main chain continues north from M. Dolent, and is followed by the Franco-Swiss frontier. The Italo-Swiss frontier continues in a roughly west to east direction across the Ferret pass (8,343 ft.) to the main ridge of the Pennine Alps.

### *The Pennine Alps*

The Pennine Alps, flanked in the west by the Val d'Aosta and the Ferret pass, extend eastward for 70 miles to Lake Maggiore. The watershed and frontier are very winding between these limits and have a length of 150 miles and an average height of 11,500 feet, seldom falling below 6,500 feet. The M. Rosa crystalline zone predominates in the region, much of which is similar topographically to the Graian Alps (p. 198). The Pennine Alps essentially consist of a compact, fan-shaped group of crystalline rocks, the two main arms of which are directed to the north and west, and form one mighty, continuous snow-covered chain. This is followed by the frontier, and culminates in M. Rosa at the junction of the two arms. As farther west, the inner face is deeply dissected by more or less parallel valleys, which glaciation has in many instances widened out of all proportion to the size of the streams now occupying them.

The *Val Sesia* is the next important valley east of the Val d'Aosta. Much of its lower part is unglaciated. As far as Scopello the Val





PLATE 51. *Mont Blanc: the Giant's Tooth*



PLATE 52. *M. Rosa: Punta Gnifetti and the Macugnaga glacier*





PLATE 53. *The Upper Val Formazza*



PLATE 54. *M. Cervino (the Matterhorn)*



Sesia is wide, with a gently undulating, cultivated floor, and gradual slopes covered with beech and chestnut, but above the village it becomes increasingly alpine, the bleakness being broken only by a few basins, e.g. Riva and Alagna. The side-valleys, however, are truly alpine, with steep sides, narrow floors, and coniferous forests.

The great mass of *M. Rosa* stands at the head of the Val Sesia, and reaches 15,200 feet in Punta Dufour (Dufourspitze). The Pennine chain, of which it is part, extends from the Gran Combin (14,167 ft.) in the west, through M. Cervino (14,691 ft.) to M. Rosa (15,217 ft.), whence it turns almost due north and extends into Switzerland (Plates 52, 53). To the west the chain, which is made up of the M. Rosa, Dent Blanche, and Great Saint Bernard nappes, is limited abruptly by the Great Saint Bernard pass (8,114 ft.). Twenty peaks exceed 13,000 feet, and there are innumerable small glaciers with a combined area of 280 square miles. The majority of the glaciers are on the Swiss side.

East of the Sesia basin, Lake Orta occupies a deep, glaciated valley hollowed out of crystalline rocks and dammed by morainic deposits. It is the smallest of the great Alpine lakes except for Lake Idro and has a length of 8 miles, an average width of 1 mile, and a maximum depth of 469 feet. Lake Orta drains northwards into the Toce and so into Lake Maggiore.

The *Toce valley* is known in its lower part as the Val d'Ossola. This is roughly 1 mile wide and has a level floor and very steep sides. The turbulent F. Toce has many channels and is liable to flood, with the result that settlements are on the sides of the valley rather than on its floor. Road and railway also keep as far from the river as possible south of Domodossola.

The western tributaries of the F. Toce all flow almost due east from the M. Rosa mass. The T. Anza flows between beech- and chestnut-covered slopes in its lower course, but most of the valley is wild and rocky, with occasional basins where cultivation is possible. M. Rosa towers above the headwaters of the river. North of this valley the general level of the watershed falls rapidly to a little over 9,500 feet, and to just over 6,563 feet at the Simplon (Sempione) pass. This provides the first important route across the Alps east of the Great Saint Bernard. It is followed by road 33 and railway along the Toce valley to the upper Rhône valley into Switzerland.

Above the confluence with the Diveria the Toce valley is known as the Valle Antigorio as far as Foppiano (17 miles), and as the Valle Formazza thence to the Giacomo pass (15 miles) on the frontier.



The Valle Antigorio is very varied. At first it is wide with gentle slopes, while higher up it is deeply incised, and opens here and there into wide basins. Part of the valley floor is cultivated and part grassland. The slopes are covered with chestnuts, beeches, and conifers. The Valle Formazza is more alpine in character, with ice-capped mountains (Blinden Horn 11,102 ft., and M. Basodino 10,744 ft.) rising on either side. The basin of Formazza extends between two narrow gorge-sections. Above the basin the valley climbs steeply, and there are many waterfalls and several small lakes (Plate 54).

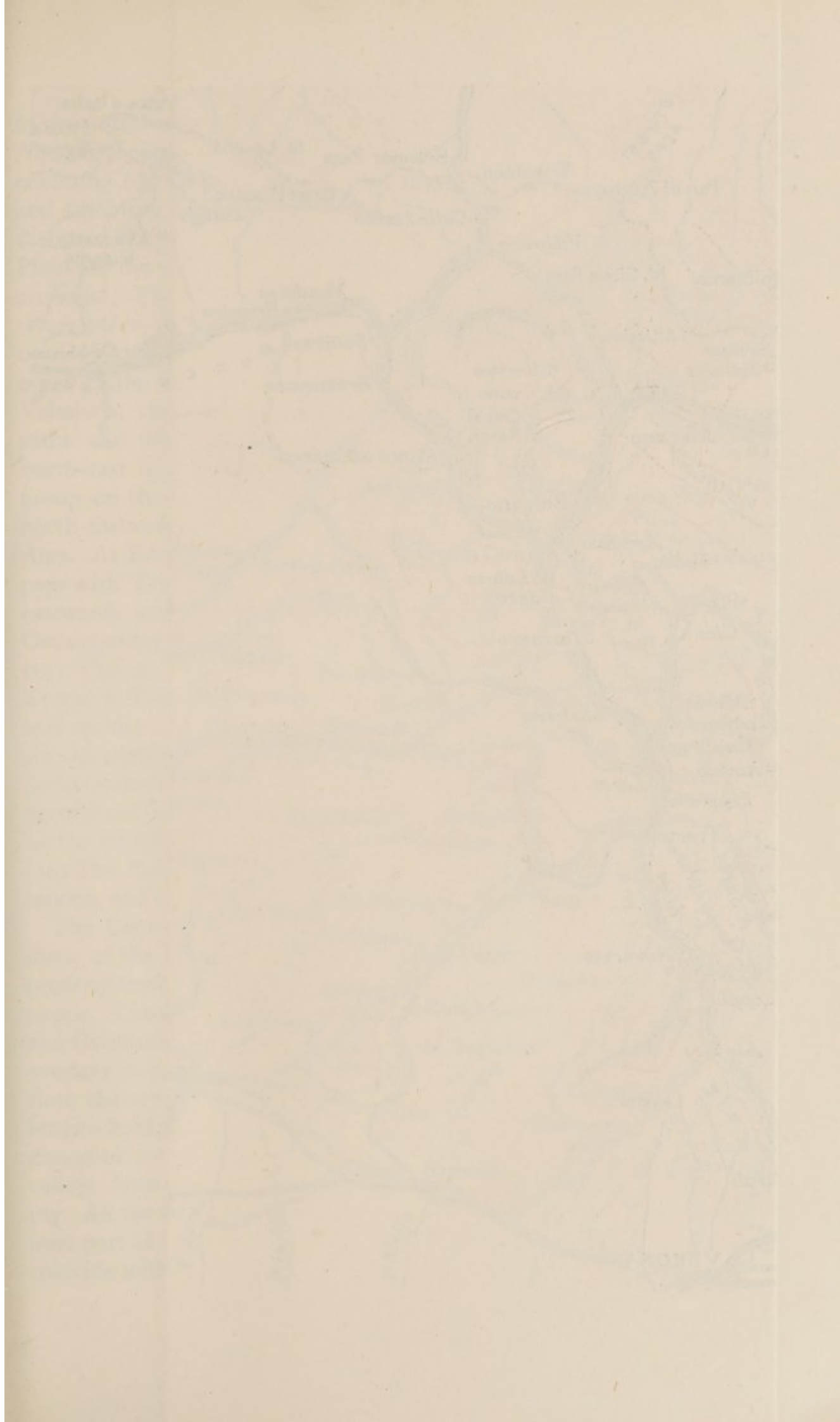
The Valle Vigezzo, which opens from the east into the Toce valley at Domodossola, occupies the western end of the discontinuous trough stretching from Domodossola through Locarno, the Valtellina, and the Val di Sole to Bolzano. Immediately above its junction with the Toce valley the Valle Vigezzo narrows to a series of deep gorges, but widens again at Druogno. Here and at S. Maria Maggiore the undulating floor is covered with fields, and the gentle valley slopes with chestnuts and conifers.

A high block of crystalline mountains rises within the ring of the Toce and Vigezzo valleys and Lake Maggiore. M. Togano (7,569 ft.) is the highest peak, but several others exceed 7,000 feet.

### THE CENTRAL ALPS

The Central Alps extend between the Northern Plain on the south and the frontier on the north, and from Lake Maggiore in the west to the line of the Adige, Isarco and Rienza valleys in the east. The whole region is composed of sixteen major subdivisions (Fig. 39). Along the southern margin are (1) The Lombardy Alps, or Sub-Alps, comprising the Western Lombardy Alps between lakes Maggiore and Como, and the Eastern Lombardy Alps extending between lakes Como and Garda. The Western Lombardy Alps are limited on the north by the frontier, and the Eastern Lombardy Alps by the west to east trough of the Adda valley and by the Judicarian Alps. (2) The Judicarian Alps form, in reality, a north-eastern continuation of the Eastern Lombardy Alps between the Adamello group on the west and the Adige valley in the east, and extend as far north as the Val di Sole and Bolzano. The Rhaetian Alps, which cover the greater part of the region between the Lombardy and Judicarian Alps and the frontier, are composed of (3) the Bernina Alps and (4) Grosina Alps to the north and west of the Adda valley, and (5) the Adamello and (6) Ortles groups to the east. The High Tirol, along the frontier











in the north-east of the Central Alps, is made up of (7) the Venoste Alps to the north of the upper Adige, and (8) the Brenner Alps enclosing (9) the Bolzano plateau and Mi. Sarentini on the south, and adjoining (10) the Aurine Alps on the east. The foregoing are the main blocks of highland, but leading into them from the Northern Plain are the valleys, where routes and population have been mainly attracted. The more important of the valleys, notably those of the rivers Mera, Adda, Oglio, and Adige, form in effect regions of their own. From the head of Lake Como (11) the Mera valley leads due north to the Splügen pass, and (12) the Adda valley, known as the Valtellina, extends due east between the Lombardy Alps on the south and the Bernina Alps on the north. At Tresenda it curves north-east between the Grosina Alps on the west and the Ortles group on the east. (13) The Oglio valley, or Val Camonica, runs north-eastwards from the head of Lake Iseo through the Lombardy Alps. At Edolo, where it is joined by the Val Corteno and Aprica pass with Tresenda in the Valtellina, the upper Oglio valley curves eastwards and provides a direct route between the Adamello and Ortles groups through the Tonale pass to the Val di Sole and Bolzano. (14) The Adige valley extends northwards from Verona through Trento to Bolzano and is flanked on the west by the Judicarian Alps and on the east by the Eastern Alps. At Bolzano the main valley curves north-westwards through Merano and between the Ortles group and the Venoste Alps to the Resia pass on the frontier. The general northerly direction of the valley below Bolzano is continued by the tributary (15) Isarco valley, which leads to the Brenner pass. (16) The Pusteria valley branches off from the Isarco valley at Bressanone, and extends along the southern margin of the Aurine Alps.

The Central Alps are composed mainly of crystalline rocks like those of the Western Alps, but have in the south a broad band of predominantly limestone rocks, which are part of the great Dinarid nappe. The crystalline belt is made up of the root zone of the Tirolid and Grisonid nappes in the south, of the Pennine nappes in the centre, overlain in parts by Grisonid, and farther north by Tirolid nappes. Both the crystalline and limestone regions have been rent by many longitudinal and transverse faults which have given rise to a broken, dissected country with very varied relief. Most of the important valleys, both transverse and longitudinal, coincide with lines of faulting. All the more important rivers follow longitudinal sections for at least part of their course, but it is notable that the great lakes mostly coincide with transverse troughs.



*Subdivisions**The Lombardy Alps*

The Lombardy Alps or Sub-Alps, which extend from Lake Maggiore to Lake Garda, are, as already suggested, divisible into western and eastern parts. The southern boundary is the Northern Plain, and the northern the Swiss-Italian frontier in the west and the Valtellina in the east. Although predominantly of limestone, the Lombardy Alps are bordered along their southern edge by glacial, particularly morainic, deposits, and along their northern edge by crystalline rocks.

The Lombardy Alps consist of highland blocks of various sizes, separated by through valleys and by long, narrow, glacial lakes, such as Maggiore, Lugano, Como, and Iseo, which succeed one another from west to east. The highland blocks are in turn further dissected by short, steep-sided valleys opening on to the Northern Plain. Up these different valleys mild, lowland climatic influences penetrate.

The *Western Lombardy Alps* cover an area between the Northern Plain in the south, lakes Maggiore and Como on the west and east respectively, and the Swiss-Italian frontier, which crosses Lake Lugano irregularly, on the north. They are composed of varied types of rock which exert great influence on the landscape. Glacial deposits, chiefly moraines, compose the southern fringe. Limestones predominate elsewhere except in the north, where there are crystalline rocks.

Lake Maggiore sharply divides this region from the Western Alps. It is the second largest Italian lake and has a length of 40 miles, a width of 1-3 miles (average  $2\frac{1}{2}$  miles), and a depth of 1,221 feet. The surface of the lake is at a height of only 637 feet, so that much of the bed is well below sea-level. Its shores are varied: the northern half is within the crystalline Tirolid belt; the southern half extends into the limestone Dinarid zone; and the extreme south is separated from the Northern Plain by a lofty moraine about 300 feet above the lake. It is drained through this morainic barrier by the F. Ticino and receives the waters of the Toce at the head of the western arm, and of the Maggia and upper Ticino in Switzerland.

The whole west shore of the lake and the northern part of the east shore are steep and grandiose, whereas south of Laveno the east shore is comparatively low. Magnificent hills (M. Zeda, 7,077 ft.), with many towns and villages, rise north of Intra, but the west shore becomes more and more deserted towards the north, with only





PLATE 55. *Lake Maggiore: Stresa and the Borromean Islands*



PLATE 56. *Lake Como at Menaggio*





PLATE 57. *The Como arm at Lake Como and the Northern Plain in the background*



PLATE 58. *Lake Como: the junction of the Como and Lecco arms*



occasional settlements. The east side is densely settled, especially between Laveno and Luino. Thick Mediterranean vegetation covers the steep hill-sides, which are frequently terraced and cultivated. Olives are grown in many places, and vines are extensive south of Stresa. Above Pallanza beautiful terraced gardens in the renaissance style climb up the hill-side.

The Borromean islands, the two best known of which are Bella and Superiore or dei Pescatori, are famous for their beauty. The former is only 550 yards long and 200 wide, but has a garden laid out in the old Italian style in ten terraces above the lake, and wide views of the shores of the lake and of the mountains beyond. The other island ( $\frac{1}{4}$  mile long and 150 yards wide) consists almost entirely of a picturesque fishing-village (Plate 55). Fishing in the lake is profitable.

Important roads and railways keep to the shores of the lake. The west shore is followed as far as the mouth of the Toce by road 33 and by railway from Milan to the Simplon pass, and then by road 34 to Locarno and Bellinzona in Switzerland. Road and railway follow the east bank from Laveno through Bellinzona and along the Ticino to the Saint Gotthard pass. Locarno is also linked by road and rail through the Valle Vigezzo with Domodossola. Other routes connect the lake eastwards with Varese and lakes Lugano and Como.

The southern edge of the Western Lombardy Alps is formed of glacial deposits, and particularly of the moraines blocking the southern ends of the great lakes. These consist of the eastern part of the Maggiore moraine between the lake and Varese, the Lugano moraines around Varese, the moraines of the Como arm of Lake Como eastwards to Erba, and finally the western part of the Lecco moraine. The moraines stretch southwards as undulating tongues of hilly country enclosing small lakes (e.g. Monate) in shallow hollows. Long north to south troughs separate the moraines and provide easy routes from the Northern Plain into the Alps. The valleys are the most densely populated areas of the moraine zone, but the whole region, and particularly Lower Brianza between Como and Lecco, is sprinkled with villages, many of them now small industrial centres.

Between the northern margin of the moraines and the steeply rising foothills of the Sub-Alps themselves there is a discontinuous east to west trough. This is most clearly marked in the west between Laveno and Varese, and in the east between Como and Lecco, where it separates Lower from Upper Brianza. In both stretches it contains small lakes, such as Varese and Annone, important east to west roads and railways, and particularly an unbroken chain of villages. In the



centre between Varese and Como the depression is less distinct, but is still marked by a dense population.

North of the morainic zone, forested mountains, predominantly limestone, rise steeply from the eastern shores of Lake Maggiore to the porphyry mass of M. Campo dei Fiori (4,023 ft.). These mountains are separated on the north by a deep transverse valley between Luino and Lake Lugano from part of the crystalline root zone of the Tirolid nappe. Only a small portion of this barren and sparsely populated mountain region is, however, in Italy.

Lake Lugano is very irregular in shape, since it consists of the submerged parts of two transverse valleys intersecting two longitudinal valleys. Only a small part of this lake, including the western shore of the western arm and the whole eastern end, is inside Italy. The lake is similar to the other larger Italian lakes with lakeside settlements, Mediterranean vegetation, and steep mountain-slopes rising almost direct from its shores. The eastern arm of Lake Lugano is separated from Lake Como by a steep limestone ridge which rises in parts to over 3,000 feet (p. 209). This ridge with its south-west to north-east trend forms a barrier between the two lakes, broken only by a deep valley, followed by road and railway, between Porlezza, at the head of Lake Lugano, and Menaggio, on Lake Como.

The remaining part of the Western Lombardy Alps is known as Upper Brianza and occupies the triangle between the Como and Lecco arms of Lake Como. This mainly limestone region has been highly glaciated and rises steeply above the depression between Como and Lecco to heights of 2,000–3,000 feet. These hills are sparsely populated, in comparison with the bordering shores of Lake Como and with Lower Brianza.

The shores of Lake Como (length 31 miles, Lecco arm 12, width  $\frac{1}{2}$ –2 $\frac{1}{2}$ , depth 1,345 ft., altitude 650 ft.) as far north as Bellano are formed of limestone, with dolomite predominating along the Lecco arm and schists along the northern. Thus each arm of the lake has its own characteristics. The slopes of the Como arm are steep and little dissected, but at the foot of the mountains there extends an almost uninterrupted strip of cultivated land. Very few streams are visible at lake level, since most of them are buried beneath loose rubble and debris brought down the mountain-side. Terraces rise above Argegno and Menaggio (Plate 56), each of which is the drainage centre of a small network of valleys. There is no river-outlet from the Como arm (Plate 57). At Lecco the shores of the lake continue in a wide glaciated valley occupied by Lake Garlate and the lower Adda.



Lake Garlate is about 3 miles long and 1 wide. South of it the densely populated Adda valley ( $1\frac{1}{2}$  miles wide) extends between low, glaciated hills 200–300 feet high, and is followed by the main Milan–Lecco–Splügen road (36) and the Milan–Sondrio railway. The dolomite shores of the Lecco arm of Lake Como are steep and wild, and in dull weather resemble those of a Norwegian fjord. Mighty walls rise almost from the water's edge to lofty, irregular peaks, with sharp knife-edges. The slopes are covered with patches of friable rock (Plate 58). The northern part of the lake penetrates beyond the limestone Lombardy Alps and has steep, almost parallel shores, above which rise massive ridges with high 'alpine' shoulders, and at still greater heights avalanche paths, corries, and small pyramidal peaks, such as M. Legnone (8,563 ft.). Where the larger rivers enter the lake alluvial fans have been built up and have provided sites for settlements, e.g. Bellano, Dervio.

The forests have been decimated on all the hill slopes, but grey-green is the predominant colour round the lake. The lower slopes are covered with stony heath or with sparse oak bushes, and the cultivated terraces with olives and other Mediterranean shrubs. Olives thrive up to 1,200 feet at Varenna, and are then succeeded by chestnuts. Elsewhere along the shore rise gardens green with cypresses, palms, cedars, magnolias, and mimosa, the widest strips of vegetation occurring round Bellagio and Cadenabbia. Here are the most striking colour contrasts between blue sky and white limestone rocks. Population is crowded along the lake shore, but the hills are almost uninhabited. Large settlements are, however, rare, and only the towns of Como and Lecco at the southern extremities of the lake are of any considerable size. The importance of the former has been greatly increased by the opening of the Saint Gotthard railway. Roads, like the settlements, cling to the shores, where there is generally a more or less level strip of land. Road 36 to the Splügen and a railway from Lecco to Colico and the Valtellina follow the east shore. The railway passes through at least twelve tunnels in a distance of about 30 miles.

The *Eastern Lombardy Alps* comprise two main subdivisions: the Bergamasque Alps between Lake Como on the west and Lake Iseo and the Oglio valley (Val Camonica) on the east; and the Brescian Alps which extend eastwards of Lake Iseo and the Val Camonica to the southern end of the Judicarian valley and to Lake Garda. The *Bergamasque Alps*, by far the largest sub-region of the Lombardy Alps, have no belt of morainic deposits fronting their southern edge,



but rise as isolated sandstone and marl hills, 1,300-2,300 feet high, directly out of the plain. These hills, which are separated by the wide funnel-like mouths of the Alpine rivers, notably the Valle Brembana, Valle Seriana, and Valle Cavallina, rapidly give way to a broad, rounded ridge of limestone (3,600-4,300 ft.), unglaciated for the most part, but incised by steep, narrow, winding valleys. North of this band of flat-topped mountains a further rise leads to an intensely folded region where glaciation has added to the confusion of the land-forms. Sharp knife-edges, ice-polished slopes, squat pyramids, and picturesque, terraced valleys are the chief characteristics of the landscape. The highest peaks are Pizzo Arera (8,242 ft.) and Pizzo della Presolana (8,271 ft.). Still farther north both limestone and crystalline rocks outcrop, and together form the ridge of the Orobic, extending from Pizzo dei Tre Signori (8,379 ft.), in the west, to M. Venerocolo (8,481 ft.), in the east. This is a gloomy ridge of sharp saw-edges and massive walls, rock-terraces and corries, tarns and waterfalls, and small glaciers above the tree-line. Most of the peaks are below 8,850 feet, but one, Pizzo di Coca, exceeds 10,000 feet. Several passes are as low as 6,500 feet (Plate 59).

The dissected foothills form a pleasant landscape, with chestnuts and oaks on the shady slopes, and cultivation, cypresses, and fig trees on the sunny sides, but no olives. The population is dense. Within the limestone belt settlement, cultivation and communications are confined to the valleys, where population is closest. The most famous and picturesque of these valleys is the Valle Brembana, but in all of them settlement is fairly dense, and many industries have arisen. Broad terraces are the chief characteristic of the Valle Seriana, with which is closely linked the broad, fertile hill-basin of Clusone with its glaciated floor. The much shorter Valle Cavallina contains the small Lake Endine and is followed by road 42 to the Oglio valley. Many farms and small villages are scattered high up on the hill slopes where fertile soil is found in the hollows (Plate 60). The outer slopes are almost treeless, but larches are widespread on the inner heights.

The *Brescian Alps* have clearly marked western, southern, and eastern limits, but are ill defined on the north, where they are bordered by the southern spurs of the Adamello group (p. 215) and by the Judicarian Alps, with which they are continuous. Like the Bergamasque Alps, the Brescian Alps are almost entirely unglaciated and have no morainic foothills. They consist of a fringe of sharp, dissected sandstone and marl hills, separated by embayments where rivers, such as the Mella and Gazza, emerge from the mountains





PLATE 59. *The Orobie ridge with Pizzo di Coca (right) from M. Gleno*

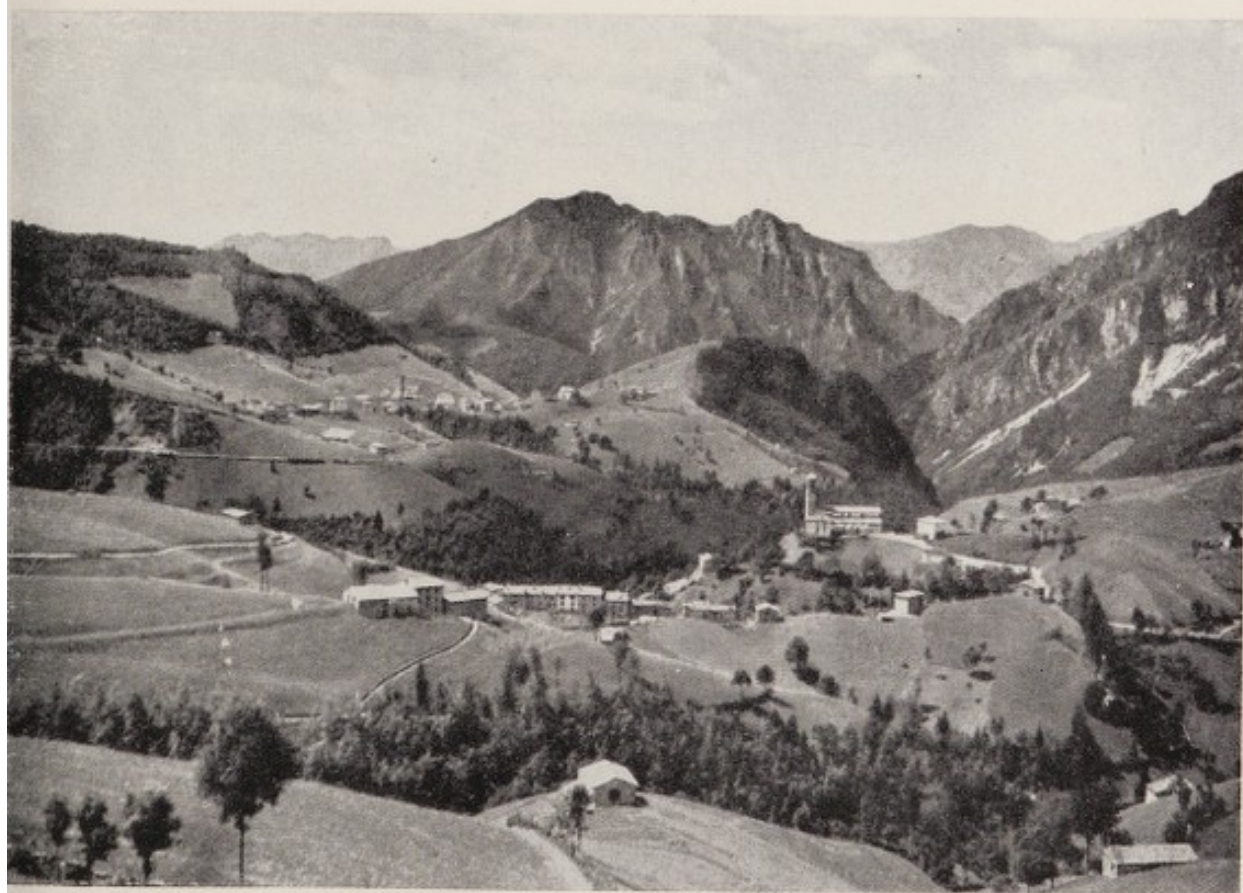


PLATE 60. *Bergamasque Alps: Oltre il Colle at the foot of M. Alben*



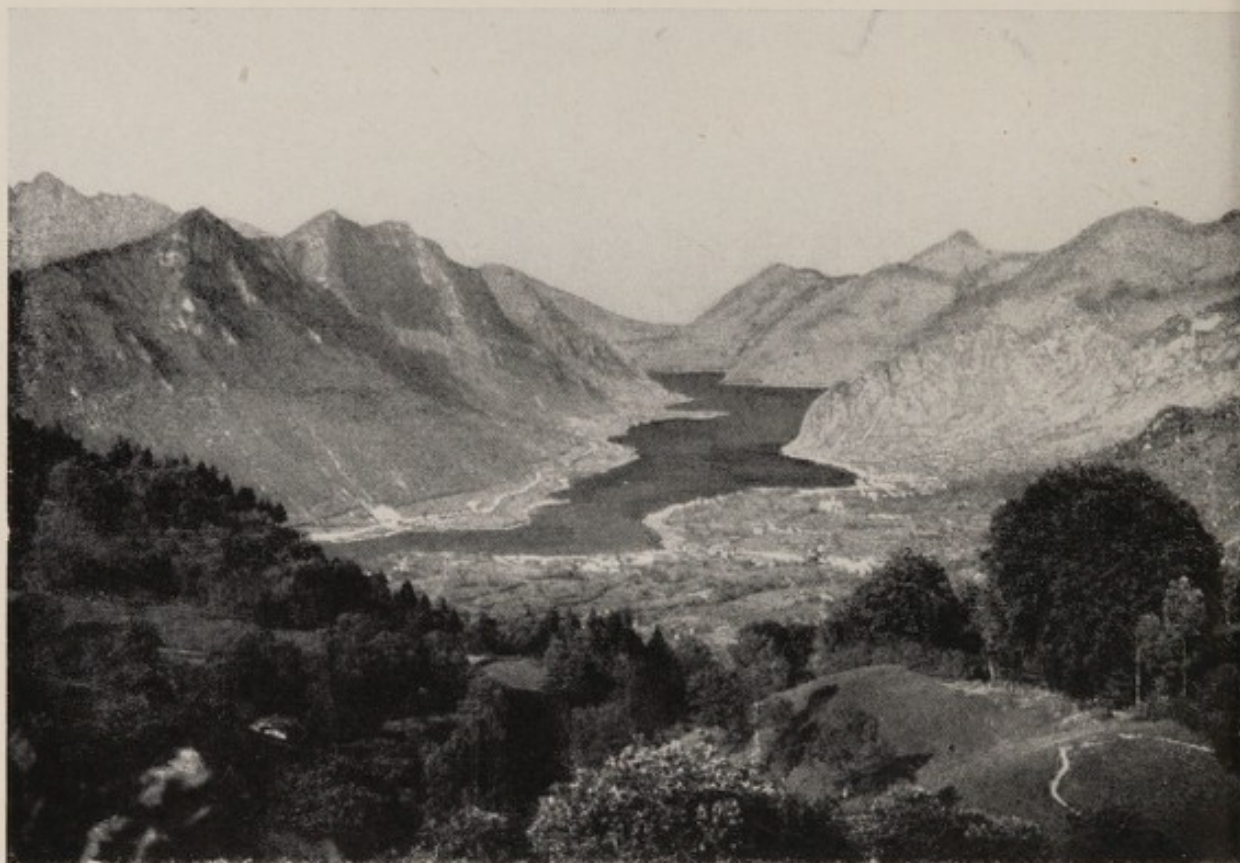


PLATE 61. *Lake Idro from the south; Brescian Alps to the left and Judicarian Alps to the right*



PLATE 62. *Lake Garda; the Gulf of Garda from S. Vigilio*



and have brought down great deposits of debris. The hills below 1,650 feet are well cultivated and settled. Rounded hills up to 2,900 feet high rise northwards into an arid limestone plateau between 2,900 and 3,200 feet. Another ascent ensues through more fertile but highly dissected mountains, mostly between 3,500 and 4,500 feet, surrounding M. Guglielmo (6,395 ft.), Dosso Alto (6,772 ft.), and Cima Tombea (6,388 ft.). The main valleys, the Val Camonica, Val Trompia, and those of lakes Idro and Garda, are separated by long ridges high up the sides of which extend scattered villages and farms surrounded by meadows. The upper flanks of the Idro valley (the southern end of the Judicarian valley) and of the Val Trompia are lined with chestnut groves, and the lower slopes with cultivated fields and gardens with evergreen shrubs. In the Val Trompia the evergreens only extend as far as Gardone, but in the Idro valley the Mediterranean influence is felt farther into the mountains. The ridge between lakes Idro and Garda is less forested than those farther west, and is mainly covered with rough pasture. Lake Idro itself has been dammed by landslides brought about by the collapse of limestone on top of saturated marls. Other small lakes in this region have been formed in the same way.

### *The Judicarian Alps*

The Judicarian Alps are, in reality, a north-eastern extension of the Lombardy Alps, where the limestone ridges curve round to the north-east. On the west they are bordered by the Judicarian valley, on the north by the Val di Sole and the Mendola pass, and on the east by the Adige valley. These mountains consist of three major south-west to north-east ridges coinciding with upfolds in the predominantly limestone rocks, separated by parallel valleys along lines of faulting or downfolding. Short transverse valleys crossing or cutting into the ridges further complicate the topography.

The western margin of this region is formed by the longitudinal trough of the Judicarian valley, the Valle Rendena, and Meledrio valley. The Judicarian valley, the through valley of the upper Chiese and the transverse part of the Sarca, is very similar to that of Lake Idro (Plate 61), of which it is the northward extension. The Valle Rendena and Meledrio valley are higher and less clear-cut portions of the trough. They also differ from the southern section in being flanked on the west by the crystalline rocks of the Adamello massif and not by limestone on both sides. The whole trough is fertile, especially in the south, and provides a through route, followed by a



road, parallel to the Adige. The most westerly ridge continues the Cima Tombea ridge of the Brescian Alps to the north of the transverse Val di Ledro. This is not only the widest but also the highest of the ridges. Its most southerly block is sparsely wooded and rises to 7,395 feet in M. Cadria. The Cadria ridge is separated from the Brenta ridge by the transverse section of the Judicarian valley, which is fertile and densely populated. The Brenta ridge rises to 10,335 feet in Cima Brenta and to 10,420 feet in Cima Tosa, both of which are flanked by small glaciers. Most of the northern part of this ridge has been glaciated, but small regions here and there remained free from ice. In the east the only evidence of glaciation is in the bare, fluted, limestone slopes above the tree-line where the rocks have been ice-polished.

Lake Garda (p. 499) marks the southern part of the next great downfold, which is continued in the north by two almost parallel depressions. The lake, which is 32 miles long and from 3 to 10½ wide, has a depth of 1,135 feet and a surface level of 213 feet. The narrower northern part occupies a deep valley, with steep walls broken here and there by small side valleys opening on to it through wild gorges. The southern end from Salo to Garda is bordered by low morainic hills rising to 500 feet above the level of the lake (p. 260). These hills are only pierced by the F. Mincio, and, though not so grand as those along the northern shore of the lake, are more fertile and charming. The shores of Lake Garda make up one of the largest, mildest, and most luxuriant of the enclaves of Mediterranean climate and vegetation at the foot of the Alps. Shrubs and bushes such as laurel, rosemary, agave, prickly pear, and oleander grow on the rocky slopes. Where the gradient permits of cultivated terraces, mainly on the west shore, olives are grown up to 1,000 feet above the lake. At Gardone, Gargnano, and Limone citrus fruit are produced on terraced south-facing slopes, each terrace being provided with white masonry pillars on which protective covers can be placed in winter. Most of the towns and villages are in the south or on the west side, connected by road 45-*bis*. The west shore to the north of Limone and the whole east shore north of Garda are too precipitous for villages, and the lake-side roads in these sections have only recently been completed (Plates 62, 63).

Two long depressions lead northwards from the head of Lake Garda. The western is for much of its course ill defined, but is traceable from Riva in the south, through Ballino and Campo Lomaso, where it crosses the transverse Judicarian valley, and past lakes



Molveno and Andalo to the Val di Non, in the north. This depression is isolated, and is served only by a poor road. The eastern depression is far wider and deeper. It extends northwards from Lake Garda along the Sarca valley past lakes Cavedine, Toblino, Terlago, and Santo to the Adige valley near Lavis. Road 45-*bis* from the west side of Lake Garda to Trento follows this depression, the floor of which is covered with olive groves and orchards as far north as Lake Toblino (Plate 64). The ridge between these depressions is narrow and steep-sided, especially in the east. It reaches a height of 5,325 feet in M. Casale to the south of the transverse Sarca valley, and of 6,971 feet in Paganella to the north. The slopes are covered with meadows and woods.

Between the Garda-Sarca trough on the west and the Adige valley on the east there rises a massive ridge. This is divided into a northern and a southern block by the deep, transverse Loppio valley, which affords a route for both road and railway from the Adige valley to the head of Lake Garda. The southern block of M. Baldo (M. Maggiore, 7,218 ft.) rises in an almost unbroken slope above Lake Garda. Its eastern flank is more dissected by streams, but presents an abrupt face to the Adige valley. The northern block is generally over 6,000 feet high (Dosso d'Abramo, 6,900 ft.), but, unlike the southern, falls more steeply to the Adige valley than to the west.

The northern ends of the Brenta and Paganella ridges are cut off by the Val di Non, which leads north from the Adige valley at Mezzo Lombardo (p. 222) and is drained by the lower Noce. Near Cles the Val di Non is joined by the Val di Sole (upper Noce) from the south-west. The Val di Non, however, continues north-eastwards in line with the Val di Sole to Fondo, whence the Mendola pass (4,472 ft.) leads to Bolzano. Road 42 along the Val di Sole and over the Mendola pass roughly marks the northern boundary of the Judicarian Alps, and divides the predominantly limestone mountains on the south from the predominantly crystalline on the north. The Val di Non (road 43 and railway), with its gentle, rounded slopes, cultivated almost to the top, is one of the most beautiful valleys of the Judicarian Alps. In contrast the Val di Sole is rugged and steep-sided, with pasture on its gentle reaches and forest on its steeper parts.

The small triangular ridge south of the Mendola pass and between the Val di Non and the Adige valley culminates in M. Roen (6,943 ft.). The steep eastern face is largely composed of porphyry, and forms the western limit of the Bolzano plateau (p. 223). The western flank is not so steep and is the more intensively cultivated and settled of the two.



*The Rhaetian Alps*

This region is bordered on the south by the Lombardy Alps, on the north by the Italian frontier from M. Marmontana (west of L. Como) to the Stelvio pass and thence by the Val Venosta, and on the east by the Judicarian Alps. For the most part the Rhaetian Alps are formed of crystalline rocks, but consist of several more or less distinct mountain groups including the Bernina and Grosina Alps to the north and west of the Valtellina, and the Adamello and Ortles groups to the east.

The *Bernina Alps* to the north of the Valtellina comprise the most massive and lofty group of the Eastern Alps and are separated from the Grosina Alps to the east by the Val di Poschiavo. Pizzo Bernina (13,294 ft.), on the Swiss frontier, is the highest point and rises out of a sea of glaciers, 12 miles long and 9 miles broad. The group is composed of a variety of rocks—gneiss, schist, serpentine, and marble—forming parts of the Dent Blanche nappe of the Pennine nappes and the overlying Err-Bernina nappe of the Grisonid nappes. In the south and south-west the valleys are exceptionally deep and steep-sided, although the general level of the peaks is 1,300–2,000 feet lower than in the main range. The southern peaks (M. Disgrazia, 12,057 ft.; Cima di Castello, 11,132 ft.; Pizzo Scalino, 10,902 ft.) are more wildly beautiful than the higher northern ones, since they rise out of the glistening white glaciers with sharp, dark saw-edges. The friable schists of the Muretto pass (8,399 ft.) have produced very jagged knife-edges. The loftier peaks of the main range rise as broad pyramids above the steep and rugged, ice-clad lower slopes. The tree and pasture limits are unusually high: tree-line 7,500 feet, pasture-line 8,850–9,200 feet. Much of the area is, however, barren (30% bare rock; over 30% glaciers; 30% grass; 9% forest). The most widespread trees are larch and pine, which are largely confined to the valleys. (Plate 65.)

*Grosina Alps and Livigno Depression.* North-east of the Val di Poschiavo, the Swiss valley bordering the Bernina group on the east, rise the crystalline Grosina Alps. These are formed by the Campo nappe overriding the Err-Bernina nappe. Although considerably lower and less intensely glaciated than the Bernina Alps, these mountains are impressive. They rise steeply from the Adda and Grosina valleys, their dark rocks contrasting vividly with the small glaciers and snowfields. Where limestone cuts across the other rocks it shows up clear and white. The greatest heights (Cima di Piazzzi,





PLATE 63. *Lake Garda: the west shore between Bogliaco and Gargnano; lemon terraces beside the lake*



PLATE 64. *The Sarca valley below Arco*





PLATE 65. *Pizzo Bernina and the Morteratsch glacier*



11,283 ft.; Corno di Campo, 10,834 ft.) are in the north of the region. Mountain passes are frequent and communication with the Bormio and Livigno basins on the east and north is comparatively easy. There are few permanent settlements in the Grosina Alps, which are little known and neglected by tourists. Between the Grosina Alps and the frontier on the north is the Livigno depression, surrounded by wild and rugged mountains. Within this rim lie rounded schist hills below 10,000 feet, and broad, habitable valleys form a small trough in the heart of the mountains. No single valley is of major importance, but the widest and longest (6 miles) of the valleys is the Val di Livigno, or the upper Spöl valley, almost the whole floor of which is dotted with villages.

The upper Valtellina (p. 219) and the Val Camonica (p. 220) form the eastern limits of the Grosina and Orobic Alps and separate them from a high mass of mountains which are divided into two groups, the Adamello in the south and the Ortles in the north, by the upper Val di Sole and Tonale pass.

The *Adamello* group of recent granite rises between the Val Camonica and the Judicarian Alps (p. 211), and is divided into two by the upper Sarca or Valle di Genova. Gloomy summits, particularly in the south and in the north-east (M. Nambino, 8,780 ft.), rise above glaciers and snowfields. Rivers radiate from the glaciers of the Adamello block (11,660 ft.) and the Presanella ridge (11,667 ft.) in steep-walled glaciated valleys, with scree-covered upper slopes. The Valle di Genova climbs in five steps from the zone of chestnut woods at its lower end, to the tree-line at its upper. Side valleys open into it with huge waterfalls. On the higher levels corries are numerous, many of them now filled with lakes. Between 9,500 and 11,000 feet the mountains are still covered with ice (7.5% of the total Adamello group), while above this level rise saw-edges and massive peaks (M. Adamello, Cima Presanella, Crozzon di Lares, 11,004 ft.).

The *Ortles* group, part of the Campo nappe, is limited on the north and east by the Adige valley. Four great chains, with high ridges separated by glaciers feeding the Adda, Adige, Noce, and Oglio rivers, radiate from the central node of M. Cevedale (12,395 ft.). The eastern branch extends almost to Merano; a north-westerly chain bifurcates, sending one branch to the north (Cima Vertana, 11,627 ft.) and another north-west to the Stelvio; the fourth chain extends south-west in a great west-facing arc towards Pizzo Tresero (11,818 ft.) and between the Adda and Oglio valleys. The whole area contains about sixty glaciers which cover some 75 square miles. The Ortles (12,828 ft.),



the highest peak, rises in the north-west, and down its north-western face flows the Trafoi glacier. The Gran Zebru (12,660 ft.) and Tresero peaks are singularly beautiful even among Alpine mountains. The western peaks are largely of limestone, but farther east crystalline rocks prevail to the mountain tops, and here the summits are lower and the passes higher. The whole group is dissected by gorge-like and gloomy valleys. In the Val di Martello and in the Val d'Ultimo cultivation and settlement are high only on the sunny northern slope (cultivation up to 6,300 ft.; forest to 7,500 ft.). The lower slopes of the western flanks are covered with grass except for occasional patches of boulders or debris.

### *The High Tirol*

The High Tirol, lying between the Adige, Isarco, and Rienza valleys on the south and the frontier on the north, extends for 50 miles from west to east and is of varying width from north to south, but averages about 20 miles. The region contains the Bolzano plateau and Mi. Sarentini between the Adige and Isarco valleys, and the Venoste, Brenner, and Aurine Alps along the frontier. Forty per cent. of the area is over 6,500 feet high and 84 per cent. over 3,000 feet. The predominant rocks are crystalline schists and gneisses, but immediately north of Bolzano (p. 223) there are porphyritic lavas, and many of the valley floors are covered with alluvium.

In the *Venoste Alps* earth-movements were among the most intense in the Central Alps, and here there is the largest number of peaks over 10,000 feet, and the greatest extent of continuously high land. The Venoste Alps rise steeply on the south from the Val Venosta, whilst over the frontier their northerly slopes are more gentle. The short Adige tributaries have narrow valleys, which, despite their southern aspect, are scarcely inhabited apart from the Val di Senales. From this valley there is a high pass which leads across the Venoste Alps to the Venter Spiegel valley by the Giogo Alto (9,432 ft.). Except for the Val di Senales, the Venoste Alps are very bare and largely covered by ice and snow. From the dazzling white of the snowfields rise the dark schists of the Tirolid nappe, which form angular pyramids like Similaun (11,834 ft.) or broad domes almost buried in the snow like the Palla Bianca (12,290 ft.). Other famous peaks are l'Altissima (11,417 ft.) and Punta Lago Bianco (11,588 ft.).

The *Brenner Alps*, at the head of the Isarco valley and on either side of the Brenner pass, include the southern tip of the Stubai Alps in the



west and extend as far as the Aurine (Zillertal) group in the east. The lofty peak of the Pan di Zuccherò (11,519 ft.) rises at the southern end of the glaciated, storm-ridden Stubai Alps which average about 10,500 feet high. From Pan di Zuccherò ridges radiate in all directions, short in the south, but much longer in the east where one extends to Tribulaun (10,158 ft.) and the Brenner pass. Mining and quarrying are still carried on along this southern face of the Brenner Alps. East of Tribulaun, where the Ötztal nappe is overlain by the Nösslacher nappe (Dinarid), the ridge is generally lower. The Brenner pass (4,495 ft.) is the lowest part of a breach in the watershed formed by a broad saddle below 8,000 feet. This saddle is floored mainly with schists, and intervenes between the mountains on the west, which are formed by the southern portion of the higher nappes, and the mountains on the east, where the lower Pennine nappes in the Aurine Alps and Hohe Tauern have been unroofed.

*The Bolzano Plateau and Monti Sarentini.* This rectangular area between the Adige, Passirio, and Isarco valleys consists of two contrasting types of highland. Immediately north of Bolzano rises the north-western part of the Bolzano porphyry mass (p. 231). The western part of this mass, between the Adige valley and the Valle Sarentina, rises in terraces covered with fields, meadows, and large villages to a high, grassy plateau which is sparsely inhabited. The eastern part rises more abruptly between the Valle Sarentina and the Isarco valley to the Renon plateau. This gently undulating plateau has a well-cultivated surface between 4,000 and 5,000 feet, except for the Corno di Renon which rises to 7,415 feet.

North of the porphyry plateau rises the horseshoe-shaped ring of the Mi. Sarentini, formed of schists and resistant granites. The western wing of these mountains has an average height of 8,200 feet and is much wilder and higher than the eastern, but neither has any glaciers. The slopes are covered with pasture up to 8,200 feet, while the summits (8,500–8,850 ft.) are flanked by scree. Punta Cervina (9,124 ft.) is the highest mountain, but seen from the Isarco and Passirio valleys many lower peaks are very impressive, e.g. M. Catino (7,947 ft.) behind Merano. The Passirio valley along the western flank is lined with many dejection-cones on whose fertile, southern slopes vines grow up to 2,500 feet (Plate 66). It is followed by road 44 over the important M. Giovo pass (6,870 ft.; Plate 67) which leads to the Isarco valley just below the Brenner pass. The centre of the porphyry plateau and southern slopes of the Sarentini are drained by streams flowing into the Valle Sarentina, and occasional



settlements occur in their valleys. The northern slope of the mountains towards the Valle Isarco is gentler than the southern.

The *Aurine Alps* extend eastwards along the frontier from the Brenner Alps to the Picco dei Tre Signori (11,480 ft.), where they join the *Pusteria Alps*, which continue southwards along the frontier to the Dobbiaco pass. The Valle Aurina comprises the greater part of the triangular area between these two mountain chains. The Aurine Alps form a lofty, saw-edged, ice-capped ridge culminating in Gran Pilastro (11,516 ft.) and M. Lovello (11,082 ft.). Granite, gneiss, and schists are the predominant rocks, and the slope down to the Valle Aurina is very steep and incised by short valleys alternating with spurs. This valley is narrow for the most part, but opens out occasionally into wider basins such as that of Lutago. Here pasture and woodland cover the floor and lower slopes, in contrast to the rocky slopes of much of the valley. Between the Picco dei Tre Signori and the Vedrette Giganti (11,269 ft.) the Pusteria Alps are snow and ice-covered and have an average height of over 10,500 feet. Onwards to Dobbiaco this average falls to about 8,500 feet and the chain is free from permanent ice and snow.

### *The Great Valleys*

The Central Alps are dissected by numerous valleys of greater or less importance, which provide the most favourable sites for settlement and for routes between the Northern Plain and central Europe. Among these are six of outstanding importance.

The great trough of Lake Como opens out at its northern end into the two important valleys of the Mera and Adda rivers. The *Mera Valley* leads almost directly northwards from the head of Lake Como, which has been filled in by alluvial deposits brought down by the Mera itself, and more particularly by the Adda entering from the east. These deposits have separated the small lake of Mezzola from Como. Above Novate, at the northern end of Lake Mezzola, the Mera cuts transversely across the line of the Bernina Alps (p. 214) in a mile-wide valley, the floor of which is covered with pebbles and finer sediments. This trough continues between steep, glaciated mountains, 6,500–10,000 feet high, as far north as Chiavenna, where the branch railway ends. Here the valley forks. An east–west valley (road 37) leads across the Swiss frontier and over the Maloia pass (5,961 ft.) to the upper valley of the Inn (Engadine). The narrow north to south Valle di S. Giacomo (road 36), drained by the F. Liro, leads to the Splügen (Spluga) pass (6,952 ft.). The sides of this



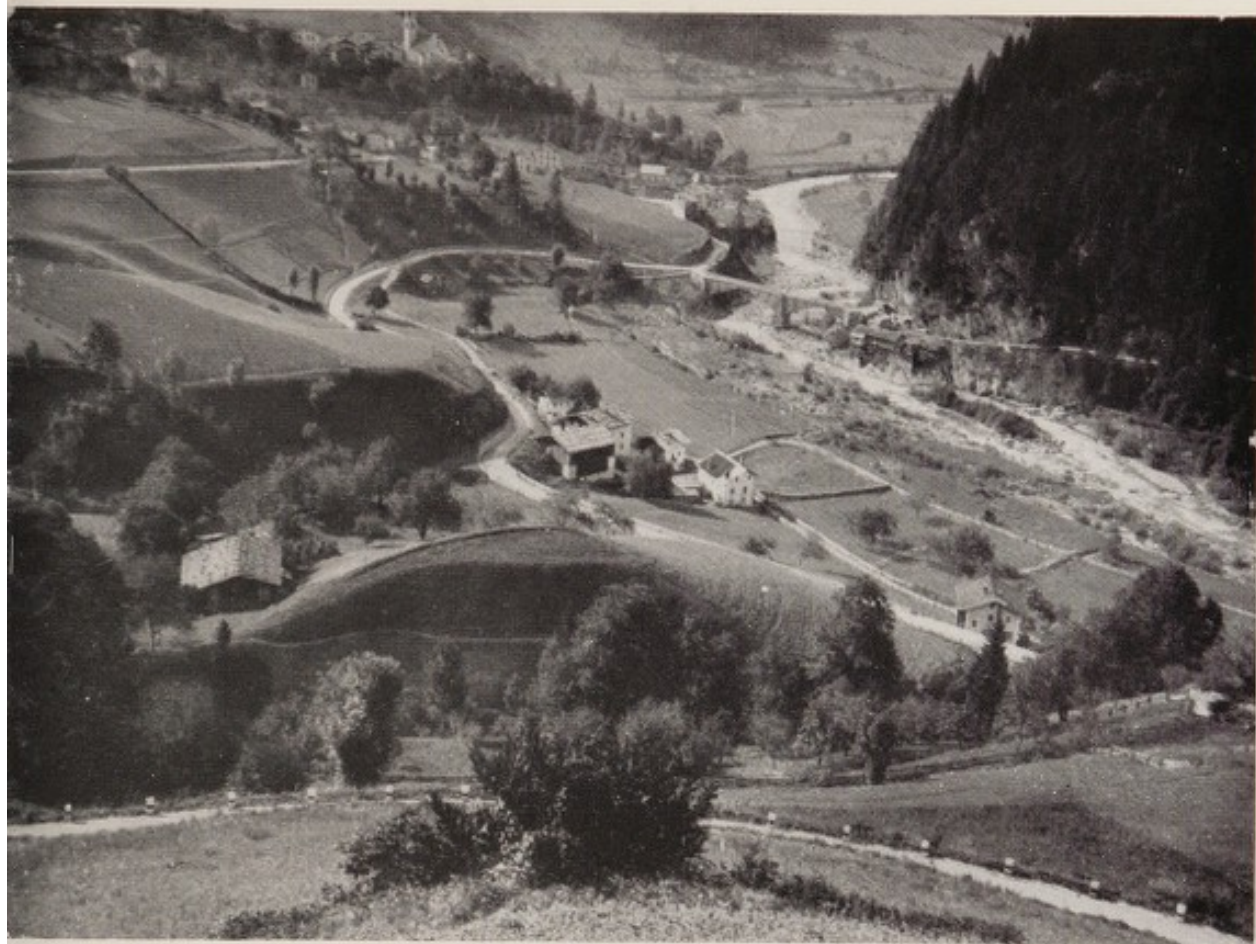


PLATE 66. *Passirio valley: dejection-cone at S. Leonardo*



PLATE 67. *M. Giovo Pass: upper tree-limit*



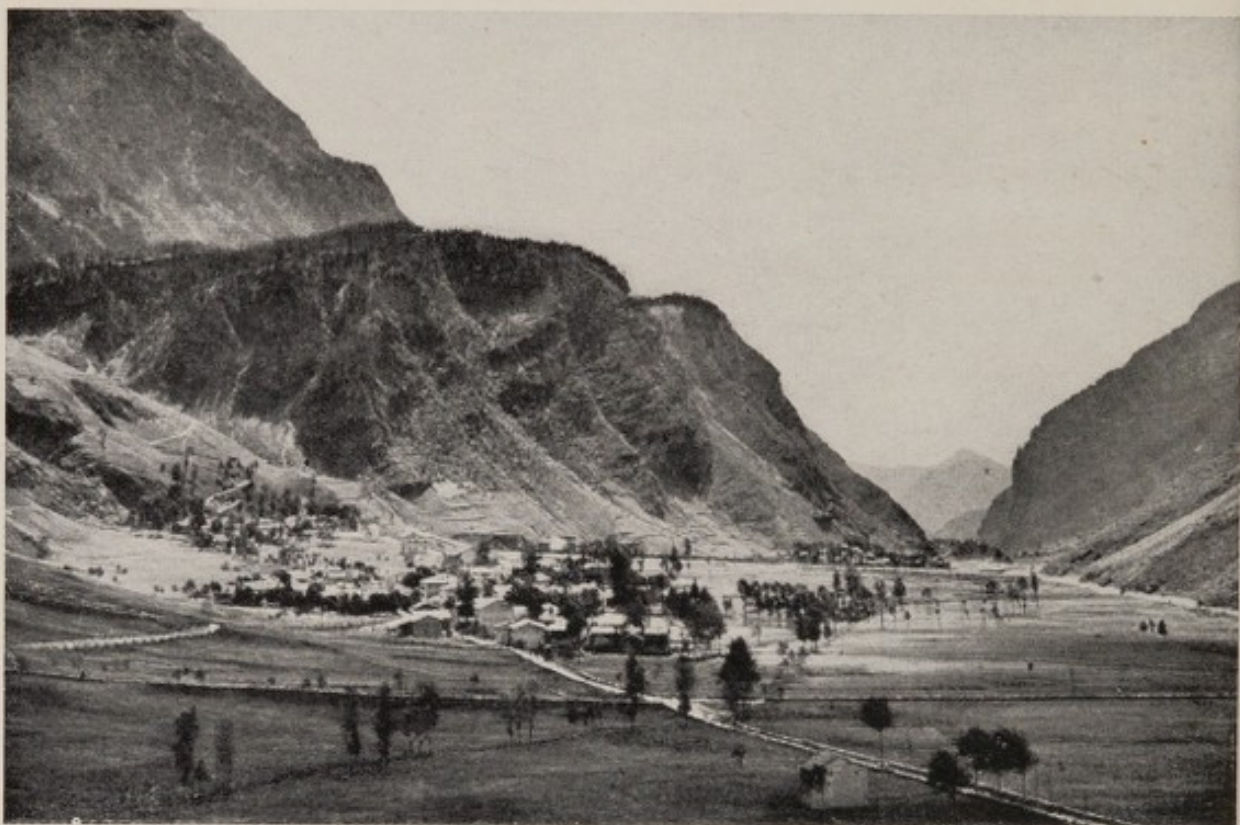


PLATE 68. *View up the middle Liro valley at Campodolcino*

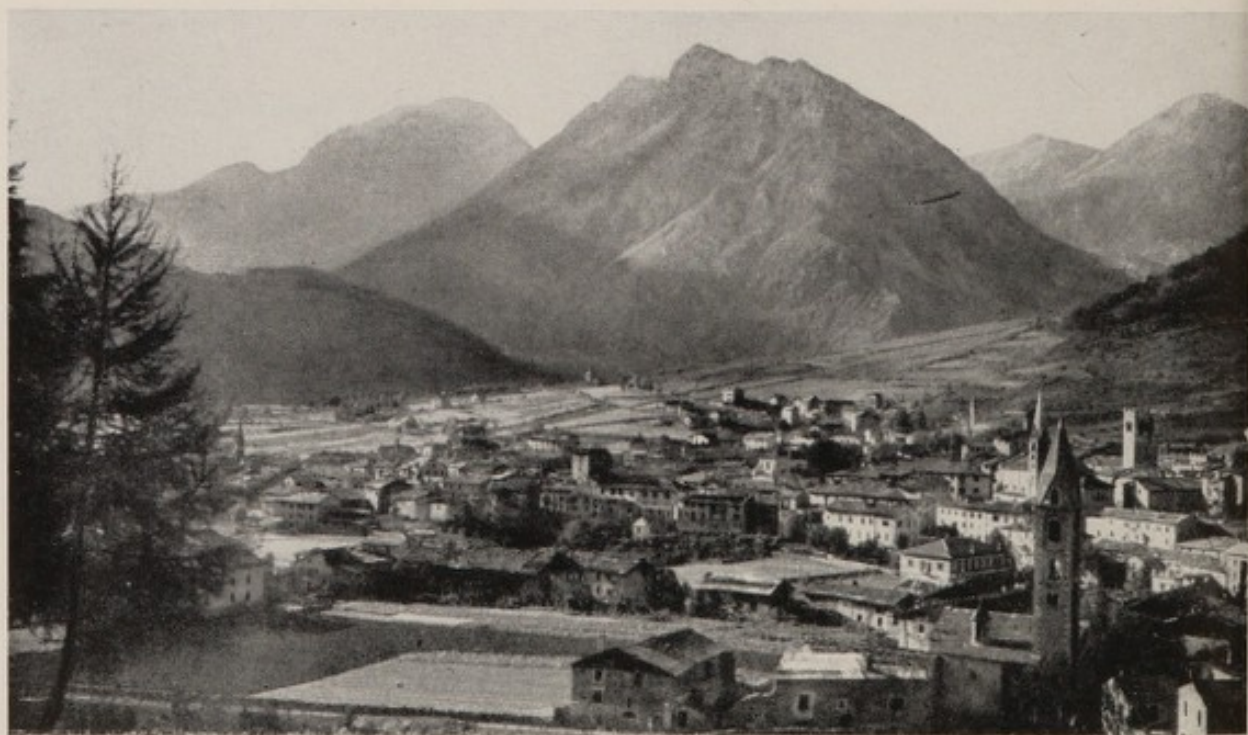


PLATE 69. *The Bormio basin*



valley, although cut in crystalline rocks, are scattered with blocks of limestone. As far as Gallivaggio the slopes are clothed with chestnuts, but farther north the vegetation becomes more and more stunted until north of Pianazzo the valley is bare and desolate with lofty, grandiose peaks rising to east and west (Plate 68).

The *Adda Valley*, known as the Valtellina between the head of Lake Como and Bormio, is, for the most part, a great longitudinal furrow coinciding with a line of tectonic weakness in the crystalline rocks. It is one of the most famous and important of the Alpine valleys both for density of population and communications.

Between the head of Lake Como and Tresenda the Valtellina extends almost due east, and separates the Orobie Alps (p. 210) on the south from the Bernina Alps (p. 214) on the north. The Adda is joined almost at right angles by short, parallel tributaries from the neighbouring mountains. These tributaries are more numerous but shorter on the south, where they have cut the flanks of the Orobie Alps into narrow ridges. The northern tributaries have cut more deeply into the snow-capped Bernina group, and have succeeded in carving wide valleys, such as the Val Masino and Val Malenco, in the schists. The swift, tributary streams entering the Valtellina have built dejection-cones well out into the valley. Many of these are cultivated and are the sites of villages. The floor of the valley is deserted since the Adda tends to flood and cover it with pebbles. Meadows occupy the flat valley-floor, while arable fields are found on the terraces which extend up the valley sides and permit settlement at great heights. On the south, or shady side, cultivated areas are surrounded by shrubs, and single farms and villages are scattered amongst the fields. On the north, or sunny slope, patches of pine-strewn heath occur above and between the flatter levels of terrace cultivation, and the villages are larger. A very good wine is produced in the Valtellina. Maize and mulberries grow on the floors of the tributary valleys with chestnuts on the shady slopes. Hydro-electricity has in recent years further increased the importance of the valley, especially below Sondrio.

At Tresenda the Valtellina curves to the north-east, but the east to west line is continued by the Aprica pass (road 38) and the Val di Corteno which leads to the Val Camonica at Edolo. It is shortly joined at Tirano by the Val di Poschiavo, nearly all of which is in Switzerland. Above Tirano the valley narrows as it passes between the Ortles group (p. 215) to the east and the Grosina Alps (p. 214) to the west, but widens to the Bormio basin at the foot of the Stelvio



pass. This basin is largely floored with terraced dejection-cones, and flanked on all sides by snow-covered, limestone peaks (Plates 69, 70).

The Adda valley is followed by railway to Tirano and by road 38 throughout. At Tresenda road 39 from the Val Camonica joins after passing through the Aprica pass, and at Tirano both road and railway lead north up the Val di Poschiavo to the Bernina pass in Switzerland. Road 38 (5 tunnels) over the Stelvio pass (9,042 ft.) leads to the upper Val Venosta, and the subsidiary S. Maria pass gives access to the Münster valley in Switzerland and so by road 41 to the Val Venosta at Studerno.

The *Oglio Valley* separates the Bergamasque from the Brescian Alps and affords an important routeway from the Northern Plain to the interior of the Central Alps.

The southern end of the Oglio valley is occupied by Lake Iseo. This lake is dammed on the south by moraines which give rise to undulating country, part of which is intensively cultivated and part oak-forested. Lake Iseo is comparatively small, having a length of 15 miles and a maximum width of 3 miles. The sides of the valley rise directly from the lake to heights of over 3,000 feet and are so steep that communication is exceptionally difficult, even for the Alps. This largely explains why the lake has developed little as a tourist centre. Its beauty is comparable with that of any of the larger Italian lakes, with its blue-green water, luxuriant vegetation, and precipitous limestone hills. The valleys opening on to the lake, particularly on the west, are fertile and covered with gardens and chestnut and olive groves. Settlements rise one above the other up the hill-sides, but the largest are at the northern and southern tips of the lake, e.g. Sarnico and Iseo in the south and Lovere and Pisogne in the north. There is little traffic on the lake itself, despite the difficulty of communications by land.

North of Lake Iseo the wide Oglio valley is usually known as the Val Camonica. The lower Val Camonica trends south-west to north-east as far as Breno, where it turns northwards. At the southern end the Oglio flows through damp meadows in a wide valley. At Darfo the valley is constricted by a moraine-covered limestone terrace, which forms a convenient bridge-point. Between Darfo and Breno, 8 miles upstream on a transverse limestone ridge, the valley is neither cultivated nor inhabited. The greater part of the valley is lined by chestnut-covered mountain-slopes, and floored with maize fields and mulberry plantations, except where there are vineyards on the dejection-cones at the mouths of the tributary valleys. These vine-



yards become fewer farther up the valley, and more or less cease at Cedegolo, 25 miles above Lake Iseo. Here a region of intense glaciation is entered where the rivers Oglio and Adda approach each other closely. The narrow watershed between the two rivers is breached at a height of 3,874 feet by the Aprica pass, now largely floored with fluvio-glacial debris, at the head of the Val di Corteno. In pre-glacial times the upper Oglio flowed westwards to the Adda through the Val di Corteno. Since glacial times the flow of the Oglio between Cedegolo and Edolo was reversed, broad terraces were formed around Tresenda (3,600 ft.), Edolo (4,500 ft.), and Temu (5,000 ft.), and the breach between the Orobic Alps and Adamello accentuated.

Above Edolo the Val Camonica is relatively narrow, with rounded higher slopes and large alluvial fans forming terraces at the mouths of tributary valleys. Higher and more shut in than the Valtellina, the valley has a less favourable climate, fewer vines, and no Mediterranean plants. Chestnuts are widespread above 2,900 feet, and settlements extend up to 5,500 feet on the sunny slopes. The greatest wealth of the valley is in its forests, particularly in the larch forests, which have given rise to wood industries. The population has become so dense that emigration is important.

The Tonale pass (6,178 ft.) at the head of the Val Camonica leads directly to the Val di Sole (p. 213), which continues the west-south-west to east-north-east direction of the upper Oglio. This pass, together with the Aprica pass, has largely contributed to the importance of the Oglio valley as a routeway. The main road from Bergamo to Bolzano (42) avoids the steep shores of Lake Iseo by taking a short cut along the Valle Cavallina through the Bergamasque Alps to the head of the lake, and then follows the Val Camonica throughout. At Edolo it is joined by road 39 through the Aprica pass from Tresenda (p. 219), in the Valtellina. The upper Val Camonica, accordingly, forms part of one of the main longitudinal Alpine routes from the head of Lake Como to Bolzano. The only railway serving the Valle Camonica links Brescia with Edolo.

The *Adige Valley*, together with the Isarco valley, forms a great glacial trough which, for the greater part, marks the boundary between the Central and Eastern Alps. These two valleys also offer the principal means of access from the Northern Plain not only to the eastern parts of the Central Alps and to the western parts of the Eastern Alps, but also to the Brenner pass and central Europe as a whole. The Adige valley is, in addition to being an important routeway, rich on its own account. It is one of the most thickly



populated of Alpine valleys, with a rural density of 250 persons per square mile, and also contains more important towns than any of the other valleys.

The valley above Verona, which controls the entrance to the Adige from the Northern Plain, passes between the low, undulating hills of the Garda moraines (p. 260) on the west, and the steep flanks of the plateaux of the Tredici Comuni (p. 227) on the east. Near Rivoli, which in the past controlled the Adige valley routes, the valley changes its direction from north-west to north-east. As far as Trento the valley is known as the Val Lagarina and is flanked on either side by the predominantly limestone rocks of the Lombardy and Venetian Alps. Between Dolce and Ala the valley is very constricted. Scree-covered slopes rise steeply on either side to mountains over 5,000 feet high, to M. Baldo (p. 213) on the west and to the Mi. Lessini (p. 226) on the east. Much of the floor of the valley is damp and liable to flood, so that the possibilities of cultivation or settlement are few.

The valley gradually widens above Ala. At Mori the Loppio valley (p. 213) enters from the head of Lake Garda and the main valley widens out into the fertile basin of Rovereto. From Mori to Trento the valley sides are more gentle, and low saddles connect the Adige with neighbouring valleys. Trento, itself situated in a constriction, commands the two most important of these, the Riva-Toblino-Terlago valley (p. 213) followed by road 45-*bis* from the head of Lake Garda, and the Fersina valley which gives access to the Val Sugana (F. Brenta; p. 228) and is used by road (47) and railway from Padua.

Above Trento the limestone of the Judicarian Alps (p. 213) continues on the west almost to Bolzano, with a very narrow porphyry fringe north of Mezzo Lombardo. On the east the porphyry of the plateau of Bolzano (p. 231) is dominant except for fragments of the limestone ridges cut off by the valley itself from the main mass of the Judicarian Alps. The valley opens out into a wide basin at the junction of the Val di Cembra (T. Avisio; road 48; p. 231) and of the Val di Non (T. Noce; road 43; p. 213). The former enters at Lavis from the Bolzano plateau on the east, and the latter near Mezzo Lombardo from the Judicarian Alps on the west. Much of the floor of this basin is, or has been, marshy, since the maintenance of the river banks has always been a problem, although a scheme of river regulation has existed since 1880. The flanks of the basin are dissimilar, the west rising in a series of terraces while the east, although still maintaining the trough-like nature of the valley, is more uniform in slope. For long stretches the flanks are of bare





PLATE 70. *Near the Stelvio pass*



PLATE 71. *View southwards from M. Penegal of Lake Caldaro and the Adige valley with the Dolomites on the horizon*





PLATE 72. *Merano: view down the Adige valley*



PLATE 73. *Chiusa in the Isarco valley (right)*



rock, but alternating with this are cultivated strips where vines grow up to 2,300 or even 3,000 feet. Mulberries are widespread, and tobacco, wheat, maize, potatoes, and fruit trees are also cultivated. Chestnuts are scarcer than in the more westerly valleys.

The Adige valley narrows near Mezzo Lombardo before widening again in the small Salorno basin which is rimmed round by limestone rocks. At the entrance to the Termeno basin the whole structure of the valley changes. Limestones finally give way to crystalline rocks and the course of the valley itself becomes more complex. Between Termeno and Bolzano the Adige occupies the original course of the Isarco. The former course of the Adige farther west is now marked by a depression through Caldaro and Appiano which is floored with morainic debris and ancient alluvium. Lake Caldaro represents a remnant of this former course, separated from the present one by a low porphyry ridge (Plate 71).

North of Laives the Adige valley widens into the Bolzano (Bozen) basin, at the junction of the Isarco (p. 224) and Sarentina (p. 217) valleys. On all sides the valley slopes rise with dark red crags above the green floor. From Bolzano to Merano the trough sides are steep, with terraces at 2,000 and 2,300 feet on the west slope (Plate 72). Although the Adige course divides into separate channels and is liable to flooding, the fertility and mildness of the valley have caused close settlement and intensive cultivation over considerable stretches. Vines are grown everywhere on the valley sides, chiefly trained on pergolas. Round Bolzano 15 per cent. of the land is under vines. Mixed cultivation spreads over the valley floor, and to a certain extent on to the hill-sides. Fruit is grown up to 4,000 feet at Merano, but the better kinds are at lower levels. Both Bolzano and Merano have a flourishing fruit-preserving industry. South of Bolzano the main cereal is maize, with oats, barley, and buckwheat subordinate. Above Bolzano rye predominates over maize and wheat. Cattle-breeding is important, and full use is made of the meadows, which occupy the lowest parts of the valley and the higher mountain slopes.

The Val Venosta is the name given to the valley of the Adige above Merano, where the Passirio valley (44) joins on the north. The Val Venosta extends as far as Glorenza along an east to west line, with the Venoste Alps (p. 216) on the north, and the Ortles (p. 215) to the south, and ascends in a number of wide uneven steps. There are two or three terrace levels along its sides, and at the mouths of tributaries conspicuous, terraced dejection-cones rise up to 1,000



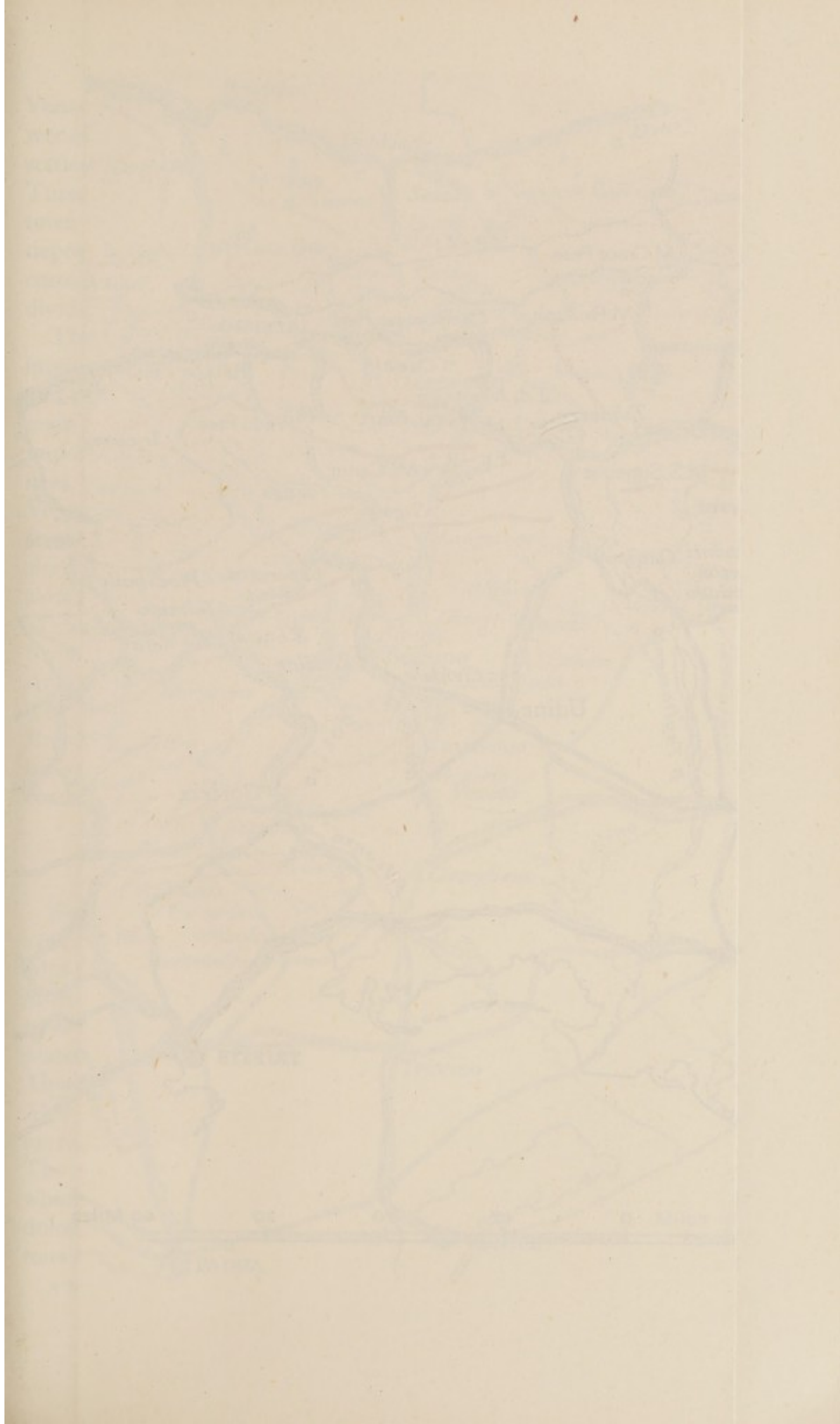
feet above the valley floor. These cones afford better land than the swampy floor, which has not justified drainage. Cultivation starts 300–600 feet above the valley floor, which is at about 1,600 feet, and there are large estates on the terraces up to 4,000 feet above it. Vines spread up to 4,500 feet on the northern slope, and maize is largely grown on the dejection-cones. Chestnut groves appear in the lower Val Venosta, and below Silandro there are orchards. Settlements are all very small; the largest, Silandro and Lasa, have only just over 1,000 inhabitants. The upper valley is poorer in vegetation, cultivation, and settlements.

Above Glorenza the Adige flows from north to south. The lakes of Muta, Mezzo, and Resia were once joined, but are now separated by dejection-cones which penetrate into the valley from the east. The most southerly of these cones forms the boulder-strewn heath of Malles, which extends along the east bank of the Adige for 5 miles, and reaches a height of 4,000 feet. The Resia pass (Reschen; 4,946 ft.), about 2 miles north of Resia lake, is a deep valley, flanked by rounded and glaciated heights, across the Adige-Inn watershed. This pass is of less importance than the Brenner, since it is less direct and more liable to be blocked by snow.

The *Valle Isarco* joins the Adige valley at Bolzano. The lower valley through the Bolzano porphyry plateau is extremely narrow and steep-sided, and the floor, which falls in steps, is on an average six times as steep as that of the Adige. Communications are forced on to the valley sides because the floor is so narrow. Chestnuts grow along the valley below 3,000 feet on the sunny slopes, and below 1,600 feet on the shady. Vines are also cultivated, though only on a small scale. Near Ponte all'Isarco the valley crosses from the porphyries into the crystalline schists, and gradually widens into the Bressanone (Brixen) basin, which has a relatively dry floor and vines and chestnuts on the hill-sides (Plates 73, 74). Above Sciaves (2,530 ft.) the valley narrows again between the Mi. Sarentini on the south-west and the Picco della Croce (10,282 ft.) on the north-east. At Vipiteno (Sterzing, 3,110 ft.; Plate 75) the final ascent commences through the Brenner Alps to the Brenner pass (4,498 ft.; p. 217). Above Sciaves the valley sides are bare or wooded.

The Isarco is joined at Bressanone by the Rienza. Rolling hill country with scattered woods and precipitous, scree-covered slopes extends between these two rivers. At Vandoies, however, the Rienza valley (road 49 and railway) turns sharply along a west to east line and is known as *Pusteria* (*Pustertal*). This valley is similar to the Val







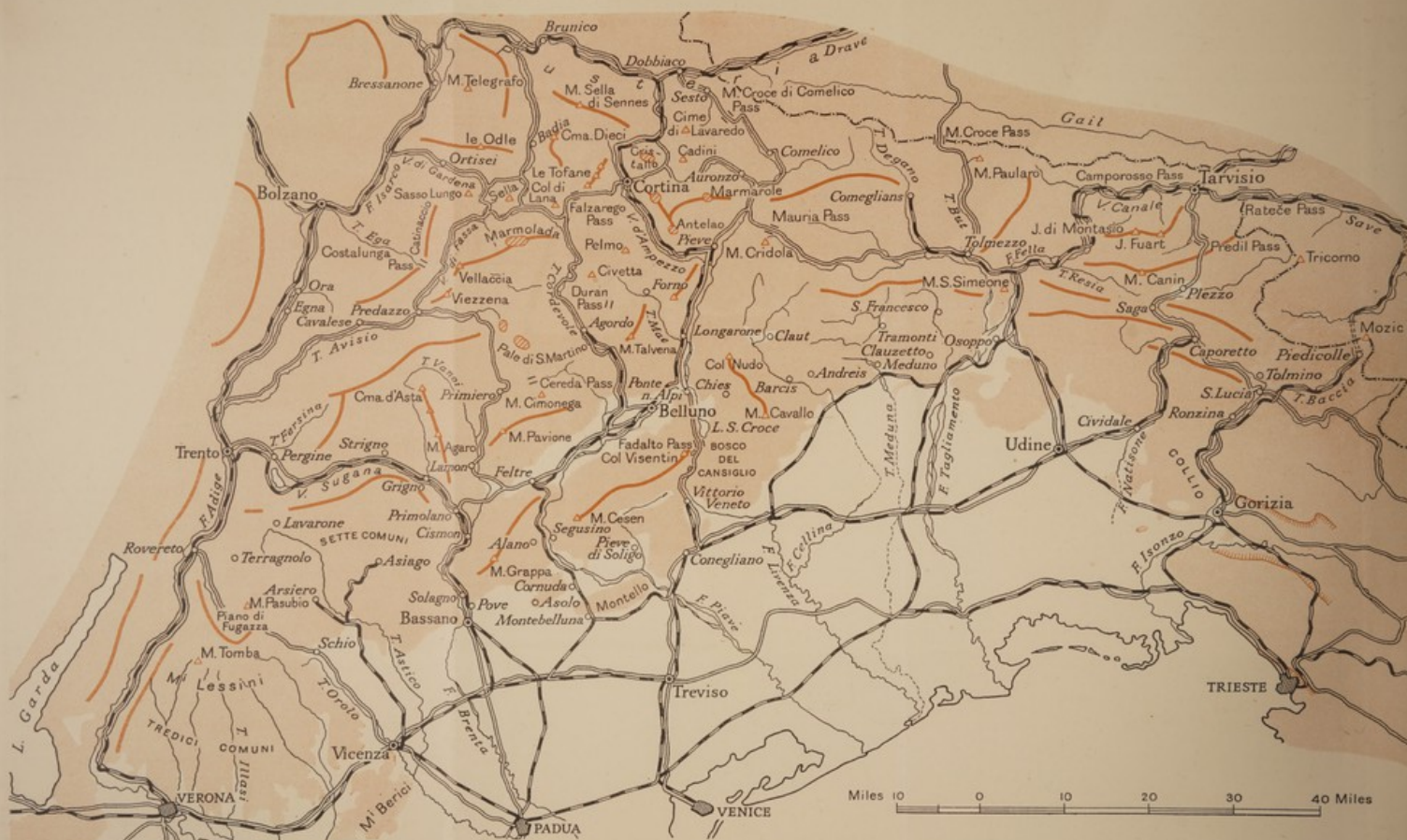


FIG. 43. The Eastern Alps. (For Key see Fig. 40)



Venosta, but is higher and less sunny. On the whole it is narrow and wooded and is used more for pasture than cultivation. The largest settlement in the valley is Brunico, at the junction with the Valle di Tures, which leads northwards to the Valle Aurina (p. 218). Below the town there are few glacial deposits, but above there are considerable deposits of glacial pebbles and sand. The Dobbiaco pass (4,232 ft.) continues, with scarcely any break, the line of Pusteria across the divide between the Rienza and Drava rivers.

The Adige and Isarco valleys, which together afford the most important routeway across the Italian Alps, are followed by road 12 and the main Brenner railway from Verona to the Brenner pass. This main line of communication is joined at different places by other important routes. Rovereto is linked with Vicenza by road 46. At, or near, Trento road 45-*bis* joins from Brescia, road 47 and railway from Venice, and road 48 from Cortina. Bolzano is the junction for road 42 from the Valtellina and the Val di Sole, and for road 38 and railway along the upper Adige. Road 38 gives access at Merano to road 44 along the Passirio valley to the Brenner route, and, together with road 41, leaves the western end of the Val Venosta for the Stelvio pass, Switzerland, and the Valtellina. Road 40 continues along the upper Adige valley to the Resia pass, but the railway terminates at Malles. The Rienza valley, which branches off the main Brenner route at Bressanone, is followed by railway and road 49 through the Dobbiaco pass to the Austrian frontier. Near Dobbiaco this route is joined by roads 51 and 52 from the upper Piave and Tagliamento valleys.

### THE EASTERN ALPS

Structurally the Eastern Alps are simpler, and have been less violently affected by earth-movements than the rest of the Italian Alps. The landscape is composed in part of lofty plateaux of almost horizontal strata entirely within the Dinarid belt of nappes. For the most part limestones of various ages predominate, but in the Bolzano plateau porphyries, and in the Cima d'Asta and parts of the Carnic Alps other rocks, mainly schists and sandstones, prevail. The Eastern Alps are on the whole less high and massive, and have smaller areas permanently covered with snow than the Central and Western Alps. The Dolomites and Carnic Alps owe their character to the rock of which they are formed, a highly jointed permeable, and light coloured dolomitic limestone. The rock pinnacles, massive plateaux, precipitous cliff-faces, bare gleaming rock, river gorges, and occasional green



slopes of the Eastern Alps contrast vividly with the solid, dark pyramids rising out of glistening snowfields and glaciers of the Central Alps.

The Eastern Alps comprise (1) the Venetian Alps, which extend along the margin of the Northern Plain between the Adige valley on the west and the Tagliamento on the east. They are bordered on the north by (2) the Cima d'Asta and the Bolzano plateaux in the west, and by (3) the Dolomites in the east. The Dolomites cover an extensive area which almost reaches the Isarco valley in the north-west and is bordered by Pusteria in the north. (4) The Piave valley, the most important valley of the Eastern Alps, forms in its upper course the boundary between the Dolomites and (5) the Carnic Alps, which extend eastwards to the Tagliamento-Canale del Ferro valley and are bordered on the south by the Venetian Alps and on the north by the frontier. (6) The Julian Alps to the east of the Carnic Alps include the remainder of the Italian Alps.

### *Subdivisions*

#### *The Venetian Alps*

The wide sweep of the Venetian Alps extends from the F. Adige to the F. Tagliamento, and is limited northwards by a discontinuous depression including the Val Sugana, and the Belluno, Barcis, Meduno, and Clauzetto basins. Like the Lombardy and Judicarian Alps they are largely composed of limestone, but are divided into a number of more or less dissected, isolated highland blocks whose highest peaks are only 5,000-6,500 feet high. These blocks are separated by river valleys, notably those of the Brenta, Piave, and Tagliamento, which provide routes from the Northern Plain to the Dolomites and Carnic Alps farther north.

East of the Adige the land rises steeply to wide plateaux, largely of limestone. The highland is cut into a northern and a southern block by the Val Sugana (the upper Brenta valley), which commences a few miles east of Trento. In the extreme south rise the Tredici Comuni, which form the southern flanks of the Monti Lessini. This highland is bordered on the north by the Piano di Fugazza, beyond which rises the great block of M. Pasubio. This in its turn is separated by the Val d'Astico from the high limestone plateau of the Sette Comuni, which drops steeply to the Val Sugana on the north and east.

The *Monti Lessini* rise to the east of the Adige valley (p. 222) and north of Verona. They are composed mainly of limestone, and are





PLATE 74. *The Isarco valley at Bressanone*



PLATE 75. *Vipiteno in the Isarco valley*





PLATE 76. *The Asiago plateau and the gorge of the Assa*



PLATE 77. *The Upper Avisio valley and the Gran Vernel (right)*



limited in the east by the Schio-Vicenza fault-line, along which the T. Orolò has cut its valley. The southern part, known as the plateau of Tredici Comuni, is cut by many south-flowing tributaries of the Adige, which have given rise to a landscape of alternating ridge and valley. Natural terraces occur at three main levels, 1,150-1,300 feet, 1,600-2,000 feet, and above 2,600 feet, and occasionally at 785 feet. The northern heights have been glaciated in parts, but on the whole the plateau, whose greatest height is 2,845 feet, has remained ice-free. The hills are gently undulating with rounded domes and occasional sharp cones. The flatter domes are covered with wooded heath, while the more rugged parts are bare. The sunny slopes of the valleys, particularly where sandstone outcrops, are, in contrast, cultivated and settled. Grapes, fruit, and chestnuts are the most important products, while the shady slopes are forested with oaks. East of the valley of the Illasi there are rich volcanic deposits which support a dense population. The smaller villages stand on the crests and spurs, but the larger ones are in the valleys, where they are surrounded by meadow land. The valleys become increasingly broad and fertile towards Vicenza and the Schio basin.

North of this plateau the crest of the Mi. Lessini rises steeply through chestnut-covered hills to barren, massive peaks of grey limestone. These mountains, the highest parts of which may be covered with snow until May, fall less steeply in the north to the Piano di Fugazza (3,796 ft.) and the upper parts of the Vallasa and Orolò valleys. These together form a depression which is followed by road 46 between Vicenza and Rovereto, and is flanked on the north by a lofty limestone plateau. This plateau is separated by the deep cleft of the Val d'Astico and Lavarone saddle (3,600 ft.) into two parts, a south-western, from which rises M. Pasubio and a north-eastern, known as the Sette Comuni or Asiago plateau (Plate 76). Tributaries of the Adige have cut the west flank of the plateau into small, steep-sided, flat-topped blocks. South of Terragnolo the land is more rugged and reaches its greatest height in M. Pasubio (7,336 ft.), a sharp saw-edged crest, which gives way to lower ridges between Schio and Arsiero. The plateau of Sette Comuni consists of a high, waterless, level area, 4,500-5,000 feet high, pitted with dolines. It is incised as much as 1,000 feet below the general surface level by a series of river or dry valleys. Asiago lies in a low trough within the southern part of this plateau, which, although lower, is windswept and bare except for small groups of pines.

*The Lower Brenta Valley and the Val Sugana.* The narrow, north



to south Brenta gorge divides the Sette Comuni from M. Grappa. The river falls from 720 to 320 feet in a distance of about 18 miles to Bassano, where it enters the Northern Plain. Despite the narrowness and depth of the valley, it is fertile and is surprisingly densely populated. There are few vines, but olives are cultivated just above Solagno. Settlements are on the gravel terraces along the valley sides. At Cismon della Grappa the valley widens and the river meanders between alder-lined banks.

Above Primolano the Brenta flows through the deep Val Sugana. Below Strigno the valley is shut in by limestone outcrops on both flanks and is deserted. Huge springs rise at the foot of the lofty ice-polished valley walls. Between Strigno and Lake Caldonazzo the valley for part of the way follows a fault-line and separates the lofty limestone scarp of the Sette Comuni from the granite of Cima d'Asta (p. 230) in the north. The lake (area 2 square miles) is very shallow and has been blocked by dejection-cones, many of which occur along the whole Val Sugana. The Brenta itself rises on a dejection-cone at a height of 1,575 feet on the flat watershed around Pergine. North of this point the valley becomes narrower and gorgelike; it swings round to the west and is occupied by the west-flowing T. Fersina, which enters the Adige at Trento (p. 222).

The Brenta valley is followed by road 47 and railway between Bassano and Trento, thus providing a second and historically important route from the Northern Plain to the Adige valley and the Brenner pass. At Primolano road 50 links the Brenta and Piave valleys across a low watershed (c. 5,000 ft.).

*M. Grappa*, a steep-sided, highland block, with an average height of 4,000–5,000 feet, rises immediately to the east of the deep Brenta gorge, and played an exceptionally important part in the defence of the Piave line in 1918. The surface is divided by shallow valleys and surmounted by flat domes. There are corries on the highest peak, M. Grappa (5,837 ft.). Pastures alternate with rocky expanses of bare limestone, with trees only here and there where ground water is not too deep. In the north the block falls gently to the Feltre basin—a westward continuation of the much greater Belluno basin (p. 236)—and steeply in the south to a valley between Pove and Pederobba. South of this valley low Tertiary sandstone hills to the north of Asolo edge the Northern Plain and are cut off from the Montello (p. 263) by a gap at Cornuda. The gorge of the lower Piave river (p. 235) completes the segregation of M. Grappa from the adjacent mountain blocks on the east.



The *Belluno Sub-Alps* form a limestone ridge between the lower Piave and the Meschio-San Croce valleys on the west and east, and the Northern Plain and the Belluno basin on the south and north. This limestone barrier is mostly as high as 4,000 feet, but rises in M. Cesen to 5,148 feet, and in Col Visentin to 5,787 feet. Along the southern edge of these mountains there are the lower, undulating hill-lands of Conegliano, 650-850 feet high, joined in the north-east to the limestone hills (p. 263). In conjunction with the Montello to the south of the Piave, these hills isolate the small alluvial plain of Pieve di Soligo, about 4 miles wide and 15 long. The red earth of these hills has been eroded by innumerable rivulets, which have cut down to soft clay, and produced wet-floored and gentle-sided valleys. Near Vittorio Veneto, in the east, these soils merge with the morainic deposits of the small amphitheatre of the Piave glacier. Immediately to the north of these hills and the plain of Pieve di Soligo rises a low limestone ridge, 650-850 feet high, between which and the main Belluno ridge is a small longitudinal trough occupied by the upper T. Soligo. The whole of this lower land is well cultivated, with vines, chestnuts, olives, and cypresses, and is dotted with small settlements, gardens, and large farms. The limestone ridge of Belluno farther north is, however, bare, its grey slopes patched with scree and cut by swift streams. The soil is poor and the population scanty. The land above 2,000 feet is very dry and has either pasture or wood land. This region was the scene of much mountain warfare in 1915-1918.

The *Meschio-San Croce Valley* divides the Belluno Sub-Alps in the west from the Bosco del Cansiglio plateau in the east. It was widened and deepened by the Piave glacier, and offers an easy line of communication (road 51) between the Northern Plain and the upper Piave valley. The southern half of the valley with Lake Morto at the foot of Col Visentin is drained by the T. Meschio. The saddle of Fadalto (1,600 ft.) forms the watershed, on the northern flank of which is Lake S. Croce (13½ sq. miles, 115 ft. deep). This is drained northwards along a marshy valley to the Piave at Ponte nelle Alpi (p. 236).

The Sub-Alps between Lake S. Croce and the F. Tagliamento and to the south of the Carnic Alps are divided by the T. Cellina into the limestone plateau of the Bosco del Cansiglio in the west, and the more dissected limestone country of the Meduno Sub-Alps in the east. The *Bosco del Cansiglio* rises very steeply from the plain in the south-east to about 5,250 feet. The western edge is roughly



the same height (M. Millifret, 5,174 ft.), but in the centre the plateau falls to below 3,500 feet. Along the north-eastern edge of this plateau rises the pyramid of M. Cavallo (7,385 ft.). Between the Cavallo ridge and the gorge of the T. Cellina the general level of the land falls once more to between 4,000 and 5,000 feet. North of the plateau the sandstone hills of the Belluno basin (p. 236) are continued to the east of the Meschio-San Croce valley in the Alpago district, round Chies d'Alpago. There is a line of villages along the foot of the southern face of the plateau, above which a narrow band of cultivation is backed by beech forests at the foot of bare limestone slopes. The surface of the plateau is bare and dry for the most part, with remnants of the ancient beech and pine forest in the centre.

The *Meduno Sub-Alps* narrow between the T. Cellina and the F. Tagliamento to a rim of limestone plateaux at the edge of the plain. The plateaux are more disjointed and less broad than farther west. Along the plain is a zone of gently-folded foothills, which is sunny, fertile, well cultivated, and scattered with large villages. Above these foothills rise the steep, dry, rocky slopes of the mountains, covered with dry heath. West of the gorge of the T. Meduna their average height is 6,500-7,200 feet and some 1,300 feet lower to the east. The belt forms waterless plateaux, or broad slopes of bare rock. Settlements are few, and only occur where beds of Tertiary rock outcrop, as at Barcis and Clauzetto. Routes avoid the river valleys as much as possible because of flooding.

#### *The Cima d'Asta and Bolzano Plateaux*

These plateaux, which are separated by the lower Avisio valley, edge the Adige valley between Trento and Bolzano. The rectangular mass of the Cima d'Asta rises immediately north of the Val Sugana and its eastern boundary extends along the Cismon valley (road 50). The Bolzano plateau forms a wedge between the lower Avisio and Isarco valleys and is bordered on the east by the north-western Dolomites.

The *Plateau of Cima d'Asta* consists of a central mass of granite,  $6\frac{1}{2}$  miles wide and extending for 20 miles north-east of Borgo. This mass is surrounded by schists which outcrop between Lake Caldazzo and Primiero and are edged with porphyry on the north. The softer schists have resulted in gently rounded hills, dissected by innumerable small valleys. Despite good soil the southern slopes are only lightly wooded. The granite, which has been subdivided by transverse valleys into north to south ridges, has steeper and









PLATE 78. *The Val di Fassa at Canazei*



PLATE 79. *Ortisei: view up the Valle di Gardena; Sella group on left and Sasso Lungo on right*



more barren slopes. The highest ridge extends from Grigno in the Val Sugana through M. Agaro (6,779 ft.), Cima Orena (7,372 ft.), and Cima d'Asta (9,341 ft.), and is almost surrounded by the Vanoi and Grigno rivers. Many corrie lakes and polished rocks bear witness to former glaciation, and there are alpine landforms above 6,500 feet. High pastures on these slopes are scarcer and less fertile than in the Alpine foothills. The seasonal streams fill the larger valleys with boulders, and often cause devastating rock falls. The northern porphyry border forms a plateau which carries the watershed between the Brenta and Avisio, and has been highly dissected by their tributaries. For the most part it rises with a steep scarp above the well-modulated schist country on the south and the Val di Cembra on the north, and is covered with grassland and scattered woodland.

The lower Avisio valley marks the northern limit of the plateau of Cima d'Asta. The valley, which is known as the Val di Cembra from the Adige to below Cavalese and as the Val di Fiemme to Predazzo at the confluence of the Avisio and Travignolo, is a deep, narrow, glacial trough cut through the porphyry. The upper slopes widen out into gentle terraces which reach up to the general plateau-level. The valley is covered with vines, mulberries, cereals, fruits, and chestnuts throughout most of its length below Predazzo. On the sunny slope settlements reach up to 1,300 feet. On the shady side, woods are predominant and there are practically no settlements, except for small mining-villages in the Val di Cembra. The most fertile part of the whole valley is the basin of Cavalese.

The Avisio valley is followed almost throughout by the Trento-Cortina d'Ampezzo road (48), and by railway between Cavalese and Predazzo, where road 50 joins from Feltre and the Belluno basin.

The *Bolzano Plateau* rises east of the Adige, north of the Avisio, south of the Valle di Gardena, and west of Catinaccio, Siusi, and Sasso Lungo in the north-western Dolomites. This is the southern part of the Bolzano porphyry mass, and has an average height of 4,300-5,600 feet, but rises to 9,338 feet in Latemar. Compared with the surrounding country this plateau is extremely level, despite the jointed nature of the rocks and the action of erosion. South of the Ora valley much of the natural wood cover has been cleared and the land settled, but to the north the landscape is much wilder. Two-thirds of this northern part is still forested, and only the upper sections of the valleys are populated, where there are morainic deposits. Apart from the Valle d'Ega, the streams are short and unimportant.



There are three main transverse roads, all of which link the Adige-Isarco and Avisio valleys. In the south road and railway follow the Ora valley, and Bolzano is joined to the main Trento-Cortina road (48) by the Valle d'Ega and Costalunga pass (5,750 ft.). The Valle di Gardena is followed by both road and railway, and the road continues beyond the valley through the Sella pass (7,264 ft.) to join road 48.

### *The Dolomites*

The Dolomites border the Belluno basin on the south, the Cima d'Asta and Bolzano plateaux on the west, the Piave on the east, and Pusteria on the north. Although dolomitic limestone is the predominant rock and the strata are more or less horizontal, the highland possesses a very varied landscape of mountain blocks, needle-like peaks, ice-fields and glaciers, and deep valleys. Despite the great variety in relief there is a surprising uniformity in the heights of the summits, most of which are about 9,000 feet. Jagged, saw-edged mountains rise white and shining from the green woods and meadows at their foot. Alternate layers of hard and soft strata produce in certain areas a step formation of rock walls and gentle slopes, e.g. the Sella group. Elsewhere jagged walls reach great heights, such as Marmolada (10,965 ft.), the southern face of which is a wall 2,000 feet high. These mountain blocks are separated by valleys and by broad saddles only a little below the average height of the range. The saddles occur in the softer beds of rock at 6,000-6,500 feet, and are used by roads connecting the deeper valleys. Rivers radiate from the central Marmolada group, and as a result the Dolomites are crossed by numerous routes, many of which pass through the centre of the region and serve the tourist industry of the mountains. West of the Cordevole valley and the Val Badia there are outcrops of volcanic deposits, particularly extensive north and south of the Marmolada group and along the Fassa and Cordevole valleys. The Viezzena and Vallaccia mountains, east of the Val di Fassa, are largely of limestone, seamed with black lines of eruptive rock. East of the Cordevole-Badia line there are hardly any volcanic rocks, and the peaks are of Triassic limestone.

The *Belluno High Alps* rise steeply to the north of the Belluno basin between the Cison valley on the west and the deep Piave and Mae valleys on the east. The south-eastern edge of the mountains is little dissected by valleys, the only three of any importance being those of the Cison, Mis, and Cordevole. The rounded foothills rapidly give place to bare, limestone slopes, jagged spurs and massive



rock formations culminating in the peaks of Pavione, 7,657 ft., Cimonega 8,366 ft., and Talvena 8,336 ft. What streams there are have cut very deep valleys, and the friable dolomite has been weathered into grotesque, jagged peaks. The scree-covered slopes were once forested but have now been stripped bare. There are few settlements within the Belluno High Alps, and little pasture. Only the Cordevole valley is wide enough for settlement, and the floor is largely of pebbles, so that cultivation is very limited. This valley is followed by road from Belluno to the main Trento-Cortina road (48) and by railway up to Agordo.

North of the Belluno Alps stretches a long depression from Primiero in the Val Cison to Forno di Zoldo in the Mae valley, including the passes of Cereda (4,521 ft.) and Duran (5,265 ft.). Between the Cereda pass and Agordo schists take the place of limestones, and the landscape is very green and dissected. The higher slopes are marked by glacial debris from which dolomite mountains rise to well over 5,000 feet. Settlements occur on the sunny slopes, but rarely exceed 3,500 feet. There are valley widenings at Primiero in the Cison valley and at Agordo in the Cordevole valley. Both basins are fertile and thickly settled.

The *North-Western Dolomites*, to the north of the Belluno High Alps, are made up of a number of individual mountain blocks, separated from one another by steep-sided valleys or dry gorges. Although the blocks differ from each other in many respects, they possess several features in common. The limestone debris has collected at the foot of the mountains and produced a gently undulating base of green meadows and woods from which the steep, straight slopes of the mountains rise, either as towering blocks (e.g. Sella group), or as pinnacles and obelisks of hard, bare rock (e.g. the Odle). The limestone is frequently pink, owing to the metallic oxide with which it is impregnated, and appears translucent on calm days. At dawn and dusk the mountains are tinted with every imaginable colour.

The most southerly of these blocks is the Pale di S. Martino (10,010 ft.), a typical dolomitic group rising to the north of the Cereda pass. It is a sharp and rugged group, with very high, almost vertical sides and a small glacier on the northern face. To its north is a plateau, 10 square miles in area and 7,900–8,800 feet high, which is bare and desolate and seamed with fissures. East of the Cordevole valley the smaller block of Civetta rises to 10,557 feet north of the Duran pass.

North of the Pale di S. Martino the dolomitic group of Marmolada



is hemmed in by the S. Pellegrino, Biois, Avisio (Plate 77), and Cordevole valleys. The Fedaia pass divides this group into two sections—a green, gently undulating southern section, and a rocky northern. There are three chief east-to-west ridges, on the northernmost of which is the longest glacier of the Eastern Alps. The highest peak, M. Marmolada, is 10,965 feet.

Immediately to the north of the Marmolada rises the Sella group, a massive block of highland, 20 miles in circumference and ringed round by roads. Great walls rise sheer to the plateau-like summit on which stands the pyramid of Piz Boe (10,342 ft.). The block is slashed from north to south by a wild gorge. The Cordevole, Avisio, Gardena, and Gadera rivers all rise within the Sella group.

West of Sella and Marmolada rise three more small groups (Catinaccio, Siusi, and Sasso Lungo), hemmed in by the Valle d'Ega on the south, the Val di Fassa (Plate 78) on the east, the Bolzano plateau on the west, and the Valle di Gardena (Grödnertal) on the north. These groups are all very beautiful, especially Catinaccio (9,780 ft.), which is more highly dissected than the others. Sasso Lungo (10,436 ft.), in the shape of a horseshoe open to the north-west, is composed of very hard, white limestone, the perfect example of 'coral rock'. The upper Valle di Gardena widens above Ortisei to a broad, flat, habitable valley.

The Odle group, bordered on the south by the Valle di Gardena, on the east by the Val Badia, and on the north by the crystalline mountains (M. Telgrafo, 8,215 ft.) flanking Pusteria, attains a height of 9,930 feet in Sass Rigais. This group, much more dissected than the others, is composed of ridges divided into many pinnacles. Both the Valle di Gardena and Val Badia are followed by roads which link the Pusteria and Isarco valleys over the Gardena pass (6,958 ft.; Plates 78, 80).

East of the Val Badia and north-east of the Marmolada group stands yet another dissected highland. The most southerly blocks consist of the three Tofane mountains, all over 10,000 feet high, and the Col di Lana (8,078 ft.) for which great struggles raged in 1916–1918. To the east of the town of Badia rises Cima Dieci (9,918 ft.), and to the north-east the block of M. Sella di Sennes (9,144 ft.). Farther north still the highland falls steeply to the Pusteria (p. 224).

The *Cadore* in the north-eastern Dolomites includes the upper Piave basin above Longarone, and the blocks of M. Rocchetta (7,992 ft.), Pelmo (10,393 ft.), Antelao (10,706 ft.), Marmarole (9,318 ft.),





PLATE 80. *Corvara in Val Badia: Sass Songher in background*



PLATE 81. *The Cristallo group from near Cortina d'Ampezzo*





PLATE 82. *The Pordoi pass above Canazei*



PLATE 83. *Dobbiaco*



Punta Sorapis (10,515 ft.), Cristallo (10,552 ft.), Cadini (9,642 ft.), and Cima di Lavaredo (10,151 ft.). These mountains are essentially of limestone, with valleys and terraces carved in softer beds of conglomerates. Villages and cultivation are almost without exception confined to the terraces and gentler slopes, where the impermeable and more fertile rocks outcrop. The highlands of Cadore are on the whole massive and steep-sided with screes on the steepest faces and glaciers on the high northern flanks (Plate 81). The most important river, the T. Boite, flows along the Valle d'Ampezzo (road 51) and divides the Pelmo-Rocchetta block from that of Antelao-Sorapis.

Three main roads cross the middle of the Dolomites, one from the Adige in the west to the upper Piave (Comelico) in the east (48), and two from north to south (Belluno-Brunico and Pieve di Cadore-Dobbiaco, 51). These roads cross a number of passes in the central area. The passes on the north to south roads are comparatively low (Campolongo 6,151 ft., Cimabanche 5,065 ft., or Misurina 5,761 ft.), but the west to east road has to climb over three high passes (Pordoi 7,345 ft., Falzarego 6,906 ft., and Tre Croci 5,936 ft.) and is closed by snow from November to June (Plate 82). Cortina d'Ampezzo, at the crossing of roads 48 and 51, is the principal route and tourist centre in Cadore (Plate 81). East of Cortina the F. Ansiei (road 48) follows a fault-line and divides the Marmarole from the Cadini and Cima di Lavaredo groups, the latter of which falls in steps on the east to the schists of the upper Piave and Padola valleys.

*Comelico*, the source district of the Piave, is a beautiful, green country with undulating schist hills, bounded on the north by the western extension of the Carnic Alps (p. 237) which form the frontier between Italy and Austria. The Comelico stretch of the Piave valley has a broad, settled valley-floor. Cattle are numerous and more lucrative than crops. Maize, the chief cereal, is grown up to 3,000 feet. As in the Valtellina, the woods are valuable and have given rise to an important timber industry. Road 52 crosses the M. Croce di Comelico pass (3,433 ft.) to Dobbiaco (Plate 83).

### *The Piave Valley*

The Piave valley is the longest and most important in the Dolomites. Above the alluvial plain of Pieve di Soligo (p. 229) the Piave flows through the gorge separating M. Grappa and the Belluno Sub-Alps. This gorge (road and railway from the plain to Feltre) is somewhat wider than that of the Brenta, especially for a short distance



near Segusino. Terraces rise up both sides of the winding valley and there is a certain amount of cultivation, particularly in the Alano-Segusino trough. The gorge leads upstream to the Belluno basin (25 miles long, 5-6 wide), in the middle of which the Piave is joined by the T. Cordevole. The basin extends from Feltre in the west-south-west to Ponte nelle Alpi in the east-north-east. In the west it forks into the two smaller downfolded troughs of Arsie and Lamon, and in the east it ends at the transverse fault of the Meschio-San Croce valley (p. 229). The somewhat gentler slopes of the Sub-Alps (p. 229) to the south of the basin are highly dissected and terraced, but the steep southern slope of the limestone Belluno High Alps (p. 232) immediately north of the basin is much less broken. The Piave winds with many channels through a pebble bed,  $1\frac{3}{4}$  miles wide, and is very difficult to cross. On either side of the river bed are fertile Tertiary and Pleistocene deposits, with well-cultivated patches of maize, wheat, and fruit trees near the numerous small settlements, which are surrounded by gardens. Chestnut groves grow on the hills south of the basin. Vines are almost absent from both the valley floor and the hill-sides. The largest settlements, including Belluno and Feltre, are built on terraces or spurs well above the river and the danger of flooding. Feltre is on road 50, which gives access to the west. Belluno, 160 feet above the floor of the basin and encircled by hills, is the most important route-centre in the basin, although served by only one main road (50).

Between Ponte nelle Alpi and Longarone the Piave valley is deep and one mile wide. Vines are sparse, chestnuts absent, and low oak shrubs cover the better soils; consequently there is little cultivation even here. Power stations, saw-mills, and paper factories have been built, but the region as a whole is unproductive and inaccessible. Consequently villages, which have been built on low terraces and dejection-cones, are few. Above Longarone the valley is narrower but more cultivated; there are, however, no vines or olives, and north of Pieve di Cadore meadows predominate over arable fields.

The Piave valley is the main artery for communications in the Eastern Alps. It is followed by roads 50, 51, and 52, which also serve respectively the Cismon, Meschio-S. Croce and Boite, and upper Tagliamento valleys. Other roads branch from the main valley along the Cordevole and Ansiei (48) valleys. A normal-gauge railway follows, with the aid of several tunnels, the west bank of the Piave to Pieve di Cadore, whence a narrow-gauge electrified line leads along the Valle d'Ampezzo to Dobbiaco.



*The Carnic Alps*

The Carnic Alps stretch from the upper Piave valley and Comelico in the west to Tarvisio in the east, a distance of 50 miles, and from the Venetian Alps in the south to the frontier along the watershed in the north, an average width of about 25 miles. The beauty of the Carnic landscape is derived not from the height, which rarely exceeds 9,000 feet, but from the great variety of rocks and the consequent contrasts of relief and of vegetation, varying from high mountain pastures to beech or fir forests and cultivated fields in the most fertile areas. The region is, roughly speaking, the basin of the upper Tagliamento, the wildest river of the Eastern Alps. Structurally, however, the region consists of two distinct belts: a southern of limestone, and a smaller northern of ancient schists and granitic rocks.

The *Southern Carnic Alps* are bordered on the south by the Alpage depression and Meduno Sub-Alps, on the west by the Piave valley, on the north and east by the valley of the Tagliamento. These mountains are very similar to the Dolomites. Although the average height of their limestone peaks is considerably lower, the landscape is almost equally rugged because the valleys are as deep and the relative heights of the two regions are, therefore, much alike. There is little variety in structure or topography. Everywhere rise solid, steep-sided blocks with scree-covered lower slopes; low saddles separate the blocks, and the valley floors are uneven and covered with large pebbles. The mountains are, however, higher in the west than in the east, being divided into two blocks by the upper Meduna valley, the largest and most steady in flow of the south Carnic streams. The high western block between the Cellina and Meduna valleys is bordered on the south by the Barcis-Andreis-Meduno depression with its line of villages. The average height of the massive peaks is over 6,500 feet (Col Nudo, 8,111 ft.; M. Cridola, 8,465 ft.). The tower of Cima Monfalcone in the north-west is particularly notable as it rises to 8,359 feet out of a wilderness of huge boulders. These mountains are cut across by the west to east Longarone-Erto e Casso-Claut-Tramonti trough, which is carved out of softer rocks than elsewhere in Carnia. Where the trough is crossed by transverse rivers it widens into basins, such as those of Claut and Tramonti, which have given rise to the largest settlements. The block of highland east of the Meduna rarely exceeds 4,900 feet. The eastern continuation of the Claut-Tramonti trough is poorly marked, but is best developed where it crosses the Arsino valley near S. Francesco. North of Osoppo



the Leale-Cavazzo valley runs almost parallel to the transverse Tagliamento, and segregates M. S. Simeone (4,941 ft.) from the main body of the Southern Carnic Alps. This falls in the east to the transverse Tagliamento valley, a wide north to south trough 6-7 miles long, through which the river flows in many channels.

The *Northern Carnic Alps* and *Upper Tagliamento Basin* are varied in formation. They consist primarily of schists and other more easily eroded rocks west of the valley of the T. But (road 52-*bis*), and of dolomitic limestone to the east. The western region is relatively gentle in outline with a rich blanket of vegetation, which is partly due to the very humid climate (200-300 rain days a year). Pasture and cultivated fields occupy over 58 per cent. of the land, and forest a further 38 per cent. Beech and fir are the most widespread trees, while chestnut and oak are almost absent. The landscape is less pleasant in the east, where bare slopes, landslides, dejection-cones, and valleys floored with coarse pebbles abound.

The Tagliamento is fed by numerous transverse tributaries, such as the T. Degano and T. But, and the alternately longitudinal and transverse F. Fella (road 13), all of which enter from the north. The southern tributaries are short and unimportant. The whole region is seamed by a network of surface streams which keep the Tagliamento very full through most of the year, and have earned the river its name (*tagliare* = to cut through).

The small plain of Osoppo (6 miles long, 4 wide) is cut off from the Northern Plain by the Tagliamento morainic amphitheatre (p. 262), and forms a vestibule to the Alpine section of the valley. Much of the main valley has been glaciated and its lower part is wide, with steep sides and a flat floor. There is a certain amount of cultivation on the sunny slopes, but pasture is more widespread, and forests are rarely found above 5,000 feet. The upper limit of permanent settlements is unusually low and they are very scattered. The eastern tributary of the Tagliamento, the Fella, has cut a deep, wild, terraced valley (Canale del Ferro) through the limestone highlands, and this dissection, accentuated by landslides, is continued into the Julian High Alps on the east by its small side valleys.

The northern margin of the upper Tagliamento basin is formed by an east to west ridge, the Northern Carnic Alps, some 60 miles long and followed by the frontier from Dobbiaco to Tarvisio. In the west the peaks are mostly over 8,000 feet high, but the average height gradually diminishes eastwards to about 5,500 feet. Small passes, some 1,000 feet below the summit of the mountains, occur with





PLATE 84. *M. Rombon and the Plezzo basin, showing river terraces*



PLATE 85. *The Isonzo valley near Caporetto and M. Nero*





PLATE 86. *The slopes of M. Maggiore: beechwood and asphodels*



PLATE 87. *Istria Grigia near Capodistria*



surprising regularity about 8 to 10 miles apart, but only the M. Croce pass (4,462 ft.) is crossed by a motor road (52-*bis*).

The north-eastern extremity of the Carnic range is a narrow ridge only about 6 miles wide, and links up with the Karawanken to the east. Along the southern margin of this ridge a longitudinal through-valley, known as the Canale, stretches from Pontebba to the plain of Ljubljana in Yugoslavia. This valley is drained partly westwards by the upper Fella (Canale del Ferro), partly northwards by tributaries of the F. Silizza across the ridge, and partly eastwards by the Save. Important roads and railways follow all these valleys and account for the importance of Tarvisio (2,464 ft.) in its basin just south of the Silizza gorge, the only breach in the frontier ridge. Tarvisio is reached from the west by the Camporosso (Saifnitz) pass (2,671 ft., road 13 and railway), from the east by the Radeče (Ratschach) pass (2,802 ft., road 54 and railway) and, in addition, from the south and the upper Isonzo by the Predil pass (3,793 ft., road 54).

The Carnic Alps are poorly supplied with routes, apart from the Tagliamento and But valleys and the Canale del Ferro. Road 52 forks at Tolmezzo, the southern branch following the Tagliamento to the Mauria pass (4,258 ft.) and the Piave valley, and the northern the valley of the But to the M. Croce pass and the Gail valley. Road 13 and railway follow a route, which has been important since Roman times, through the Tagliamento gorge and along the Canale del Ferro to the Camporosso pass and Tarvisio and thence to Klagenfurt. A short branch railway serves Tolmezzo and Comeglians.

### *The Julian Alps*

The Julian Alps, between the Tagliamento-Canale del Ferro and Isonzo-Baccia valleys, are of varied formation and have a principal north-west to south-east trend which is continued in Dalmatia. North of Udine the mountains rise above the Tagliamento morainic amphitheatre, but in the south the sandstone hills rise gradually from the Northern Plain itself. Backing these foothills the Julian Sub-Alps extend to the middle Isonzo, beyond which the limestone mountains of the Julian High Alps extend to the frontier. The F. Isonzo has cut deep down into the countryside, and consequently the Julian streams, nearly all of which ultimately flow into the Isonzo, have also deep valleys.

The *Julian Sub-Alps* include the belt of highland which drains direct to the Northern Plain. These hills, generally below 3,000 and never over 5,400 feet, are long, narrow ridges of sandstone and marl,



highly dissected by small valleys, one of which, the Natisone, provides an easy through-route, followed by road 54 and railway from Udine to Caporetto (Karfreit) in the middle Isonzo valley. Between the F. Tagliamento and Cividale the steep-sided hills rise in terraces, but farther south-east, in the Collio region, the general height of the land falls and fertility increases. Collio is famous for its vineyards and orchards, and the slopes are covered with small settlements.

The *Julian High Alps* are of limestone, much of which is little folded. They have an area of roughly 500 square miles, and extend east of the Canale del Ferro for 35 miles to the Baccia valley and Istria (p. 241) and north of the Julian Sub-Alps and the middle Isonzo between Saga and Tolmino to the frontier. The Julian and eastern Carnic Alps, although separated by the Canale del Ferro and the Val Canale, have a very similar topography. Both have exceptionally heavy snow and rainfall so that erosion has been rapid. The landscape of the Julian Alps is made up of small, waterless, limestone plateaux with dolines and swallow-holes, and serrated ridges cut by wild ravines, with jagged, conical peaks. The general uniformity of the region makes recognition of small areas difficult. The drainage has no definite pattern, apart from the Isonzo with its complicated alternate transverse and longitudinal course, and the parallel Resia, Raccolana, and Dogna, all short, longitudinal tributaries of the Canale del Ferro. These have succeeded in dissecting the great masses of M. Canin (8,481 ft.), Jôf di Montasio (9,035 ft.), and Jôf Fuart (8,747 ft.). M. Canin, with its small glaciers, rises from the ridge forming the Fella-Isonzo watershed, which falls steeply to the basin of Plezzo and the upper Isonzo (Plate 84). This flows along the eastern flank of this watershed in a deep valley shut in on the east by the semi-circular ridge extending along the frontier. Tricorno (9,403 ft.) in the west is the highest point of this ridge which tends to diminish in height towards the east, where Mozic is only 5,256 feet. Although pierced by several small passes it is not crossed by either road or railway.

Mediterranean influences are little felt in the Julian Alps, which are surprisingly barren. The small mountain basins experience extreme climatic conditions, so that with intense summer heat and heavy precipitation they are able to produce maize. The cultivation of cereals is rarely found above 3,000 feet and ceases altogether at 5,000 feet. Forests only reach to between 4,500 and 5,250 feet, and the limit of permanent settlement is from 3,000 to 4,500 feet. All these limits are low compared with the rest of the Italian Alps. Over one



*[Faint, illegible text, likely bleed-through from the reverse side of the page.]*





FIG. 44. Istria. (For Key see Fig. 40)



quarter of the land is quite unproductive, and consists of meagre heath and bare rock. There is a little cattle-breeding, but farming of all kinds is very limited.

The *Isonzo* has a very zigzag course through the Alps, with alternate transverse and longitudinal stretches. Between Gorizia and Ronzina the valley is cultivated with Mediterranean fruits; vines are grown up to Caporetto, and the higher slopes are forested (Plate 85). In the upper Isonzo valley long stretches are bare and are frequented only by chamois hunters and shepherds. Serious landslides are not uncommon. There are practically no pastures at low levels and barely 1 per cent. of the land is cultivated. A little maize is grown low down on the slopes, but the scanty population depends for its wealth on fruit and timber products. The only exception to this poverty is found in the Plezzo basin (2 miles long, 1 wide), where 'extensive' cultivation is practised.

The T. Baccia, along the northern margin of Istria, is the principal tributary of the Isonzo. Its valley is twisting and narrow but is followed by the railway from Gorizia through the Piedicolle tunnel to Yugoslavia and Austria. The Isonzo valley itself is followed by road (55 and 54) from Gorizia to Tarvisio, and by the Gorizia-Piedicolle railway as far as S. Lucia in the Tolmino basin.

## ISTRIA

ISTRIA, 100 miles long from north to south but varying greatly in width, occupies the north-eastern corner of Italy. The greater part of the region consists of the peninsula extending into the Adriatic between the ports of Trieste and Fiume. In the north, however, Istria adjoins the Northern Plain and the Julian Alps along the Isonzo valley. On the north and east it extends to the Yugoslav frontier.

*Physical Features.* Few regions exhibit as clear and strict a correspondence between relief and geology as Istria. Topographical and geological features are both arranged in a series of parallel north-west to south-east bands, conforming with the general trend of the Dinaric Alps. The bands consist of massive limestone plateaux alternating with smaller, sandstone, lowland basins. Although the north-eastern part of Istria is similar to the Julian Alps and forms a link between the main Alpine chain in the north and the Dinaric Alps in the south-east, it is not Alpine in type because of its lower elevation and comparative lack of glaciated forms. In Istria, indeed,



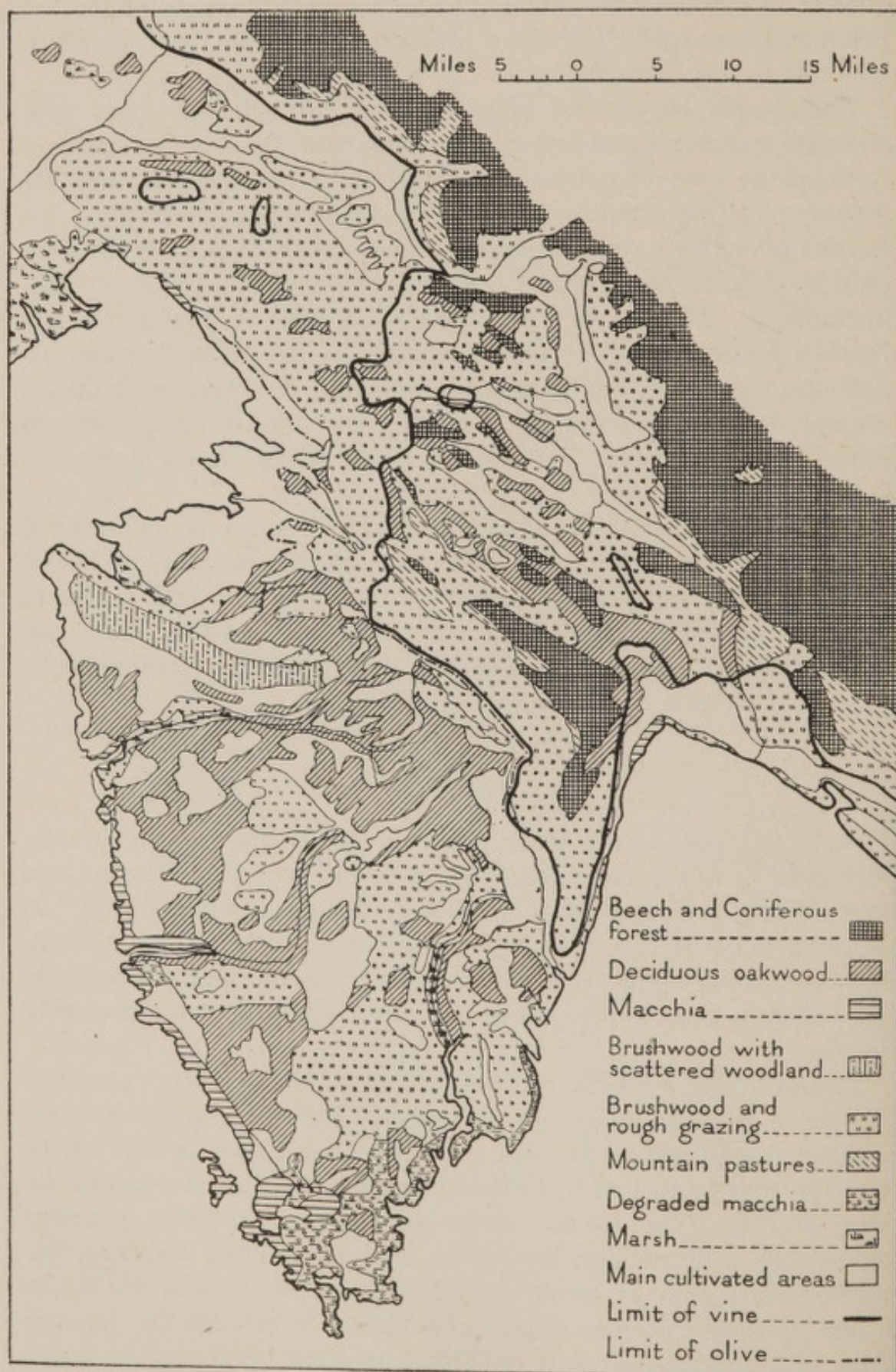


FIG. 45. *Istria: Vegetation*



the Alpine forms give way to a series of limestone plateaux, and there is no plain between these plateaux and the coast. The region gains unity from its peninsular nature and from the generally overwhelming importance of limestone rock and its accompanying underground drainage and special landforms (p. 37). The same structure and composition are continued in the islands of the Quarnero. The coast from Duino to Aurisina, and from Point Salvore all the way round to Fiume, is formed by the broken edge of the limestone plateaux, and is in consequence high and steep. Where the sandstone comes to the sea between Trieste and Point Salvore, alternating high and low stretches of coast occur.

*Vegetation.* The southern parts of the region have, roughly speaking, a Mediterranean type of climate with corresponding flora and vegetation (Fig. 79). In the north, on the Carso, the winter conditions are, in contrast, frequently severe, and the strong northerly wind (bora, p. 414) is very harmful to plant life, which has a more central European character. The vegetation is, however, affected by the special conditions due to the predominance of limestone, though large areas of limestone rock are covered with *terra rossa*. The *terra rossa* is a reddish, sticky clay from which the calcareous material has been so leached out that lime-avoiding plants grow on it.

In a strip extending along the southern half of the west coast true *macchia* occurs, though it is less luxuriant and varied than in southern Italy. The species include holm oak, wild olive, a broom-like plant (*Spartium junceum*), spiny asparagus, Mediterranean juniper, turpentine tree, and smilax. On the lower eastern slopes of M. Maggiore between Laurana and Volosca and above Volosca to Mattuglie there are woods and brushwoods dominated by laurel, usually in the form of bushes not more than 10 feet tall, but north-west of Volosca as trees 50 feet high.

In the interior of the peninsula the prevailing plant communities are those of rocky and stony limestone habitats, such as the limestone brushwood of deciduous shrubs and junipers, and open herbaceous and low shrubby vegetation, growing amongst limestone boulders and pavements. The lower vegetation includes many bulbous and tuberous plants. In places true forest occurs, varying in character with altitude. In peninsular Istria, forest, which covers only a fifth of the area, is mostly of deciduous oak, with evergreen oak increasing in importance towards the coast. Oakwood was probably at one time the most extensively developed of all communities over most of the lower limestone plateaux, but much of it has been reduced to mere



scrub and coppice, especially on the western Istrian plateaux (Istria Rossa). The forests of Montana (deciduous) and of S. Michele di Leme (evergreen) are, however, well known for their exceptional size and height. On the higher plateaux in the north-east, and on the frontier ranges, there are great beech forests such as the Selva di Tarnova and the Selva di Piro. M. Maggiore also rises into the beech region, and its summit is surrounded by some fine woods (Plate 86), though on the slopes these have been seriously exploited. Above the beech forest, in the highest areas, there are coniferous forests continuous with those of the Alps. It is remarkable that the extreme type of limestone topography does not occur where the natural forest-cover has been allowed to remain undisturbed, and though it would be too much to say that such topographical features have been caused by man, there is no doubt that they have been intensified and extended by forest destruction. Pine plantations, especially of black pine, have been successfully established even directly on the limestone plateaux.

The areas of agricultural importance in Istria are comparatively scanty. The 'terra rossa' area of south Istria, in the coastal region at any rate, is the most productive part, and here is developed the typical mixed cultivation of Mediterranean Italy, with vines occupying a very important position. In the sandstone region between Capodistria and Arsa cultivated land amounts to 30 per cent. of the area, mostly under cereals, vines, roots, &c. The broader valley-floors are mostly marshy, and cultivated land is confined to the valley sides which are often terraced. The basin of Lake Arsa has been drained and is cultivated. Along the coast between Trieste and Point Salvore, where cultivation is most intensive, olives grow up to 400 feet above sea-level. On the Carso grazing is important, but cultivated land (10%) is confined to depressions (dolines, and dry valleys), where some residual soil has gathered. Here cereals and some fruit trees grow.

*Communications.* The north-west to south-east trend of the relief has an obvious effect on the number and alinement of routes, both road and rail. The Vipacco valley offers the only natural gateway into the region; elsewhere, to pass from one sandstone trough to the next, advantage has to be taken of local depressions in the ridges. On the plateaux themselves the development of routes in all directions is easy, but the steep edges and the canyons present great obstacles.

In the north of this region the Alpine barrier is at its narrowest and lowest (Gorizia to Ljubljana, 45 miles; Postumia Gate less than



2,000 ft.). In addition, the purity and massiveness of the limestones, in spite of the very high rainfall (80 in.), have led to the complete absence of surface drainage except in the main valleys. There is no real watershed or crest-line south of the Circhina pass (north of Idria). An abnormal number of roads and particularly railways crosses the Istrian and Julian Alps from Trieste and Fiume to Yugoslavia and Austria, thus giving enormous economic and strategic importance to this debatable land. The Istrian ports form the chief maritime outlets of large parts of central Europe, particularly of the former Austro-Hungarian territories.

### *Subdivisions*

Since the dominant features of the relief and of the geology are along parallel north-west to south-east lines, the main subdivisions follow the same plan. The south-western part of the peninsula between Point Salvore and Point Nera is known as Istria Rossa. This plateau region is bordered inland by the hills and valleys of Istria Grigia, which extends from the gulf of Trieste south-eastwards to the basin of Lake Arsa. Istria Bianca, which rises steeply along the eastern margin of Istria Grigia, is composed of three main regions: the Carso Tergestino in the north-west, the Cicci plateau and Mi. della Vena in the centre, and in the south M. Maggiore, which curves southwards along the coast to Point Nera and cuts off Istria Grigia from the sea. This highland belt is succeeded north-eastwards by the Vipacco-Timavo depression, a discontinuous and irregular region of lowlands and hills. Beyond this there rises a belt of limestone plateaux, the Istrian Alps, which in the south reach as far as the frontier, but in the north are separated by the Tolmino-Idria tectonic trough from a small, more truly Alpine area around M. Porsena in the north-east.

### *Istria Rossa*

The coast between Point Salvore and Point Nera is formed by the edges of the largest and most uniform of the plateaux. The surface of the plateau of Istria Rossa is best preserved near the centre around Gimino (1,243 ft.), S. Pietro in Selve (1,119 ft.), Montreo (1,115 ft.), and Visinada (883 ft.). Towards the edges, especially towards the west, level surfaces appear at lower heights, with scattered hills, the summits of which rise to the higher level of the central part of the plateau, giving the country a rolling appearance. Apart from slopes



from one level to another the relief lacks outstanding features. The plateau character of the area is emphasized by the remarkable canyons which traverse it, particularly the three main, transverse valleys of Quieto, Draga, and Arsa. Each of these has very steep sides and a flat floor, where quantities of soil, washed down from the neighbouring plateaux, have collected (in the Quieto valley, a depth of 25 feet since Roman times), so that they are marshy, malarial, and useless for anything but forest. These canyons are for the most part without side-valleys, and hence a great obstacle to communications, which avoid them and keep as far as possible to the surface of the plateau. None of the canyons is followed by a road of any importance, except for road 61 in the short Val Carpano. Road 15 avoids the Draga canyon, although closely following its direction, by a detour through Pisino on the edge of the sandstone country.

The population, like the communications, has sought the surface of the plateau, which is covered for the most part with terra rossa, especially thick in slight depressions (p. 38).

### *Istria Grigia*

Separating Istria Rossa from the Cicci plateau to the north-east, and bounded on the east by the Arsa basin and the M. Maggiore range, is Istria Grigia, a belt of sandstones, which has been cut up by rivers into a typical hill-and-valley country, of moderate relief and regular grades. In the north this widens to the sea between Trieste and Point Salvore, and is drained partly by a number of short streams flowing directly into the gulf of Trieste, and partly westwards, through the limestone area, by the rivers Quieto, Foiba, and Arsa. A narrow extension of the limestone plateau of Istria Rossa stretches from Buie to near Pingente and is crossed west of Pingente by a gorge of the Quieto. Of the westward-draining rivers the Foiba disappears underground near the dry Draga valley and has a basin about 600 feet higher than the neighbouring rivers Quieto and Arsa, both of which reach the sea. This high Foiba valley is used by the Pola railway and road 60, which thereby avoid too sharp and long a gradient in climbing the edges of the plateaux to the north and south. The north coast, consisting of alternating hilly promontories and valleys debouching into small bays, is among the most fertile and closely populated parts of Istria (Plate 87). The main road from Trieste (15) cuts across the headlands, before climbing the edge of the western plateau to Buie. At the eastern end of the sandstone region and at the foot of M. Maggiore is the limestone basin of Lake Arsa





PLATE 88. *The Recina gorge near Fiume and the Castua plateau*



PLATE 89. *The Carso Tergestino north of Trieste (in winter)*





PLATE 90. *Postumia*



PLATE 91. *Reclamation by warping in the flood plain of the river Po*



(Cepich See), normally without surface outlet although joined to the Arsa valley by a low sill. The lake is now artificially drained by tunnel to the Vallone di Fianona, and its bed reclaimed.

### *Istria Bianca*

North-east of Istria Grigia extends a strip of high, limestone country composed of two rather different parts divided by the Rosandra gorge and the saddle followed by the Trieste-Erpelle-Divaccia railway. The Carso Tergestino in the north-west, the scene of much hard fighting in 1915-1917, is a true plateau (Plate 89) with strikingly level surfaces. Between Duino and Aurisina the edge of the plateau comes down to the sea, but south-east of Aurisina it gradually recedes inland, forming behind Trieste a high scarp, broken only by the narrow gorge of the Rosandra. Somewhat dislocated by faults, the Carso rises south-eastwards to 1,400-1,600 feet, and falls steeply on its other three sides to sandstone valleys or to the sea. Three lines of hills rise from the surface of the plateau which is traversed by the Vallone di Brestovizza, one of the broad, dry valleys of these plateaux. The best crossing of the plateau is over its surface from Trieste through Sesana (road 58), where there is a break in the central hill-ridge and in the dry valley. The Carso Tergestino, which is only thickly wooded along its edges and mountain ridges, is comparatively closely settled in large, evenly-spaced villages.

South-east of the Erpelle-Divaccia saddle, the Carso takes the form of a range of mountains, the *Mi. della Vena* or *dei Cicci* (*Tschitschengebirge*), on either side of which extend limestone plateaux. On the south-west the long, narrow Cicci plateau (*Tschitschenboden*), a high, waterless, scrub-covered plateau, dominates the lower, sandstone lands of Istria Grigia to the south-west, and falls away sometimes 1,300-1,600 feet in one drop, as at Pinguente, but more often in several steps, as at Acquaviva. The Pola railway avoids the more broken sandstone country by keeping to the surface of the plateau from Erpelle to Lesichina and climbing step by step to the upper levels.

The *Monti della Vena* themselves consist of three parallel ranges of mountains, bleak and waterless, partly forested and partly covered with brushwood and moorland. The tectonic, limestone-floored Erpelle-Ruppa trough (road 14) bounds them on the north-east and is continued towards Abbazia and behind Fiume by the Castua plateau, only the higher forested portion of which is in Italy (Plate 88).



The southernmost of the ranges is continued south of a high saddle (crossed by road 60 at 2,015 ft.) by M. Maggiore (4,580 ft.) and thence by a narrow strip down the east coast to Point Nera. Cherso and Lussino islands represent continuations of these parallel ranges, which are truncated by the steep faulted edge of the coast between Fianona and Abbazia.

### *The Vipacco-Timavo Depression*

Separating Istria Bianca from similar limestone plateaux to the north-east is a belt of three clay-sandstone lowlands, crossing the root of the peninsula from Gorizia to Fiume. Each is centred round one of the three rivers, Vipacco (Wippach), Piuca (Poik), and upper Timavo (Reka), of which only the first has a continuous course above ground. The Vipacco and Timavo valleys are separated by Osvinica, an eastern extension of the Carso Tergestino between M. Auremiano (3,366 ft.), Prevallo, and S. Pietro del Carso; but the Piuca basin is, as it were, displaced farther to the north-east into the angle between the Piro and M. Nevoso plateaux. The result is that communications (roads 57 and 59 and the Fiume-Ljubljana (Laibach) railway) using these sandstone valleys are forced to go round the Osvinica through Postumia, and are canalized in the two gaps at Prevallo and S. Pietro. The Erpelle-Ruppa trough provides an easier route (road 14) between Venetia and Fiume than that (roads 56-57-59) utilizing the three lowlands. The Vipacco-Timavo depression does not reach the coast in the south-east extremity, and the routes (road 14, Fiume-Ljubljana railway) have to cross the Castua plateau from Abbazia to Ruppa.

The basins are all more closely settled than the limestone areas, forest is less common, and the agriculturally favoured areas are covered with crops. The Vipacco valley is a broad, low-lying, steep-sided corridor as far upstream as Rifembergo, where it is divided by a central, hilly, sandstone ridge into two valleys which continue south-east to Prevallo. The Piuca basin is a triangular hill-land at about 1,600 feet, with much gentler sides, well watered by springs from the limestone, and closely settled. The F. Piuca disappears at Postumia (Adelsberg) into a celebrated cave (*grotta*), much embellished for tourists, and drains north-east subterraneously to the F. Unica at Planina and thence to the Save. The Timavo portion is broader than the Vipacco or Piuca valleys, and contains not only the Timavo valley itself at the foot of the M. Nevoso plateau on the north-east, and tributary valleys from either side, but also to the south-west a long, sandstone ridge which slopes gently south-westwards to the Erpelle-



Ruppa trough. Since the floor of this trough is of limestone, the rivers draining down the south-western slope of the sandstone ridge all end in blind valleys, and disappear before they reach the bottom of the trough or are collected by any master stream.

Below Primano (Prem) the Timavo valley is incised in the floor of the sandstone trough, but above Primano is open and marshy. The Timavo vanishes into the limestone at S. Canziano to reappear at S. Giovanni near Monfalcone. In the extreme south-east the valley of the upper F. Recina follows a narrow continuation of the sandstone zone across the frontier, before turning west through a remarkable limestone gorge to Fiume (Plate 88).

### *The Istrian Alps*

The line of high, limestone plateaux stretches continuously from the gorge of the Isonzo (p. 241) south-east to M. Nevoso (Krainer Schneeberg) and beyond. They are too steep-sided to be crossed by main lines of communications except along four well-marked, natural passages. Although the rainfall is often over 100 inches, the surfaces of these plateaux are almost completely waterless. Like the Julian Alps to the north-east, they are among the most forested parts of Italy.

The first route, followed by road 55 and the railway from Gorizia to Tolmino (continuing to Klagenfurt and Vienna), is along the Isonzo valley (p. 241), which forms the western edge of the Bainsizza plateau. An alternative to this, followed by a secondary road, is presented by the remarkable dry Vallone di Chiapovano, a flat-bottomed passage, which is trenched deeply into the plateau. This valley is, however, robbed of some of its usefulness as its ends hang 900 and 1,240 feet above the valleys of the Isonzo and Idria respectively. The Chiapovano valley cuts off the Bainsizza plateau on the south-east from the Selva di Tarnova (Ternowaner Wald), a rather higher plateau (2,600 ft. in its southern half) merging on the north-east (M. Calvo, 4,895 ft.) into a series of parallel ridges, but on the south and south-west dropping sharply for 1,600–3,300 feet to the level of the Vipacco valley. The next plateau to the south-east, the Selva di Piro (Birnbaurer Wald), is at roughly the same height as the last, and rises to 4,308 feet in M. Re (Nanos), and except near Zolla, on its highest and steepest edge, is not clearly separated from the Selva di Tarnova. Here a narrow sandstone strip gives rise to a deep, gorge-like valley cutting back into the plateau and giving practicable access from the Vipacco lowland to the plateau surface. This, the third of the natural passages, is followed by road 56 across the plateau and steeply down



into the Idria-Planina trough. The fourth of the passages across the zone of the high plateaux follows the widest and least strictly canalized gap. Road 58 and the railways from Fiume and Trieste to Ljubljana meet at Postumia, in the Piuca basin, and cross the low, narrow, limestone plateau of the Postumia Gate (about 2,000 ft.; Plate 90) by the valley of the Piuca-Unica rivers. To the south-east the Postumia plateau rises to the M. Nevoso plateau, the highest and largest of the high plateaux. The term 'plateau' is really misleading, since with M. Nevoso alpine forms begin again and continue southwards. The rounded and rolling surface is by no means flat, and it is surmounted by a series of isolated mountains rising well above the general level, of which M. Nevoso (5,892 ft.), with its two small corries, is only the chief example. As well as having a less uniform surface than the other plateaux, the M. Nevoso plateaux has less abrupt edges, although it falls sharply south-westwards to the Timavo valley. The plateau is crossed in Italy by two minor routes before it merges into the high, limestone ranges of the Dalmatian hinterland.

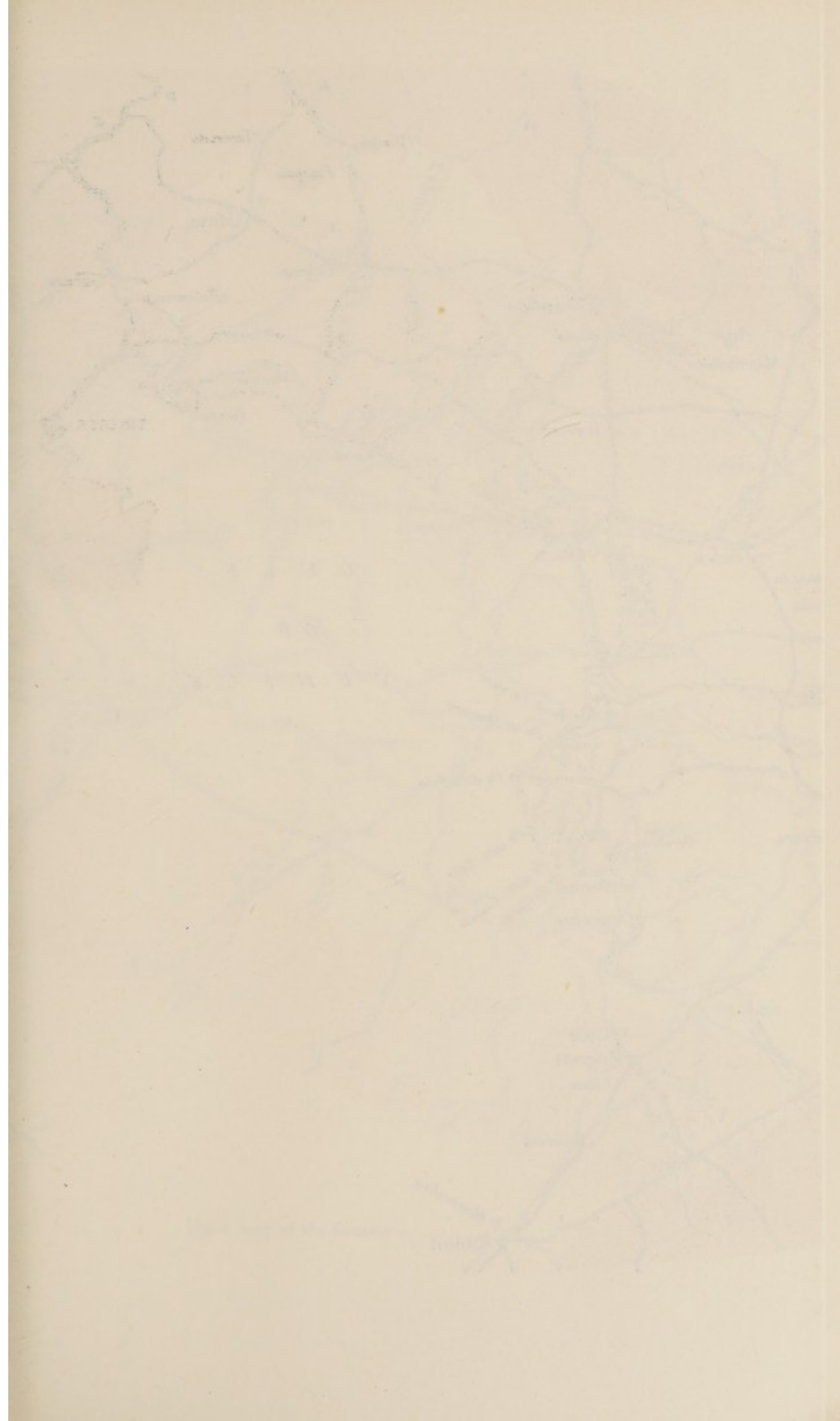
The four high plateaux descend precipitously on the north-east to a long, tectonic trough, the Tolmino-Idria trough, which is continued north-west by the middle Isonzo and the Valle di Resia in the Julian Alps (p. 240), and in the south-east by the line of poljes (p. 38) of Planina and Cerknica, in Yugoslavia. Between the basin of Tolmino (p. 241) and Gottedrasizza (Hotederšica) this trough is Italian and is mainly occupied by the F. Idria and its tributaries. Road 57 follows the trough through the mining town of Idria over the frontier. Owing to the underground drainage there is no defined watershed and no crest-line for the frontier to follow.

North-east of the trough and south of the T. Baccia (p. 241) the frontier includes a small section of mountainous country which is a continuation of the Julian Alps to M. Porsena (5,341 ft.) and the Circhina (Kirchheim) pass. The bulk of this highland is composed of rounded, sandstone hills, with occasional rougher, limestone outcrops. The portion draining east to the Save is far less deeply cut down since the base-level is much higher. Several minor roads cross the frontier.

### THE NORTHERN PLAIN

THIS is, in general, a low-lying area of slight relief between the Alps on the north, the Apennines on the south, and the Adriatic on the











east. It has a relatively high density of population, at least 250-500 to the square mile, and contains no less than eight towns of more than 100,000 inhabitants. Not only is the plain a region of intensive agriculture, but the abundance of hydro-electric power in the surrounding mountains has caused the concentration of a large proportion of Italian industry along its margins. In addition, the area has an important position in relation to international routeways.

### *Physical Features*

The boundary of the plain is, for the most part, fairly sharp and coincides with the geological boundary between older, folded rocks and recent (Pleistocene) sediments derived from the erosion of the surrounding mountains. Sometimes the Alps rise immediately out of the plain, as south of the F. Dora Riparia in upper Piedmont; usually low foothills are interposed between the two. On the south the Apennine edge is straighter, but lower and rather less clearly marked.

The river courses reflect a gentle and even slope towards the Adriatic and at the same time towards the axis of the plain. Three groups of hills break the general flatness: the Monferrato hills (p. 305), between Turin and Alessandria, Mi. Berici, south of Vicenza, and the Euganean hills west of Padua.

Although the plain is generally flat, and although original differences in the surface soil have been obliterated by centuries of husbandry, the area is by no means without diversity or, when considered in detail, relief. Both diversity and relief are associated with subsoil differences, which are arranged very roughly in concentric zones following the line of the hills, but with important contrasts between the north and south sides. In distinguishing these zones and in correlating them with the landform map (Fig. 38) attention has been concentrated on the area draining to the Po from the Alps. Here the zones between the mountains and the river are: (1) Foothills, (2) High Terraces, (3) High Plain, (4) Low Plain, (5) Flood Plain. The zoning in Venetia, east of the Mi. Berici, is rather different (p. 264). Finally, the watercourses themselves form an important element in the landscape.

*The Foothills.* Along the Alpine margin, but particularly in Piedmont and Lombardy, a very discontinuous strip of foothills is formed by a series of morainic amphitheatres (p. 39). These are found round the mouths of the valleys through which the Pleistocene glaciers debouched on to the plain: the Dora Riparia and Dora Baltea valleys, numerous valleys between Lake Orta and Lecco, and the



valleys of Lake Iseo, Lake Garda, and the Tagliamento. On the south side of the plain this zone is absent.

*The High Terraces.* Between the edge of the Alps or the morainic foothills and the flood plain of the river ('alluvial plain' on Fig. 38, except in eastern Venetia) a broad zone, especially wide on the north of the Po, is occupied by a series of wide terraces. These diminish in height, age, and coarseness of material as the river is approached. Most of them, and in particular the lower ones, are too broad and shallow to be recognized easily as terraces, except occasionally at their edges, and where they are crossed by the Alpine rivers. This area is divided into three topographical zones, which do not necessarily coincide with any particular terrace levels: the high (fluvio-glacial, p. 34) terraces, the high plain, and the low plain.

In the intervals separating the morainic amphitheatres and fronting them in the section between the rivers Sesia and Adda are a series of high gravel terraces (Fig. 38). These represent remnants of great fluvio-glacial dejection-cones (p. 35) and are most extensive in Piedmont and Lombardy, though found also in a narrow fringe along the Apennine margin. East of Lake Garda their place is taken by younger but rather similar deposits. All these high terraces are composed of coarse material and are consequently permeable and dry. The surface soil of many of them has, however, been altered by weathering to form a sticky, impermeable, red clay, known as *ferreto*, which masks the gravel below. The *ferreto* is infertile, and the high terraces are normally covered with heath (p. 456) or pine forest. The Alpine rivers have incised their valleys by 100 to 230 feet into these gravel terraces, and cut them up into sections.

*The High and Low Plains.* Below the high terraces, and along the Alpine margin when these are absent, there occurs a continuous ring of lower, shallower terraces of rather finer material (alluvial and gravel terraces on Fig. 38). This ring is much broader on the north than on the south, and forms the bulk of the plain, at least in the west and north. The proportion of finer material increases with distance from the mountains. This terraced zone is divided, on a hydrographical basis, into two parts, the high plain and the low plain. The high plain (*alta pianura*) is dry and waterless, its surface incised with watercourses, while the low plain (*bassa pianura*) is moist and rich in surface water. Great quantities of water, both from rainfall and from rivers, are absorbed into the porous material of the high terraces and the high plain. This water begins to reappear at the surface as the height decreases, and as the ground becomes less permeable, towards



the centre of the plain. The water reappears within a fairly distinct zone in well-defined springs (*fontanili*, *resorgive*, or *resultive*), mostly artificially improved, since the water is used for irrigation. The upper limit of the *fontanili* (Fig. 46) therefore marks the division between the low and the high plain. In Venetia, east of the Mi. Berici, the low plain nearly coincides with the alluvial plain area on Fig. 38.

*The Flood Plain.* The transition is usually gentle from the low plain to the flood plain, or to the corresponding lagoon-delta zone in Venetia. Above the confluence of the Adda the Po has swung close to the lowest of the terraces on the north bank and has formed a comparatively abrupt step or bluff, up to about 40 feet high. The flood plain is made of material, mainly silt and mud, even finer than the low plain, and slopes very gradually towards the Po. The river itself, however, has gradually raised its bed, so that even at Pavia the high-water level is well above that of the surrounding plain, and this difference of level increases downstream to as much as 20 feet in the delta. The river is only kept from flooding vast areas of land by means of dikes, which supplement the natural levees formed along its banks. These dikes extend up the Po for more than 250 miles, and also up the main tributaries. The flood plain, which was formerly marshy but is now largely reclaimed, is far wider south of the river than north of it, and in western Venetia than in Piedmont and Lombardy (Plate 91).

The *watercourses* of the different rivers vary considerably. The Alpine rivers in their sections through the high plain tend to have multiple courses spreading over broad beds. The F. Tagliamento at its exit from the Alps spreads to a width of up to  $2\frac{1}{2}$  miles. Except in flood the bed is mainly dry, but is criss-crossed with small channels interspersed with shingle, sandbanks, and islands. The courses are also deeply incised into the upper terraces, often with an abrupt descent on either side. The fall of the rivers in this section is still considerable, especially among the high terraces, where some of the Alpine streams form rapids, e.g. the Adda at Paderno.

Streams rising in the high plain do not have multiple upper courses, nor are they deeply incised into the terraces. Others rise in the *fontanili* zone, and their whole course is within the low plain, which is, therefore, traversed by an enormous number of watercourses.

### *Vegetation*

This is one of the most intensively productive parts of Italy, though only rendered so by human activity, irrigation, and drainage. So far



as can be judged from the remnants of the natural vegetation, the area is essentially transitional between the central European and Mediterranean botanical regions. Since Mediterranean vegetation is limited to a few especially suitable localities (e.g. the shores of Lake Garda and the south-east slope of the Euganean hills), and even then is scarcely typical, the area may be placed in the central European region.

Woodlands, in particular, have been much reduced and are limited to the more elevated areas, the moraines, the high terraces, and isolated hills. On non-calcareous soils, such as on some of the morainic amphitheatres, there are chestnut woods. Sometimes, as in the volcanic Euganean hills, they are mixed with hornbeam, hop hornbeam, and hazel, and more rarely with beech, birch, maple, and lime. Deciduous oaks are found elsewhere, e.g. the Montello. Somewhat degraded *macchia* occurs on parts of the Euganean hills. Along the Adriatic shores are some littoral pinewoods; north of the Po, chiefly near the mouth of the Tagliamento, there are thin woods of black pine, and south of the mouth, around Ravenna, the Mediterranean pinewoods of Classe, S. Vitale, and Cervia (pp. 148, 450). Some of the high terraces have soils too sterile for intensive cultivation and are largely, even to-day, left as heaths (p. 456) with heather, common juniper, and a large number of herbs. These are called *vaude* in the lower Canavese (Campo di S. Maurizio, near Cirie), *baraggie* near Biella (those of Candelo and Benna), *brughiere* or sometimes *groane* in Lombardy (between Saronno and Seveso), where they are particularly extensive in the Bresciano and between Como and Milan, and *magredi* on permeable soils in the high plains of Friuli. A few patches of cultivation are found on these heathlands where reclamation is going on; some use of them is made as army training-grounds, and parts, particularly in Lombardy, have been afforested with Scots pine and oak. Marshes, at one time very extensive, are still widespread in the eastern part of the plain, in and around the present delta of the Po. Here there are open sheets of water with aquatic vegetation surrounded by dense zones of marsh plants, especially reed-grass and tall sedges. The numerous canals and ditches of the flood plain also have aquatic and marsh vegetation. Canadian pondweed grows with such luxuriance as to impede navigation.

Apart from these woods, heathlands, and marshes, the appearance of the plain is determined by the crops grown. Of the total area 91 per cent. is cultivated; 23 per cent. is in wheat, 15 per cent. maize, 4 per cent. rice, 3 per cent. sugar-beet, 3 per cent. hemp, and 40 per



cent. meadow. The most distinctive crops are (1) maize, a tall (5-7 ft.) hoed-crop (i.e. with clean ground between each plant), grown everywhere but most common in Venetia (over 20% of the cultivated area) and in the north of Lombardy; (2) rice, fields of which are flooded during the earlier part of its growth, concentrated particularly on reclaimed and irrigated marshlands of the low and flood plains around Vercelli and Novara and as far east as the Adda; (3) grass, both permanent and rotation, occupying about half the cultivated area of the plain south of Turin and of a broad band extending between Pavia and Bergamo, Mantua and Bologna. In Lombardy, south of the Novara-Milan-Brescia railway, many of the low-lying meadows are kept flooded in winter under a thin sheet of slowly flowing water which, coming from warm, underground sources, never freezes. These meadows are locally known as *marcite*. Though pastures of a dry stony type are found on some hill-slopes, such as those of the high terraces, these lush meadows are more characteristic of the plain. They are dominated by tall-growing grasses and other herbs, and pass imperceptibly into marshy meadows, which in their turn merge into marshes.

Tree-crops are abundant, though the area devoted exclusively to them is small. Vineyards are found mainly on the slopes (sometimes terraced) of the surrounding mountains, and also of the Monferrato hills, as at Asti; but vines are planted among other crops on the plain itself, especially to the east of a line from Piacenza to Mantua. In all they are planted on 29 per cent. of the agricultural area. The vines usually climb on supporting trees, often mulberries. The mulberries are very numerous and always pollarded. Other trees, grown between the fields and not used to support vines, are usually pruned very tall and slim, with a clump at the top. Vines and mulberries both prefer the drier soils and tend to be less common in the irrigated areas.

### *Communications*

The Northern Plain is traversed by numerous important roads and railways. Below the high terraces, where the incision of the valleys and the multiple courses of the rivers make crossing difficult, the relief offers few obstacles to communication. The morainic hills are neither high nor continuous enough to have much effect on lines of communication, though among them the roads tend to lose the straightness which they have in the plain itself. These hills are penetrated, especially transversely, by roads and railways, including all the



western trans-Alpine routes; longitudinal routes tend to avoid them. Below the high terraces certain nodal points, such as Turin (p. 259) and Stradella (p. 261), are fixed by the necessity of avoiding the neighbouring hills. Otherwise, the main obstacles here also are the watercourses, although these provide an alternative form of communication as they are, in a general way, navigable as far as the upper limit of the fontanili. In the low and flood plains the watercourses are not incised as in the high terraces, but increase in size and, below the fontanili zone, in number. The flood plain and lagoon-delta zone form, except where reclaimed, difficult obstacles and are relatively poorly provided with roads. In the low and flood plains the system of irrigation canals (e.g. Cavour canal) and the innumerable irrigation and drainage ditches add to the difficulties of communication. On the whole, therefore, the most favourable alinement for routes is just above the zone of the fontanili, where the river beds are neither so deeply incised nor so broad as higher upstream, and yet where the excessive amount of surface water in the low plain is avoided. The main communications in the Northern Plain are, accordingly, peripheral, with a number of transverse links, the road and rail networks being remarkably similar. The northern road (11)<sup>1</sup> and railway run from Turin through Vercelli, Novara, Milan, Brescia, Verona, and Vicenza, and then through Treviso to Udine (53, 13); the southern road (10, 9, Via Emilia) and railway from Turin through Asti and Alessandria (using the Tanaro valley), Piacenza, Parma, and Bologna to Rimini. The considerable barrier of the river Po, with its marshy plain, is only crossed by nineteen road and six railway bridges between Pavia and the mouth, though between Turin and Pavia, where the river and its plain are narrower, bridges are more frequent (8 road and 4 railway). The transverse road and railway links generally use the same river-crossings. The principal rail-crossings are from Novara and Milan to Alessandria, Milan to Piacenza, Verona to Bologna, and Padua to Ferrara and Bologna or Rimini; the chief road-crossings are from Vercelli to Alessandria (31), from Milan to Voghera (35) and to Piacenza (9), from Brescia through Cremona to Piacenza (45-bis, 10), from Verona to Parma (62) and to Modena (12), and from Padua to Rimini (16). In addition there is a central line of communications running from Piacenza to Padua and thence to Gorizia, the road (10) being relatively more important than the railway. The principal centres of communication occur where through routes from the north, west, and south converge on the plain and

<sup>1</sup> The northern road is doubled by an autostrada from Turin to Brescia.



cut the peripheral lines, especially at Milan, Turin, and Bologna. Piacenza, guarding the Stradella Gate and the crossing of the Po by road 9, is another major route-centre.

### *Settlement*

The population of the Northern Plain, which is usually well above the average density for Italy (Vol. II), is concentrated especially between the foothills and fontanili zones. Here are found the majority of the towns, commercial and manufacturing centres, extending along the Turin-Milan-Verona-Venice and Piacenza-Rimini lines. For the most part these towns avoid the immediate neighbourhood of the rivers, as also do the smaller market towns, which are especially numerous in the low plain where industry is less developed. Over most of the plain the rural population lives in numerous, thickly scattered, small hamlets; isolated farms are, on the whole, rare. Immediately west of the F. Ticino, however, in the irrigated rice region, where reclamation is recent, and the land-holdings large, settlements are sparsely and uniformly distributed. The individual farm is here usually both large and isolated, and generally just off the public road, though some groups occur at cross-roads. The villages, like the towns, are seldom close to the rivers, even at fords or bridges. Many of them are concentrated round castles or monasteries. Brick and tile rather than stone are the common building-materials.

### *Subdivisions*

The plain may be divided into four major subdivisions: (1) Piedmont, west of the F. Ticino; (2) Lombardy with the part of Venetia west of the F. Adige; (3) Venetia; and (4) Emilia, embracing the whole area south of the Po except the Marengo plain around Alessandria, which is included in Piedmont.

### *Piedmont*

The innermost section of the plain is also the narrowest, being restricted by the Monferrato hills, a great northward extension of the Apennines, to a width of as little as  $10\frac{1}{2}$  miles near Turin. This hill-mass moulds the plain into an arc, swinging round from a main east-to-west direction to a north-to-south direction in the west. The two ends of the arc are connected in the south by the broad valley of the F. Tanaro between Bra and Alessandria. The main road (10)



and railway from Asti to Alessandria follow this valley, but otherwise the main routes have to make a detour to the north of Monferrato.

Morainic amphitheatres block the mouths of the Alpine valleys of the rivers Dora Riparia, Dora Baltea, and Ticino where they enter the plain. The first is small and compact, but reaches in places a relative height of as much as 660 feet (i.e. above the surrounding country). It narrows the plain between Turin and Rivoli to a gap of only 8 miles through which pass the main communications between the upper and lower plain of Piedmont. The amphitheatre of the Dora Baltea is far larger. Its north-eastern side along the continuous wooded ridge of la Serra is also higher (relative height up to 1,300 ft.). On the south-eastern side there are, however, some easy openings, and on the south the relative height is not more than 660 feet. The moraines of the Ticino group, which form the beginning of a series stretching as far east as Bergamo, are less marked features of the relief. The barrier south of Lake Orta is 660 feet high but narrow, while that south of L. Maggiore is never much over 330 feet. There are, however, tunnels on most of the railways crossing these moraines.

In the intervals between the moraines much of the Alpine edge of the plain north-east of the F. Dora Riparia is bordered by high gravel terraces, largely with an impermeable surface-layer of ferreto, and covered by heath or pinewoods. These arid heaths (*vaude*, *gerbidi*, *brughiere*, or *baraggie* in Piedmont) extend from S. Gillio (north-west of Turin) to Cameri, near Novara. They are especially widespread on either side of the T. Stura di Lanzo, and are practically continuous from la Serra to the F. Sesia, and even, apart from an enclave round Momo, to the F. Ticino.

South of the F. Dora Riparia the Cottian Alps rise much more immediately from the plain. There are no moraines and practically no high terraces. On the Apennine side of the plain, however, some patches of the high (fluvio-glacial) terraces, less noticeably desolate than those between Turin and Novara, occur in the Tanaro and Stura di Demonte valleys and south of Chieri.

Below the level of these high terraces, north of Turin, the division between the high and low plain, marked by the upper limit of the fontanili, runs close to the edge of the belt of moraines and high terraces, so that the high plain is narrow. South of Turin the high plain is represented by a wider strip of dry alluvium at the foot of the Alps. In the southernmost section, which is drained by the F. Tanaro, the streams have incised their courses deeply, and as a result the plain is here more dissected than farther north.



The low plain shows more rapid slopes in Piedmont than elsewhere. Cuneo, in the south, stands at 1,752 feet; Savigliano, in the middle of the upper Piedmont plain, at 1,053 feet; Turin at 830, Vercelli at 427, Casale Monferrato at 381, Mortara at 354, and Pavia at 253 feet. Rising out of the low plain are a few small hillocks, the largest of them, at Novara and Trino, being patches of gravel, and the smaller ones (*dossi*), probably former sand-dunes, are especially common near Vigevano in the eastern Lomellina.

Owing to the steep slopes, the Alpine streams of Piedmont are swift and torrential, and their courses are not so subdivided as the rivers of Lombardy and Venetia. They have, however, tended to form wide deflection-cones by frequent changes of course (T. Stura di Lanzo, T. Pellice) and to have forced the Po to flow at the foot of Monferrato. The main road (11) keeps fairly close to the north bank as far as Chivasso, whence it follows roughly the upper limit of the fontanili zone.

East of the F. Dora Baltea the large amount of water available for irrigation between the high terraces and the river has made rice cultivation possible on a large scale. Other crops are only grown to rest the land, and even the infertile heathlands north of Vercelli are being reclaimed for rice cultivation by means of irrigation. The shallow, light soils of the narrow plain south of the F. Dora Baltea are characterized by permanent meadow and pasture and the mixed cultivation of vines and cereals, chiefly wheat.

The Marengo plain, an isolated portion between the Po and the Ligurian Apennines, is cut off from the rest of the plain of Piedmont by Monferrato. Rivers converge on this area, chiefly on Alessandria, and the same features of high terraces and fontanili are repeated between the F. Tanaro and the T. Scrivia. There is more wheat grown here than in any other part of the plain, and vines are cultivated on the hills to the west and south. In the east the Marengo plain is limited by the edge of the Apennines trending north-east towards the Stradella Gate (road 10, Tortona-Piacenza railway). From the southern margin of the plain important routes (1 autostrada, 2 main roads, 3 railways) lead across the Apennines to Genoa.

Turin is the main route-centre and crossing-point of the Po in Piedmont, since all east to west routes must pass either to the north or the south of Monferrato, and the easiest north to south routes either through the constriction of the plain between Rivoli and Turin or east of Monferrato through the Marengo plain. Turin also commands the road (25) and railway debouching on to the plain from the



Mont Cenis pass, as well as the roads (23, 24) from the Monginevro pass. The main road and rail routes east from Turin pass to the north of Monferrato through Chivasso, Vercelli, and Novara, and to the south through Asti and Alessandria. Southwards through the narrow section of the plain are two more or less peripheral routes, the more easterly being the more important.

### *Lombardy*

The Lombardy section of the plain, between the Ticino and the Adige, embraces only the slope north of the main stream. The width of this slope varies considerably from over 50 miles south of Como, where the plain north of the river is at its widest, to about  $13\frac{1}{2}$  miles south of Verona, on the eastern border. The general height of the plain is less than in Piedmont and the gradients gentler. At the Alpine edge (excluding the morainic hills) the plain stands at 850–1,000 feet in the west, 650–850 round Bergamo, 500 near Brescia, and only 150 near Verona; the altitude of the lower edge is indicated by the heights of Pavia (253 ft.), Cremona (154 ft.), Mantua (66 ft.), and Ostiglia (43 ft.).

The system of moraines on either side of the Ticino is prolonged in Lombardy as far east as the F. Adda in a continuous and very confused belt of hills, with a relative height of up to about 660 feet. These hills (p. 207) cause the roads and railways to adopt tortuous courses and to show occasional moderate, though short, gradients. Otherwise they have little effect on communications. A small morainic amphitheatre to the south of Lake Iseo fills the angle between the narrow ridge of M. Orfano and the Brescian Alps and rises about 500 feet above the plain. Another more massive group of morainic hills round the southern end of Lake Garda (p. 212) rises 500 feet above the level of the lake and forms a fairly uniform horseshoe-shaped barrier, 8 miles wide and 45 miles long, from Salo to Caprino in the Adige valley, and only interrupted by the notch cut by the F. Mincio. West of Manerba the hills enclose several small lakes. This barrier is twice crossed by the main west to east railway and road (11) without much difficulty.

The high terraces extend continuously in front and on either side of the morainic hills from the Ticino to Lake Iseo, but are not found in eastern Lombardy. The terrace surfaces stand between 50 and 100 feet above the surrounding plain and are often thickly covered with ferreto. There are still large areas of heath and brushwood, especially in the west. Wheat and maize are the chief crops, with mulberries and





PLATE 92. *The Adda at Trezzo; river incised in the high plain*



PLATE 93. *The Apuan Alps and the coastal plain of Viareggio from Point Bianca*



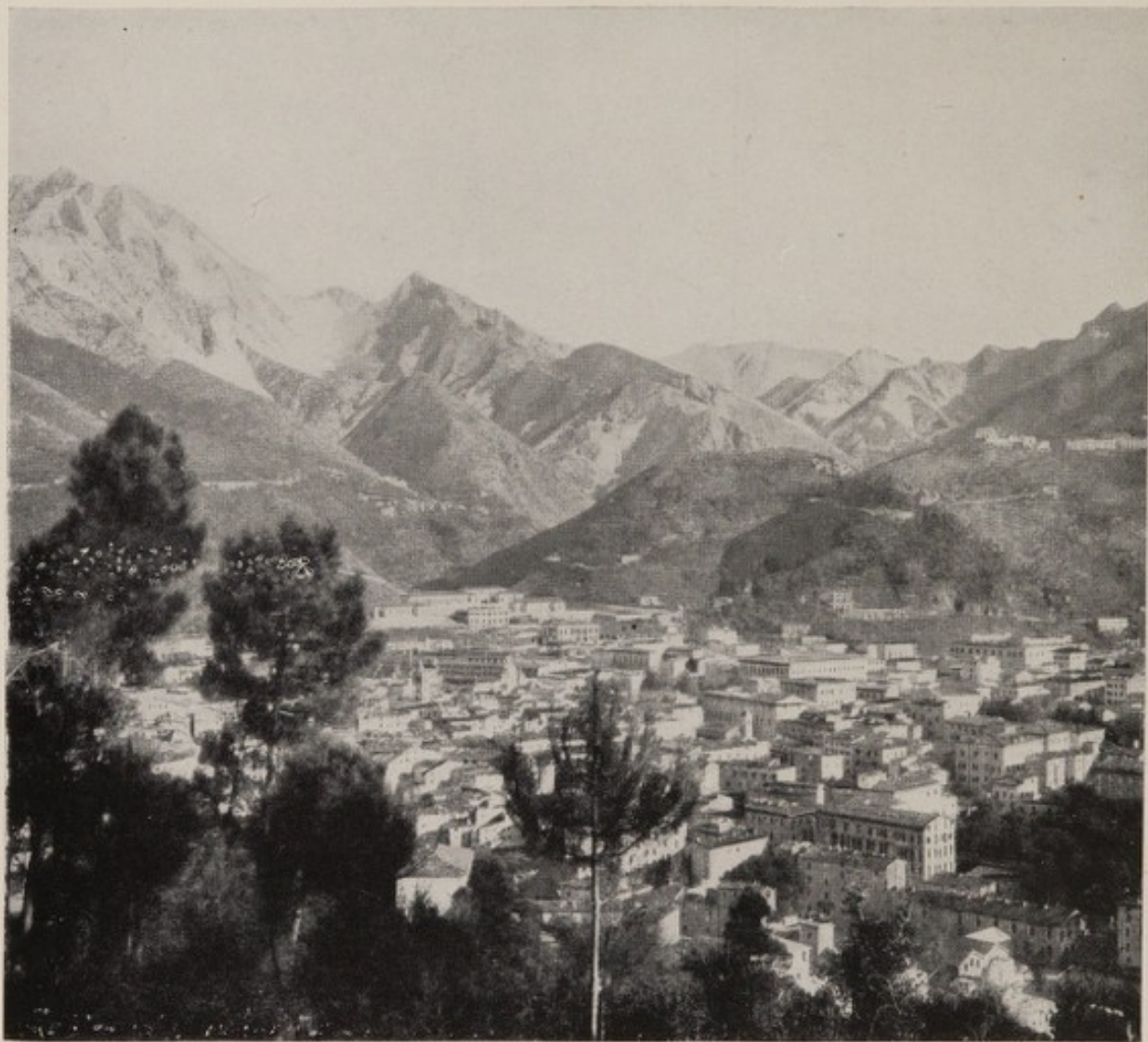


PLATE 94. *Carrara: marble quarries in the Apuan Alps*



PLATE 95. *The plain of Pisa at S. Rossore*



fruit trees. The gravels near the base of the terraces have sometimes been cemented into a coherent stone, known as *ceppo*, which is valuable as a local building-material.

Terraces extending down to the alluvial belt along the Po are more widespread in Lombardy than farther east or west. The river valleys have terraced sides (Plate 92), and along the north bank of the Po the lowest of the terraces falls 30-40 feet to the flood plain. This step is frequently broken by the rivers crossing the plain. The low plain is intersected both by rivers and by numerous canals and is exceptionally wide and productive. This part of the low plain is characterized by the high proportion of irrigated meadows (*marcite*), which produce up to seven or more crops of hay in a year. Other permanent and rotation meadows, supporting high densities of cattle, are also important.

Several small and isolated eminences rise out of the Lombardy plain, and have a higher proportion of vines than the surrounding plain. These are formed of patches of old gravels spared by later erosion, or of late Tertiary rocks representing the summits of old relief-features otherwise buried under the thick alluvium. Among the older gravel patches are the low hills of Bagnolo and Chieve near Crema, of Romanengo near Soncino, and the broad hill (relative height about 100 ft.) of M. Netto at Capriano, south-west of Brescia. Among the Tertiary hills the most noticeable are the peculiar, long, narrow M. Orfano (relative height 820 ft.) which merges into the morainic amphitheatre of Lake Iseo; the hills of Castenedolo (relative height 495 ft.) and Ciliverghe, south-east of Brescia, and of S. Colombano, east of Pavia. The last is composed of three distinct hills, which rise to a maximum height of 230 feet above the plain and represent a portion of the Apennines cut off by a southward swing of the Po. The gap between the S. Colombano hills and the Apennines, referred to as the Stradella Gate (p. 259), is used north of the Po by the road and railway from Pavia to Cremona. The most important part of the gap, however, is the narrow passage between the river and the Apennines on the south (p. 306) used by road 10 and the Alessandria-Piacenza railway.

The flood plain of the Po is wide in Lombardy and has suffered frequent changes of the river's course, which have left backwaters, lakes, and marshes. Much of the area in the immediate neighbourhood of the river and its main tributaries is wooded.

The greater part of the plain of Lombardy as far east as the Mincio is meadow-land, with some *marcite*. Between the Mincio



and the Adige the proportion of wheat, maize, and fruit tends to increase.

The rivers of Lombardy are of three classes. The large Alpine rivers, Ticino, Adda, Oglio, Mincio, and Adige, have broad multiple upper courses and wide, but comparatively steep, terraced valleys. Their lower courses resemble the Po in having intricate meanders and a single, deep bed. All except the Adige have a regular flow due to the lakes through which they pass. This combination of characteristics makes them important obstacles. The three widest, the Ticino, Adda, and Mincio, have been of military importance throughout the history of Italy since they afford a series of defensible lines extending from the Po to the Alps and are crossed only at a few points. There are even now only eight road-bridges over the Ticino as compared with eighteen over the Thames between Pangbourne and Teddington lock, a roughly similar distance.

Other rivers, such as the Lambro, Serio, Mella, and Chiese, have only short Alpine courses and are not such formidable barriers because they are smaller and not so deeply incised. Finally a large number of streams, which have their origin in the *fontanili*, rise in the low plain and flow over the surface of the terraces, forming numerous but insignificant obstacles.

### *Venetia*

The plain of Venetia slopes to the sea instead of to a river, and consequently has a southern fringe of lagoons and deltas not found in Lombardy or Piedmont. The mean elevation of the plain also is less. The height at the inner edge varies greatly, but is mainly between 150 and 300 feet, although in the northern portion of Friuli it is much higher (up to 600 ft. and over). In general the country is very flat; Verona, in the north-western corner and over 60 miles from the sea, stands at only 187 feet. There are, however, some steep slopes on the great dejection-cones of Friuli. The hilly zone at the foot of the Alps, which in Lombardy and Piedmont is practically continuous, is fragmentary in Venetia, and the mountains frequently rise abruptly from the plain.

Morainic amphitheatres are lacking between Lake Garda and the F. Tagliamento, but immediately east of this river and north of Udine there is a final, isolated example. This has blocked up the valley and forced the Tagliamento to make another exit through the narrow gorge at Pinzano, whence a confused mass of hills, 3 to 7 miles wide and edged by a distinct outer rampart, runs through Fagagna to



Tarcento (p. 262). The hills, which rise about 500 feet above the plain, are covered with fruit trees, vines, and mulberries and are closely settled. They are traversed by many minor roads, but the main road (13) and railway from Udine avoid them.

The high terraces are almost entirely absent, though in Friuli the upper portion of the high plain has a similar type of landscape. One remnant of high terrace, however, does form the Montello, a small highland 8 miles long, south of the F. Piave where the latter emerges from the mountains. Together with the similar but older and more rugged hills of Asolo and Conegliano north of Treviso, the Montello forms a semicircle enclosing the small basin (p. 229) from which the Piave escapes by a narrow gorge at Nervesa. The flat-topped Montello rises to a maximum of 840 feet above the plain and is rather higher on the south side than on the north, but has a steep scarp (130-260 ft.) on the north, where it is undercut by the Piave. The hill is largely composed of calcareous gravels, so that its surface has a number of dolines, and springs occur mainly along the northern flank. The western section is isolated from the rest by a former valley of the Piave, now followed by road and rail. The Montello was an important bastion in the defence of the Piave after Caporetto in November 1917.

In the west of Venetia two isolated masses of hills rise abruptly from the alluvium. The Mi. Berici, immediately south of Vicenza, are composed of volcanic rocks and limestone and are similar to the Mi. Lessini, the nearest portion of the Alps, from which they are separated by a passage some 2 miles wide (Verona-Vicenza railway and road 11). The Mi. Berici are a compact group of hills, about 12 miles long from north to south. They are gently sloping except on the eastern side and culminate near the centre in M. Alto (1,457 ft.). The volcanic Euganean hills, a less compact group 5 miles to the south-east of the Mi. Berici, cover a similar area but reach rather greater heights (M. Venda 1,978 ft.). The Euganean hills are more thickly wooded (chestnut and some oak) than the Mi. Berici.

These two small hill groups effectively interrupt the zone of the fontanili (or *risorgive* as they are called locally), which is broken here and starts anew near Vicenza. To the west the whole plain is low-lying. The high plain is narrow and relatively low (less than 150 ft.). Below it the greater part of the area is occupied by the Po-Adige delta, with artificial drainage to streams flowing above the level of the country. Where reclaimed, the lower-lying area is important for the cultivation of hemp and sugar-beet.



To the east of these hills the division between the high and the low plain becomes more marked until in Friuli it is clearer than anywhere else. Here, to the west of Udine and north of road 13, the high plain is 15 miles wide and as much as 800 feet above the low plain. The whole of the high plain of eastern Venetia is excessively porous, and practically waterless except for the Alpine streams, Piave, Tagliamento, and Isonzo. It is a very sparsely populated area, covered with heathlands (*magredi*) and rather thin pasture. Even the Alpine streams lose a great deal of their water in their passage through this zone, and have broad beds of pebbles and gravel, filled only during flood. The Tagliamento and the Isonzo have actually been known to dry up in this section of their courses. Other streams, such as the T. Meduna and the T. Cellina, dry up regularly and have very variable courses on the great gravel dejection-cone which forms the high plain west of the Tagliamento between the Alps and road 13.

The upper limit of the fontanili occurs mostly at about 100 feet above sea-level and is exceptionally well marked. It is followed for much of its length by road and rail and by a line of settlements at regular intervals, e.g. between Codroipo and Palmanova. Below the fontanili the rivers become fuller and their courses concentrated into one bed. The country is green, well watered, and intensively cultivated, with wheat, maize, rotation grasses, vines, mulberries, and fruit trees. The recently reclaimed land in the south is characterized by the 'extensive' cultivation of cereals.

Fringing the low plain, and between it and the sea, the lagoon-delta zone forms a second rather deserted area where the land has not yet been reclaimed and artificially drained. Much of this zone lies scarcely above sea-level, and some well below. A sandy bar, often dune-crowned, more or less cuts off the lagoons from the open sea. The largest of the open lagoons (*lagune vive*), for example those of Venice, Marano, and Grado, are affected by the tides (about 3 ft. at Venice), the ebb and flow of which keep open an intricate series of branching channels (*canali*) within the lagoons, as well as the passages (*porti*) to the open sea. The tidal influence spreads, although with rapidly diminishing force, into the remoter parts of the open lagoons, and even into the closed ones (*lagune morte*), where the water is brackish. The channels in the lagoons are divided by banks of mud (*velme*), dry at low tide and sometimes covered with grass in their higher parts (*barene*). On the sands of the Lido between the lagoon of Venice and the sea intensive market-gardening is carried on.

The main groups of lagoons (Venice, Caorle, and Marano-Grado)



are separated from each other by four deltas which are formed by the large Alpine rivers. These are the composite delta of the Po, Adige, and Brenta and the deltas of the Piave, Tagliamento, and Isonzo. The delta of the Po, by far the largest and most active, is also the best known. Its seaward growth is continuous, but the rate varies from time to time, and from mouth to mouth, according to the amount of water brought down by the river. In 1928<sup>1</sup> the percentage of water flowing through the various channels in order of importance was:

	<i>High water</i>	<i>Low water</i>
Po della Pila . . .	61.2	69.8
Po delle Tolle . . .	16.7	15.1
Po della Gnocca . . .	12.0	12.0
Po di Goro . . .	8.0	0.1
Po di Maestra . . .	1.0	1.0
Po di Levante . . .	?	?

The greatest growth of the delta, therefore, is round the Pila mouth in the north (about  $\frac{3}{4}$  mile from 1900 to 1930), while around the Po di Maestra and the southern branches some retreat is occurring. The delta is composed of very low and in general flat areas of fine alluvium, in part reclaimed. This fertile new land is under meadow, beet, and cereals, with some rice round the lagoon of Venice. Along the coast are beaches and dunes of coarser material. Old sand-dunes (*dossi*), marking the positions of former coastlines, occur some way inland. Such old dunes are most frequent south of the main stream, where their lines have an obvious influence on the shape of the lagoons of the Valli Bertuzzi, Giralda, &c. (p. 143).

The other Venetian deltas are similar to that of the Po, but are much smaller, have simpler systems of branching, and more sand in their composition.

### *Emilia*

The southern part of the Northern Plain, between the Po and the Apennines, is a triangular area tapering westwards towards the Stradella Gate. This area differs from that north of the river, mainly because of differences between the Apennines and the Alps. The Apennines are lower, have softer rocks, fewer lakes, and a more markedly seasonal (winter) rainfall. As a result all the Apennine rivers are liable to heavy floods during which they carry down such great quantities of material that the alluvial plain of recent sediment is wider than in the north. On the other hand, the amount of glacial

<sup>1</sup> Perhaps an abnormal year owing to the high flood of 1926.



debris derived from the Apennines during Pleistocene times was small compared with that provided in the north by the Alps. Consequently in the south the higher terraces are confined to a narrow zone along the foot of the Apennines and are reduced to small patches scarcely distinguishable from the hills against which they rest.

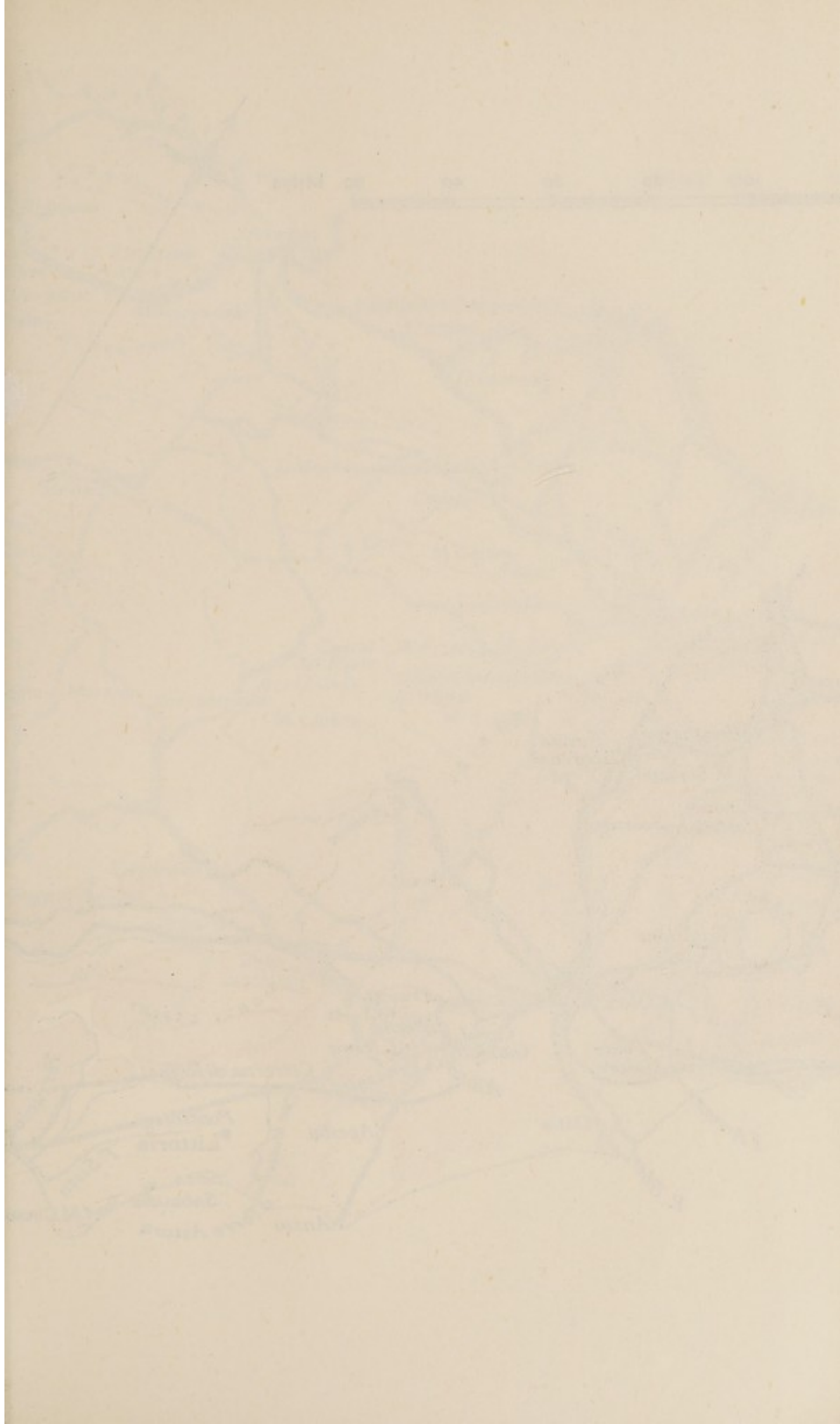
The zone of the high plain is narrow and not so clearly demarcated by the line of the fontanili as in the north. The Via Emilia (road 9) from Piacenza through Bologna to Rimini follows almost exactly the lower edge of the older and coarser sediments. To the north of this the fontanili zone is much interrupted and broken, but the belt of low plain is narrow and soon gives way to the present flood plain. North of the Via Emilia the country is featureless and flat. The difference in height between the road and the river is usually less than 100 feet. Towards the east the flood plain widens steadily to about 25 miles at Ferrara. In the lower Modena and Ferrara and Ravenna districts practically the whole area is reclaimed land, with its characteristic rectilinear watercourses. The lagoons (*valli*) of Comacchio continue the lagoon-delta zone to the south of the Po delta, where reclamation is still going on. Agriculture in the flood plain is characterized by the predominance of hemp and sugar-beet, but to the south wheat (particularly in the south-east) and rotation grasses are more common. Along the southern edge of the plain vines are grown in mixed cultivation.

The Emilian rivers form obstacles to communication not so much on account of their size, nor except in the Apennine foothills the depth of their incision, but owing to their sudden and violent floods. The Emilian rivers have not played a part in the military history of the country comparable in importance with that played by the left-bank tributaries of the Po. Piacenza, however, is the most easterly place on the south bank where comparatively dry alluvium is found near the river and is an important crossing which enhances the nodal significance of the Stradella region (p. 259). The other main crossings farther downstream at Cremona, Casalmaggiore, Borgoforte, Ostiglia, and Ferrara involve an increasingly wide traverse of the flood plain.

### THE PRE-APENNINES

THE Pre-Apennine region embraces western Italy from the Magra valley in the north to M. Circeo and the Pontine marshes in the south, a distance of about 270 miles, and is separated on the east from the Northern and Central Apennines, between 40 and 60 miles inland, by











the Arno-Chiana-Tiber trough. The region, which as a whole is lower and less unified than the Apennines, rises above 5,000 feet only in isolated peaks. It consists not of long, imposing chains, but of several units of very diverse structure and composition, welded together by deposition and uplift during and after Pliocene times, when nearly the whole region was submerged beneath the sea.

*Physical Features.* Six main types are exemplified: *mountains* and *basins*, both similar in type and trend (NW.-SE.) to those of the Northern Apennines; the mountains are composed mainly of sandstone or of older crystalline rocks; the basins are steep-sided depressions floored with Pliocene and Pleistocene lake or river sediments. In addition to and often intermingled with the first two are remnants of Pliocene and Pleistocene marine deposits, now raised into dissected *plateaux* or *terraces*, and extinct *volcanic cones*, surrounded by *volcanic tuff* plateaux. Finally there are small low-lying alluvial *plains* along the coast.

In the extreme north the Apuan Alps, a small mountain group of rocks older than the rest of the Pre-Apennines, have an Apennine trend, which is continued to the south in the smaller M. Pisano. South of the Apuan Alps lies the alluvial plain of the Arno, with isolated ridges of higher land to the north of the river. This plain is in turn succeeded to the south by the Tuscan upland, a composite highland region containing the remains of lands which sank when the Tyrrhenian Sea was formed, and were subsequently uplifted. Between its two mountain rims, disjointed on the west but more continuous on the east, lies the Pliocene trough of Siena, a region of more uniform relief. In the southern part of the upland, beyond the Ombrone valley, the volcanic rocks of M. Amiata and M. Radicofani emerge through clays, sandstones, and marls. South of M. Amiata are the North Latin hills, a large continuous expanse of more recent volcanic tuffs surrounding four principal volcanoes. This volcanic area is crossed by the Tiber where these tuffs are at their lowest in the Roman Campagna, a lowland separating the North Latin hills and the Alban hills, which rise out of it, on the south. At intervals along the coast of both the Tuscan upland and the volcanic region small alluvial plains occupy embayments in the edge of the hills. In the extreme south a larger alluvial plain, the Pontine marshes, lies at the foot of the Mi. Lepini (p. 289). Finally, along the eastern margin of the whole region from the Apuan Alps to the Alban hills extends the Tyrrhenian trough of interconnected basins (the Garfagnana, Florence, Valdarno, Arezzo, and Val di Chiana basins, and the Chiani-Paglia,



middle Tiber, and Sacco-Liri-Volturno valleys). For the most part this trough is steep-sided and, with its flat floor, is always sufficiently distinct to indicate clearly the eastward limit of the Pre-Apennines.

*Vegetation.* The vegetation is very varied owing to the fragmented structure of the region. The usual altitudinal zones succeed one another. The lowlands are closely cultivated and the hills often terraced. Within the lowland zone the vegetation differs in three types of area: (1) the Maremma, (2) the Pliocene and river basins, and (3) the folded hills and Pliocene and volcanic plateaux.

The vegetation of the Maremma, which extends along the coast between Leghorn and Civitavecchia, most nearly approaches the original plant cover. On the coastal headlands the slopes are covered with *macchia*. Along the low-lying shores, including the Tiber delta and Pontine marshes, there is great variety. The sandy areas and dunes are often covered with pinewoods (maritime, stone, and Aleppo pines; p. 450); inland these merge into dense thickets of evergreen and deciduous oaks, sometimes mixed with alder, white poplar, and ash, and in places into *macchia*. The thickest and largest of the forests are between the Pontine marshes and the sea. Much of this woodland was cleared in the reclamation of the marshes, but about 11 square miles were preserved in the M. Circeo National Park. Bracken forms a dense cover in some areas where forest has been destroyed. Marshy areas, too waterlogged for the growth of trees, also occur, and in places there are wide, open grazing-grounds, green in winter and spring, desiccated and brown in summer. On the reclaimed lands corn and fodder crops are intensively grown in rotation. The Pliocene and other semi-enclosed basins are the most generally favourable agricultural areas, and are covered with vineyards, olive groves, and small cornfields. Mixed cultivation of trees, including mulberries, and of ground crops is practised. The hills and volcanic plateaux are mostly poor, treeless, grazing land, but some of the hills rising above the general level and many of the steep valley-sides are still forested. Mixed cultivation occupies the more favourable slopes. The surface of the Roman Campagna is mainly cornland and poor pasture, but is being transformed by reclamation. The Alban hills are for the most part covered with gardens, vineyards, olive groves, and chestnut plantations, but there are considerable areas of *macchia*, small oakwoods, and rocks with open, often tufted vegetation.

The plants typical of Mediterranean areas extend well up the sides of the hills. In the Apuan Alps, however, the high rainfall makes the limits exceptionally low, and the upper limit of the olive is only 330-





PLATE 96. *The Arno at Signa*



PLATE 97. *Fiesole at the edge of the basin of Florence*





PLATE 98. *Reclaimed land at Alberese near Grosseto*



PLATE 99. *Monte Oliveto near Siena; 'calanchi' and ridge-road*



800 feet. Near Lucca, in a more protected situation, it rises to 1,800 feet. On M. Pisano the limit is 1,300 feet, near Florence 1,600–2,000 feet, in Umbria about 1,500 feet, and in Latium 1,600 feet. In general the chestnut zone is between 1,000 and 3,000 feet, and that of the beech above 3,000 feet. As usual the forests have been largely replaced by scrub and coppice, but chestnut groves are widespread and include some 500 square miles in the compartment of Tuscany.

*Communications.* The two lowland edges of the Pre-Apennines are followed by north to south railways. Along the coast there is the Via Aurelia (1), and the Tyrrhenian trough is followed by road from Pistoia to Orvieto (66, 69, 71). The Siena Pliocene trough is also important for north to south routes (road 2 and railway). For transverse routes the lower Arno and Tiber valleys are particularly important, but two railways and four main roads cross the uplands from the coast to the Tyrrhenian trough. Rome is, and has always been, the greatest route-centre, with roads and railways converging from all parts of the country. Florence, the other major centre, stands at the junction of the most important routes across the Apennines to the Northern Plain and the east coast. The Pre-Apennines are, on the whole, poor in main roads and railways.

### *Subdivisions*

The Pre-Apennines can be divided into nine main topographical subdivisions: (1) the Apuan Alps, (2) the lower Arno, (3) the Tuscan upland, (4) the North Latin hills and Tolfa mountains, (5) the Roman Campagna and lower Tiber valley, (6) the Alban hills, and (7) the Pontine marshes. These seven areas are separated from the Apennines by the Tyrrhenian trough, which includes (8) the middle Arno valley in the north and (9) the middle Tiber valley in the south.

#### *The Apuan Alps*

The Apuan Alps are a small highland some 40 miles long and 12 miles wide, bounded on the north by the Magra-Aulella valley and on the east and south by the valley of the F. Serchio. To the west is the narrow coastal plain of Viareggio, from which the Alps rise steeply (Plate 93).

This region is geologically one of the oldest of the Peninsula, and is the highest part of the Pre-Apennines. The most widespread rock is hard limestone, so that despite the tectonic connexion between the Apuan Alps and the neighbouring Apennines (p. 306) the two moun-



tain regions present widely differing landscapes. The Apuan Alps were originally folded in a north to south direction, and later uplifted along a north-west to south-east line, in direct continuation of the Gottero chain (p. 306) of the Northern Apennines, from which they are cut off by the transverse Magra valley (roads 62, 63).

Since the mountains rise steeply and close to the sea above a narrow coastal plain, precipitation is heavy. As a result denudation of the hard rock has been rapid, and steep walls, jagged mountain crests, and narrow, deep valleys have been formed, all in strong contrast to the rounded forms of the neighbouring Northern Apennines. These features are particularly striking on the western slopes. The line of highest peaks, of which the five highest average over 6,000 feet, rises less than 10 miles from the sea. M. Pisanino, the highest point (6,385 ft.), bears on its northern side traces of glaciation in moraines and striated and rounded rocks. East of the watershed the mountains fall to the upper Serchio valley, known as the Garfagnana. Within this district lie two small, densely populated Pliocene basins, each about 3 miles long, centred on Castelnuovo and Barga. Apart from these basins the valley is wild and narrow.

Owing to the predominance of limestone, the surface is permeable and large springs occur at the junction of the limestone and impermeable strata near the foot of the mountains. Here and in the Garfagnana and Lunigiana are the areas of densest population. Elsewhere population is sparse.

The Apuan Alps are world famous for their abundance of marble. Yellowish and grey marbles of coarse grain are widely quarried, but it is the pure white of Carrara, with fine uniform grain, that is most sought after (Plate 94).

### *The Lower Arno Region*

South of the Apuan Alps and the Cusna chain of the Northern Apennines (p. 307) is the lower Arno region (Fig. 49). The relief of this complex of hills, low-lying, alluvial plains, and interconnecting valleys is partly explained by its recent geological history. In Pliocene times the area was covered by the Etruscan gulf, out of which M. Pisano and, somewhat later, the Cerbaie platform rose as islands. The gulf extended inland as far as M. Albano, which separated it from the lake occupying the Florentine basin. Gradually the Albano ridge was cut through by the river Arno and the lake was drained. Sediment filled in the gulf and joined the islands together with low, swampy, alluvial plains. Deposition still continues near the river



mouth, and it has remained for man to drain these plains and make them habitable.

The coastal plain of Pisa communicates with the interior by two west-east passageways along the northern and southern margins of the region. The northern is the less well defined and is not followed by a continuous watercourse. The southern is the valley of the Arno itself. These passageways are separated and linked together by parallel transverse hills and plains. In the west the coastal plain is bordered by the marked barrier of M. Pisano. Eastwards as far as M. Albano stretches a lowland area, out of which rise low Pliocene hills. Between these the interconnected expanses of alluvial plains are normally less than 100 feet above sea-level. The comparatively high and continuous ridge of M. Albano is breached by the Serravalle pass in the north and by the Gonfolina gorge of the Arno in the south, both of which lead into the large Florentine basin.

The two passageways are followed by important routes from the coast: the northern by autostrada, main road, and railway; the southern by main road (67) and railway. These two routes are frequently interconnected.

The alluvial *plain of Pisa*, narrow in the north where it adjoins the coastal plain of Viareggio (p. 73), broadens to 17 miles in the south. Here, between the steep, southern edge of M. Pisano and the gentler slopes of the Tuscan upland, the Arno valley forms a wide, inland extension to Pontedera. Like so much of the west coast of Italy, the plain of Pisa became increasingly marshy during the Middle Ages, and the existence of the city was threatened. Drainage was begun in the seventeenth century by canal and pump, and the greatest efforts have been made, especially in recent times near Coltano, to raise the level of the marshes with alluvium brought down by the Serchio and Arno (Plate 95). The decline of Pisa, once a famous port, was due to silting, and its place has been taken by Leghorn (Livorno) at the southern extremity of the plain.

*M. Pisano*, structurally an isolated fragment (12 miles long) of the Apuan Alps, from which it is separated by the deep, narrow valley of the Serchio, rises on the other three sides like an island from its surrounding alluvial plain. It is made up of schists and limestone, and culminates in Croce di Termini (2,980 ft.). The lower slopes are densely populated and covered with orchards and the higher parts with chestnut trees. At the foot of M. Pisano, in the south-west, rise the warm springs of San Giuliano, the most northerly of many such springs typical of the Pre-Appennines.



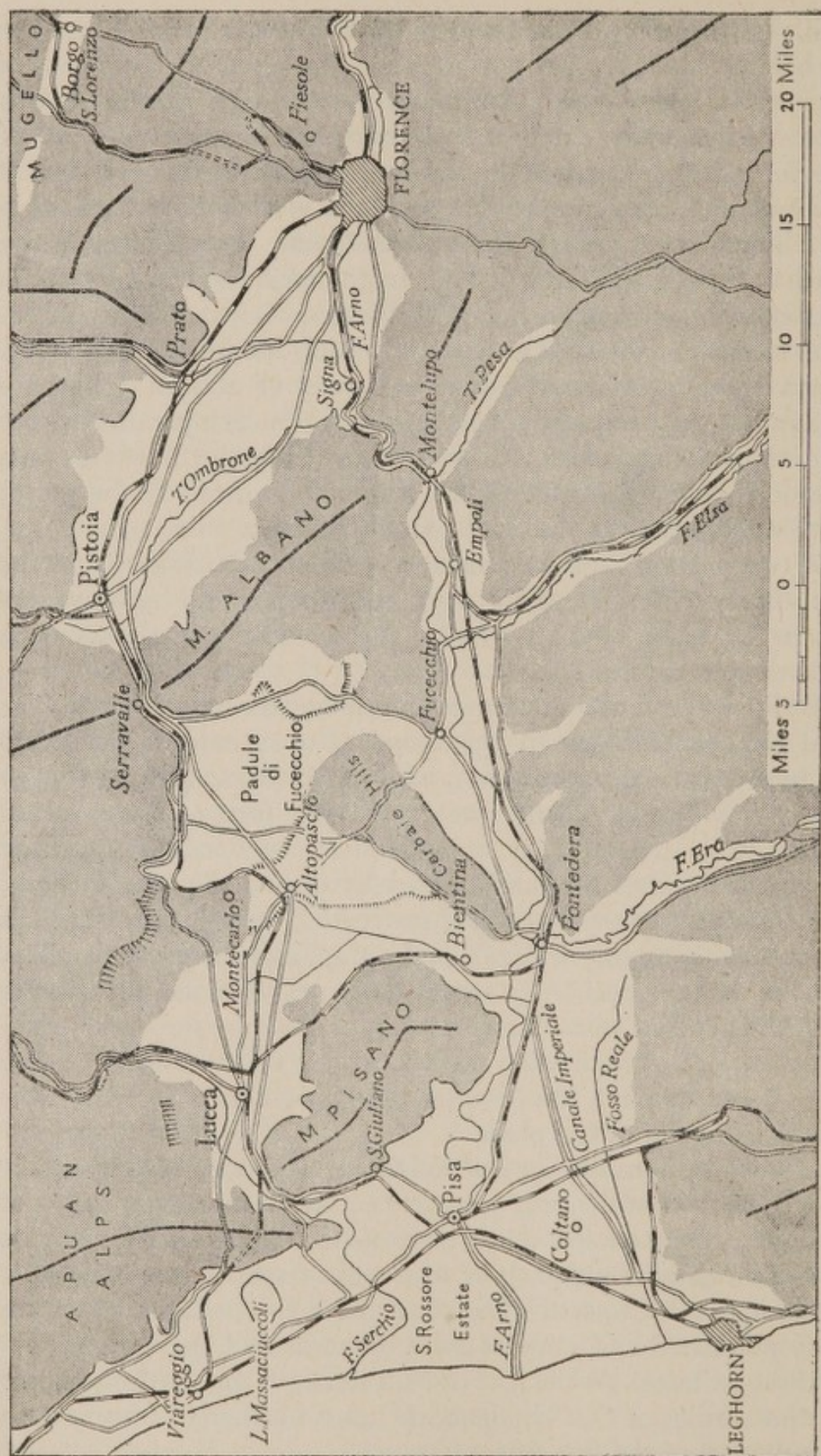


FIG. 48. The Lower Arno Basin. (Key as for Fig. 40)



North of M. Pisano and east of the lower Serchio valley the fertile and intensively cultivated *plain of Lucca* stretches along the foot of the Northern Apennines. These rise steeply from the low, undulating foothills which form the margin of the plain and extend south round Montecarlo. The *plain of Bientina* completes the ring of alluvium to the east of M. Pisano. At one time this basin, like that of Florence, was occupied by a lake without outlet to the sea. Now its marshes have been drained southwards by the Imperial Canal which reaches the sea independently of the Arno. By this means the Arno floods are prevented from interfering with the drainage system.

The Bientina plain is flanked on the east by the *Cerbaie Hills*, a gravel-capped platform barely 300 feet above the land around and separated on the north from the hills near Montecarlo by the northern passageway at Altopascio. Pontedera, near the southern end of the Cerbaie, guards the first constriction of the Arno valley. This, however, soon opens out into a lowland which limits the Cerbaie on the east and expands northwards into the wide Padule di Fucecchio, formerly marsh but now reclaimed.

The sandstone ridge of *M. Albano* is divided from the Cusna chain of the Northern Apennines (p. 307) by a low saddle at Serravalle (600 ft.). The ridge, which is well wooded, rises to 2,014 feet and is continued to the south of the Arno in the Mi. del Chianti (p. 275), from which it has been separated by the Gonfolina gorge. Above Fucecchio the Arno valley narrows gradually to Montelupo at the entrance to this gorge, which is narrow and deep and curves in wide meanders for 7 miles to Signa, in the south-western angle of the Florentine basin (Plate 96).

The *basin of Florence* (25 miles long, 6 wide; av. alt. 150 ft.) is a flat lowland, enclosed on all sides by steep slopes. On the east are the abrupt sandstone sides of the Cimone chain of the Apennines (p. 307), and on the south the basin is closed by the junction of this chain with the Mi. del Chianti. The basin is floored with lacustrine deposits, and in its western portion marsh may have persisted during early historic times. The oldest settlements, such as Florence (160–210 ft.), Prato (210 ft.), and Pistoia (213 ft.), were built at the foot of the surrounding hills, and others, such as Fiesole (968 ft.; Plate 97), high up the hill-sides. The basin is now drained and thickly covered in parts with trees and vines. The T. Ombrone, which receives many canalized tributaries, keeps to the western side and the Arno only flows across the southern end. The Arno (p. 283), despite its terrible floods (its average discharge has varied in different



years from 530 cu. ft. to 70,628 cu. ft. per sec.), is the vital artery of Tuscany. The river is navigable only for a short distance above Florence, but is used higher up for floating timber. The Arno and lower Serchio valleys are more densely populated and productive than the rest of Tuscany, and their cities and towns are rich in historical memorials. All the more important cities, with the exception of Siena, are within their valleys.

### *The Tuscan Upland*

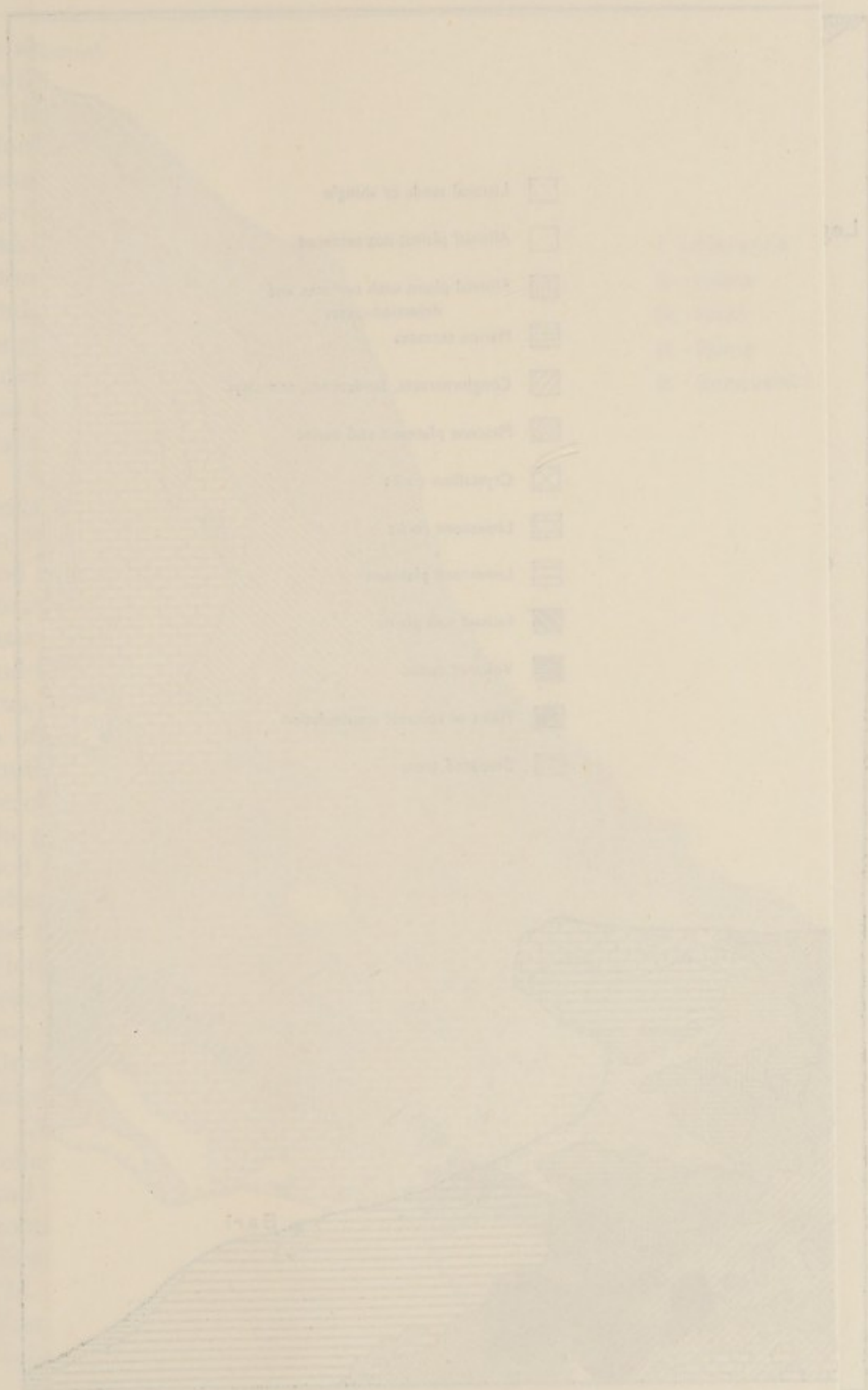
To the south and west of the Arno rises the undulating Tuscan upland. It is composed in the north of three belts parallel with the coast: the Maremma and western highlands, a confused region of coastal uplands and lowlands; the Siena trough, a region of Pliocene clays, sands, marls, and limestones, which are softer than the rocks of the surrounding belts; finally, the mountain ridges of Chianti along the eastern margin. In the south beyond the F. Ombrone there is a fourth transverse belt of rugged volcanic country.

*The Maremma and Western Highlands.* This most westerly belt includes mountains which come down close to the sea, intervening coastal plains, and rocky islands, some of which have been joined to the shore as peninsulas by silting.

The lowlands occur either near the mouths of the longer rivers or in narrow strips between the foot of the hills and the sea. They were, until recent times, for the most part marshy and unhealthy. Since many of them penetrate, sometimes even to a depth of 30 miles, into the mountains, the lower slopes of the latter have also become infected with malaria. As a result the Maremma has been sadly notorious and its population sparse, at least until the last decade. The only important town is Grosseto near the mouth of the Ombrone. Although much of its alluvial plain has now been drained and is used for pasture or cereal cultivation, there is still a large area of marsh. Great efforts have, however, recently been made to drain the Maremma by warping and artificial silting (Plate 98; p. 74).

The mountains are mainly composed of Tertiary sandstones with much older and harder rocks outcropping here and there, but especially in the Catena Metallifera in the south. The mountains are separated into two main blocks by the valley of the Cecina (road 68 and railway). Both are for the most part barren and uncultivated. The smaller northern block is comparatively low and only rises to over 1,000 feet in a small central area (M. Vitalba, 2,214 ft.). It is crossed from north to south by a depression (c. 300 ft.) which offers







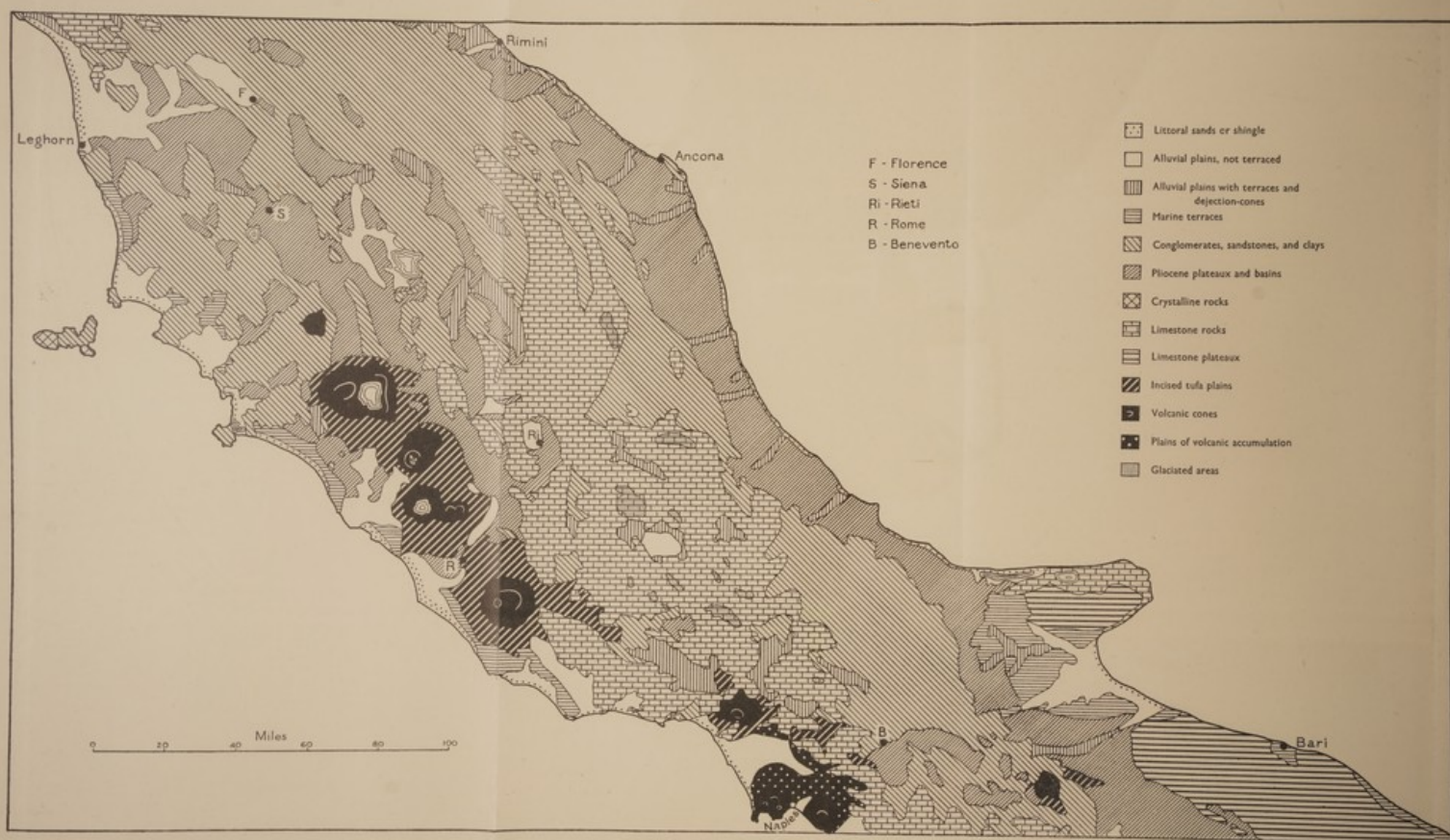


FIG. 49. Landform types: Central Italy



an alternative to the coastal route between Pisa and Cecina. The southern block, including the Catena Metallifera, reaches 3,475 feet in the limestone peak of Le Cornate and 3,448 feet in Poggio di Montieri. Farther south the height diminishes and the plateau-like nature of the country becomes less marked. From Roccastrada southwards low hills are separated by tributaries of the Bruna and Ombrone, which occupy short, gentle-sided valleys. Those of the Bruna have almost cut off the Ballone block from the rest of the western highland, the western face of which is cut into by river valleys and tongues of coastal lowland, especially north and east of Grosseto. Advantage is taken of these by roads and railways, especially road 73, and the coastal routes which cut inland behind the sandstone Poggio Ballone (2,067 ft.).

*The Siena Trough.* This is occupied by Pliocene rocks and is drained by the Elsa to the north and by the Ombrone to the south. In Pliocene times this trough joined the Latin and Etruscan gulfs and separated the Catena Metallifera in the west from the Chianti chain in the east. The Pliocene clays, sands, and limestones were later folded in the north-west to south-east direction of the Apennines, and this trend can be seen in the present river valleys. The folding was, however, fairly gentle, and the general appearance of the trough is of a gently undulating, dissected plateau rising gradually to the south. Landslips are common, and rapid erosion has given rise to a desolate type of country, such as near Siena (Plates 99-102). Where the ground is firm vines and cereals are grown. The natural vegetation is *macchia*, with trees on the higher slopes, but wheat is grown where the land is sufficiently level. Its comparative lowness has made the trough an important line of communication between Rome and Florence (road 2). Routes sometimes follow the main valleys, but frequently, owing to the danger of landslips, prefer the ridges. The one great centre of population, Siena (1,014 ft.), on the Elsa-Ombrone watershed in the narrowest portion of the trough, is an important route centre.

*Chianti.* The parallel mountain ridges of Chianti, which clearly follow the main Apennine direction, form a barrier between the Siena and Tyrrhenian troughs. The ridges are comparatively gentle and continuous, and few peaks exceed 3,000 feet. To the north-east of Siena low, gently undulating parallel ridges rise to the Mi. del Chianti (M. S. Michele, 2,930 ft.), which fall steeply to the Arno or Valdarno. East of Siena a depression, followed by road 73 and railway to the Val di Chiana, separates the Mi. del Chianti from their southward



continuation through M. Cetona (3,763 ft.) and M. Rufeno (2,408 ft.) almost to Orvieto. These mountains, like the Northern Apennines, are composed largely of sandstone, but in the northern part the highest peaks are of limestone, and in the southern part the Pliocene rocks rise up from the Siena trough and even form the tops of the mountains, such as Poggio di Pietraporciano (2,776 ft.). Chianti is famous for its wine, and has a relatively dense population (Plate 103).

*Southern Volcanic Region.* The Tuscan upland reaches its greatest heights south of the F. Ombrone, where volcanic activity has produced a rugged, wooded country. From the coast two spurs, separated by the F. Albegna, rise from the Mi. dell' Uccellina (1,362 ft.) and M. Argentario (2,083 ft.) and unite in the limestone peak of M. Labbro (3,894 ft.). M. Civitella (3,632 ft.), east of the Fiora valley, is also of limestone. The trachytic cone of M. Amiata (5,690 ft.), which dominates this region, rises from a platform of schists 2,000 to 3,000 feet above sea-level. It is among the most thickly wooded of Italian mountains, with chestnuts below and beech above. Copious springs well from the porous rock around the foot of the mountain and feed streams draining to the Ombrone, Tiber, and Fiora. Thanks to these springs the mountain is surrounded by a ring of large villages, such as Arcidosso, Santa Fiora, Pian Castagnai, and the whole wild countryside is furrowed by deep valleys. The eastern flank of M. Amiata slopes steeply down to the F. Paglia, near the head of which the picturesque, basalt rock of Radicofani (2,940 ft.) rises from the Pliocene clays above road 2. The rocky and wooded nature of the country give to this southern region a rugged aspect, very different from the rest of the upland (Plate 104).

The great variety of rocks in the Tuscan Upland has resulted in areas of diverse vegetation, ranging from the productive slopes of the Chianti mountains to the bleak, infertile areas of old, hard rock in the Catena Metallifera, and to the marshes of the Maremma. Secondary limestones occur here in greater variety than elsewhere in the Peninsula and provide white, yellow, green, and red marbles, famous throughout the country. Those of the Montagnola Senese have been largely used in the construction of the cathedrals of Siena and Orvieto. In the Catena Metallifera small quantities of copper, zinc, lignite, and mercury, a little pyrites, and other minerals are mined. Warm and mineral springs are common but of little economic importance. They are all closely connected with volcanic activity and lines of fracture dating from the Pleistocene age.





PLATE 100. *'Calanchi' near Siena*



PLATE 101. *Dissected plateau south of Siena*





PLATE 102. 'Balza' at Volterra



*The North Latin Hills (Mi. Volsini, Cimini, Sabatini, and della Tolfa)*

The North Latin hills and the volcanic plateaux above which they rise extend for 60 miles south of M. Civitella almost to Rome, and for 30 miles from the F. Fiora and the coast in the west to the Tiber in the east. These hills consist of over 2,000 square miles of volcanic tuff, the greatest expanse of this rock in continental Europe, but also include narrow alluvial strips along the coast and a small region of sandstones and schists behind Civitavecchia.

The coastal region south of the F. Fiora is closely akin in structure to that of the Tuscan upland, and contains four distinct zones: (1) A coastal zone, similar to the Maremma, extends as far south as Civitavecchia. It is backed by (2) a narrow belt of ridged Pliocene hills of clay, marl, and sandstone. South of Civitavecchia both these types of country are replaced by (3) more resistant sandstone hills, which are a geological continuation of the western highland rim of the Tuscan upland (Catena Metallifera). These hills rise steeply from the coast, and inland extend northwards to the F. Marta. (4) Where the trachyte of the Mi. della Tolfa (M. le Grazie, 2,021 ft.) flowed on to these sandstones the country is more rugged and hot springs persist. This small coastal region is backed to the north and east by the North Latin hills.

The different parts of the southern Pre-Apennines, including the North Latin hills, the Roman Campagna, and the Alban hills, have a common geological history. At the end of Tertiary times this area between the foot of the Apennines and the coastal ridge was occupied by a gulf which became the site of four principal volcanoes, Bolsena (Mi. Volsini), Vico (Mi. Cimini), Bracciano (Mi. Sabatini), and Albano (Alban hills). Gradually the gulf became filled with sediment from the Apennine rivers and volcanic debris. The land rose and increased quantities of alluvium, calcareous tufa derived from the Apennines, and material from the volcanoes cemented the cones together.

The highest parts of the North Latin hills are now along the eastern edges of the three main craters; M. Cimino is 3,455 feet high, and the Mi. Volsini and Sabatini rise to between 1,900 and 2,300 feet. Each of these great volcanic cones has gently sloping outer sides and a central lake, with many inflowing streams, which have cut up the surrounding crater rim into numerous peaks. In between the main cones the gently undulating country of tuff and ash is furrowed by shallow, steep-sided valleys, and is relieved only by occasional cones



or by flat-topped relics of more resistant lava which rise with rugged sides from the surrounding country. These form natural acropolis-sites on which such towns as Orvieto, Orte, Bagnoregio, and Civita Castellana have been built. As many as fifty-two craters have been identified, some of which contain lakes or marshes. Besides a number of small lakes scattered throughout the plateau there are three large ones within the main craters. By far the largest of these is Lake Bolsena (surface at 1,001 ft., area  $33\frac{1}{2}$  sq. miles, depth 479 ft.), which drains to the sea by the F. Marta. The south and east sides of the crater are fertile and covered with the famous vineyards of Montefiascone; the west is sterile and arid and largely covered with macchia. On this side the rim of the large lateral crater of Latera reaches 2,175 feet in Poggio Evangelista and surrounds the small Lake Mezzano. Farther south the crater lake of Vico (surface at 1,663 ft., area 4 sq. miles, depth 161 ft.) lies in the centre of the Mi. Cimini and has no surface outlet. Within the crater the inner cone of M. Venere rises to 2,736 feet. The Mi. Sabatini, surrounding Lake Bracciano (surface at 538 ft., area 22 sq. miles, depth 525 ft.), form a less perfect crater rim which is highest on the north. On the south the F. Arrone drains the lake to the sea, but the artificial outlet of the Acque Paola has been constructed to the Tiber in order to supplement the flow of the river during low water and safeguard the Roman water-supply.

Although there are orchards and cultivated lands round the larger lakes, the landscape is on the whole monotonous. Not only is the relief uniform, but the vegetation is largely macchia. The most dreary region is to the west and south-west of Lake Bolsena. Here the few farms are surrounded by thickets, which, up to the end of the last century, helped to protect them from the attacks of brigands. Farther south and in the east the country has a more prosperous air, with cultivated fields, olive groves, and vineyards.

The Via Cassia (2) and a branch railway cross the region from north to south and skirt the three main craters. Only five main or secondary roads and one railway lead inland from the coast to the Tyrrhenian trough.

#### *The Roman Campagna (Campagna di Roma)*

Rome lies in the midst of a plain which forms a broad saddle in the volcanic plateau between the Mi. Sabatini and the Alban hills. The plain extends, from the coast to the Mi. Sabini, 33 miles inland along the coast to the north-west of Rome towards the Mi. della



Tolfa, and south of the city as far as Anzio and Cisterna di Roma on the borders of the Pontine marshes. Similar country surrounds the Alban hills on all sides (Plate 105).

Of this expanse of erstwhile steppe-land, about half is now cultivated, and nearly half is still bare and melancholy. Massive, sinister farmhouses here and there bear witness to former habitation and cultivation. Practically the whole plain consists of a covering of volcanic tuff through which the Tiber has worn down to the Eocene clays beneath. Masses of travertine derived from the limestone of the Central Apennines have also been deposited by the river, for example round the seven hills of Rome and at Tivoli (Plate 123). Alluvium, too, has been laid down along the Tiber, Aniene, and other less important tributaries, but the Campagna remains essentially a region of volcanic rocks.

In Pleistocene times a trough (p. 282) was formed between the Apennines and the Latin hills, in which the waters of the inflowing streams collected, probably forming a lake. An outlet, now followed by the lower section of the Tiber, was formed across the saddle between the two most southerly volcanoes, Bracciano and Albano. The Tiber has since eroded its bed some 150 feet below its former level, and radial streams from the cones on either side have further dissected and lowered the surface. Gradually flat-topped spurs were left between these valleys, and the ends of these spurs abutting on the Tiber valley became frayed and cut into low hills by numerous small, wet-weather streams. A small group of these hills, south of the Tiber, not otherwise distinguished from their fellows, form the site of Rome.

The lower Tiber meanders through the middle of the Campagna in a flood plain three-quarters of a mile to 5 miles wide, from which the Campagna rises gently on either side. The delta extends inland as far as Ponte Galera, and well to the north and south of the mouth, along the coast. Behind the coastal dunes there is a strip of alluvium,  $2\frac{1}{2}$ –3 miles wide, naturally marshy, but now largely reclaimed. Ostia, in Roman times a port at the river's mouth, now stands about  $1\frac{1}{2}$  miles away from the river and 2 miles from the sea. Above Ponte Galera the Tiber is flanked on both sides by the monotonous, low-lying Campagna, through which it has cut a valley up to  $2\frac{1}{2}$  miles wide ( $\frac{3}{4}$  mile near Rome,  $2\frac{1}{2}$  at Scarano,  $\frac{1}{2}$  near Torrita Tiberina).

In earliest historical times the region was cultivated, and remained prosperous till the beginning of the Christian era. By the end of the Roman Empire, however, the irrigation and drainage works were



neglected, and the land reverted to its former nature, marshy near the river, and arid elsewhere owing to the porosity of the tuff. Thus the land was both marshy and fever-ridden, and used only for sheep pasture and a little 'extensive' grain growing. Malaria, however, was not so prevalent as in the Maremma or Pontine marshes. Only Rome, set on hills above the plain, was comparatively free from malaria. By the beginning of the eighteenth century a certain amount of reclamation had begun, and was continued intermittently thereafter. It was not, however, until the Fascists came into power that the drainage became really effective. To improve fertility and drainage the hard, impervious sub-soil was ploughed up, certain areas were sown with wheat, and others were converted into improved pasture. Around Rome itself there is a narrow fertile belt of vineyards, olive groves, and parks, in strong contrast to the Campagna, both before and since its reclamation.

The Roman Campagna provides a variety of building materials. Among the travertine deposits those at Tivoli are particularly famous. This rock provides easily worked building-stone and has been largely employed in the construction of Rome, while *pozzolane*, a fine incoherent tuff, provides excellent material for hydraulic cement. The combination of these two building materials explains the good preservation of Roman remains. The lava of the Campagna provides a valuable paving stone.

This region is served by a network of roads which converge on Rome from the coast, the valleys of the interior, and the neighbouring volcanic hills.

#### *The Alban Hills (or Colli Laziali)*

About 10 miles south-east of Rome rise the tree-clad, volcanic Alban hills, an oasis in the midst of the bare Campagna. The hills rise out of the Campagna like the Mi. Volsini, Cimini, and Sabatini above the plateau of the north Latin hills. The Alban volcano, which may have been active as late as very early historic times, is still well preserved. It has a greater girth (35 miles) than Vesuvius, but is not so high. The original cone, of which only the crater walls now remain, was probably over 6,500 feet high and composed of incoherent cinders. The volcano now consists of three craters, one inside the other. The rim of the outer crater, known in the south as M. Artemisio, reaches 3,080 feet at M. Peschio. Its gentle outer slope is furrowed by radial river valleys, but the inner slope falls steeply to the floor of the crater, which takes the form of a crescentic



depression. The western part of the outer rim has been largely destroyed by smaller, more recent craters, two of which are occupied by lakes. Nemi (area  $\frac{1}{2}$  sq. mile, depth 112 ft.) is a tranquil lake in the midst of dense forest. The shores of Lake Albano (area  $2\frac{1}{2}$  sq. miles, depth 557 ft.) are cultivated and bedecked with villas, such as Castel Gandolfo, the Pope's summer residence (Plate 106). In the centre of the crater floor rises a smaller dissected cone, the rim of which reaches 3,137 feet in M. Faete. Finally within this the innermost cone of M. Vescovo (2,697 ft.) rises from the flat crater floor, known as the Campi d'Annibale.

The volcanic soil, which is rich in alkalis and very fertile, together with the heavy rainfall, have encouraged a dense vegetation and the cultivation of fruit trees and vines. The population is dense; the outer rim particularly is girt with large villages picturesquely set on the hill-side at between 1,000 and 2,000 feet. Such are Albano, Frascati, Genzano, Marino, and many others, known collectively as the Castelli Romani. These are to Rome as the south coast resorts are to London, the holiday centres of summer and autumn, since their height above the plain makes them healthy. A number of railways, tramways, and roads link these resorts with Rome.

A wide saddle (1,150 ft.), the southward continuation of the Tyrrhenian trough, sometimes known as the Latin valley, intervenes between the Alban hills and the Mi. Ernici to the north-east. This saddle, covered like the Roman Campagna with volcanic tuff, is little eroded. A similar saddle on the south-east separates the Alban hills from the Mi. Lepini (p. 289). Lines of communication make great use of these depressions, particularly the northern, which is followed by the inland road (6) and railway from Rome to Naples.

### *The Pontine Marshes*

The Pontine marshes, a region 35 miles long and with an average width of 9-11 miles, are bordered by the coast between Anzio and Terracina, by the Roman Campagna on the north-west, and by the Mi. Lepini and Ausoni on the north-east. Three main belts are included. First there is a coastal belt of dunes, backed by lagoons. This extends from Torre Astura to Terracina, except for the picturesque limestone headland of M. Circeo in the midst of an otherwise flat and uninteresting coast. The second belt,  $3\frac{1}{2}$ -4 miles wide, behind the lagoons, consists of much older, consolidated dunes from 50 to 100 feet high (Colle della Guardia, 131 ft.), which are partly covered with macchia and woods. The third belt of country consists



of the Pontine basin, 28 miles long and 5 wide, formerly a marsh but now largely reclaimed. Nowhere do the marshes rise above 45 feet, and in several small areas they fall below sea-level (p. 81).

The almost level plain has never been able to cope adequately with the vast supplies of water from the rivers and many springs at the foot of the limestone Mi. Lepini. There are signs that during pre-Roman times the region was densely populated. Towards the end of Roman times, however, the Via Appia had become impracticable and canals were dug to the south of it to drain the land. Ever since then attempts have been made at reclamation, but the method of warping or silting, used with success in the Maremma and Val di Chiana, proved useless owing to the clarity of the rivers from the limestone hills. Little success was achieved until the Fascists built the Mussolini Canal to carry the waters from the hills direct to the sea, and the marshes were drained by canal and pump. Now the marshes are mainly a cultivated plain, criss-crossed by drainage channels, and dotted with isolated farm-houses and the new agricultural centres of Littoria (1932), Sabaudia (1933), Pontinia (1935), Aprilia (1936), and Pomezia (1939). The Via Appia (7), the coast road from Rome to Naples, is once more important. The railway from Rome clings to the foothills of the Mi. Lepini and tunnels through the Mi. Ausoni towards Naples. A single line branches off to Terracina, for many years the only town in the region, where plainsmen, mountain dwellers, and fishermen foregathered.

The *Tyrrhenian trough* separates the Pre-Apennines and the Apennines from each other. This trough includes the middle Arno valley from Florence to Arezzo, south of which the line of the Arno is continued in the Val di Chiana. This in turn is linked by the Chiani with the Tiber valley. The trough is of the greatest importance to drainage and communications. It is followed throughout by the main railway from Florence to Rome, and by main roads from Florence to a short distance south of Orvieto. Most of the remaining stretch is without roads.

### *The Middle Arno Valley*

The evolution of the Arno valley has been complex. In Pliocene times the Valdarno and Arezzo basins were, like those of the Apennines, occupied by a number of lakes. The Valdarno drained to the Pliocene sea near Siena, along what is now the Ambra valley. In Pleistocene times, however, the Pre-Apennines were uplifted more



than the Apennines and tilted towards the east. Streams and rivers accordingly flowed east from the Pre-Apennines and collected against the Apennines. All the lowland between Arezzo and Chiusi became a large lake of which Lake Trasimeno is a remnant. The Valdarno could no longer be drained by the Ambra valley, and, together with the Casentino (upper Arno, p. 308), found an outlet through the Arezzo basin to this enlarged Lake Trasimeno. In due course the headwaters of a river draining north to the Florentine basin cut back a passage to Incisa, through which the drainage of the Valdarno and also of the Casentino was directed.

East of Florence (p. 273) the valley of the Arno narrows to a gorge, which is deep above Pontassieve, at the confluence of the Arno and Sieve rivers. Below Pontassieve the river flows westwards, but above the town the direction of the gorge changes to more nearly north and south. Between Pontassieve and Rignano (6 miles) the floor of the valley is composed of rocks similar to those of the bordering Mi. del Chianti and Pratomagno. There is a narrow flood-plain, and from this rise the steep slopes of the surrounding mountains.

Between Rignano and Incisa (5 miles) the *Valdarno* widens out slightly, but along this stretch of the river the mountains are close together, and were formerly joined by the low saddle at Incisa (Plate 107). The Valdarno assumes a completely different character above Incisa. The river is less rapid, and, if free to do so, would meander through the S. Giovanni basin, which is roughly 28 miles long and 6 miles wide. The river has, however, been artificially straightened throughout most of the basin. On either side of the river is an almost flat flood plain, half to one mile wide, rising southwards from 400 to 475 feet. The flood plain is bordered by a series of low, gently sloping ridges which rise to flat-topped Pliocene hills (900-1,000 ft.). These are both dissected by steep gullies cut by the mountain streams from the Mi. del Chianti to the south-west and the Pratomagno to the north-east. The Pratomagno (5,224 ft.) rises uniformly, with lower slopes ravined and lightly wooded. The Mi. del Chianti are over 2,000 feet lower than the Pratomagno. Consequently the streams from the south-west are shorter and less powerful than those from the north-east, and the Arno is considerably closer to the Chianti foothills than to those of the Pratomagno.

The whole S. Giovanni basin is very fertile and intensively cultivated with olives and vines, and with trees planted among the vines on the ridges. There are many scattered villages, but the most important towns, Figline, S. Giovanni, and Montevarchi, are all on



the left bank of the river. Bands of lignite have been exploited and have given rise to an important industrial centre at S. Giovanni. Apart from this, however, the Valdarno is essentially rural.

The Valdarno is continued upstream by more Pliocene lake-basins. A short gorge leads to the *Val Laterina*, a basin less than 2 miles long and a few hundred yards wide, and another into the roughly circular *Arezzo Basin* (width  $5\frac{1}{2}$ – $6\frac{1}{2}$  miles, alt. 820–850 ft.). This basin is almost enclosed by a rim of steep-sided hills penetrated by gaps followed by roads and railways. On a rocky hill in the middle of the plain, at 971 feet, stands the town of Arezzo. The surface of the Pliocene rocks has here been far less dissected than in the Valdarno, and is practically intact except near the river itself.

On the south the Arezzo basin is linked with the *Val di Chiana* by a gap one mile wide. The Val di Chiana is a flat plain of Pliocene and Pleistocene deposits and alluvium, and is even less dissected than that of Arezzo. To the west the land slopes gradually to the Chianti hills, while in the east rise the abrupt slopes of the southern end of the Cimone chain of the Apennines (p. 307). Through the centre of the valley flows the Canale Maestro, or main Chiana river. The valley forks 8 or 9 miles south of Arezzo to either side of a low, sandy ridge. The western branch, 10 miles long and 2 wide, is followed by the F. Chiana upstream to Lake Montepulciano and Lake Chiusi near its southern limit; the eastern branch, 9 miles long and  $2\frac{1}{2}$  wide, extends to the western edge of Lake Trasimeno. The whole Val di Chiana, except in the immediate vicinity of the river, is covered with vines and trees which extend up the slopes on either side. The larger towns, such as Cortona and Castiglion Fiorentino, are along the eastern edge, which is more densely populated than the west.

A brief statement of the development of the Val di Chiana during historic times helps to explain its present topography. Formerly the whole valley was tributary to the Tiber, but shortly before historic times the drainage of the northern section was reversed to the Arno. The wide alluvial valley was healthy and densely populated during Roman times. In the eleventh century, however, the mountain tributaries began to silt up the main river. By degrees marshes appeared, accompanied by fever, so that the plain became deserted. Gradually, with artificial aid, more of the valley began to drain towards the Arno, until the F. Chiana was formed. By 1600 the Esse and Foenna, former tributaries of the Tiber, had been diverted to the Arno and the watershed was between the lakes of Montepulciano and Chiusi. The watershed is now south of Lake Chiusi, and is crossed





PLATE 103. *Chianti: vineyards*



PLATE 104. *Castel del Piano at the foot of M. Amiata*





PLATE 105. *The Roman Campagna and the Alban Hills (before 1934)*



PLATE 106. *Castel Gandolfo and Lake Albano*



by a canal between the Chiana and Chiani. During the nineteenth century drainage schemes were continued, the main object of which was to accentuate the Arno-Tiber watershed and to increase the gradient on both sides. Dykes were made and eventually the marshes were entirely drained. Now the plain is once more becoming inhabited at the expense of the surrounding hills.

Lake Trasimeno, in the eastern arm of the basin, is the remnant of the Pleistocene lake. Uplift of the land to the east, and the filling in of the northern part of the lake, thus forming the wide alluvial Val di Chiana, robbed the lake of many of its tributaries. The inflow no longer equalled evaporation and percolation, so that the volume of the lake was diminished to such an extent that the former surface outlet by the Chiana was above the level of the water, and the lake became enclosed. In the fifteenth century, to prevent flooding, the F. Tresa and F. Maggiore were diverted to Lake Chiusi, and an artificial, underground outlet was made to the T. Caina and the Tiber. This outlet, rebuilt in 1897, now maintains the lake at a constant level, and prevents the flooding of the Val di Chiana. Lake Trasimeno has a surface area of 50 square miles, with a paltry catchment basin of 63, making a total of 113 square miles. Its average level is 850 feet, with a variation of 6 feet between flood and low water. The low banks are largely cultivated with cereals, and at the northern edge where the slope is greater, with vines and olives.

### *The Tiber (Tevere) Valley*

The Val di Chiana is continued to the south by the Chiani-Paglia-Tiber valley, which separates M. Cetona, M. Rufeno, and the North Latin hills on the west from Umbria (p. 318) and Sabina (p. 321) on the east. The Tiber is the largest river of the Peninsula and historically the most important and famous river of the country. It is 250 miles long, and its catchment basin, including Lake Trasimeno, has an area of 6,645 square miles. The volume and speed of the river are extremely variable. The mean flow of the river at Rome is 7,700 cubic feet per second, but in the year 1834 the average was as low as 3,178, while in 1870 the maximum flow rose to 158,822. In addition to this variation from year to year there is marked seasonal variation. The period of greatest flood is in early spring, when the winter and spring rains have filled the tributaries and reached the main stream. Above the confluence of the Nera, the Tiber, with a largely impermeable basin, is torrential in nature and may diminish to 106 cubic feet per second in times of drought. Below the confluence the flow of



the river is more even throughout the year, thanks to the Nera, which drains the vast limestone plateaux of the Central Apennines, and so has a large and uniform volume, 3,000 cubic feet per second even in drought. There is a tendency for this lower part of the Tiber to flood. Great efforts, largely successful, have been made to strengthen the banks and keep the river in check.

Although the direction of the Tiber valley as a whole is almost north to south, it really consists of two north-west to south-east longitudinal stretches, alternating with two transverse oblique stretches. The upper longitudinal and transverse stretches are in the Central Apennines (p. 315); the latter stretch brings the river through to the Tyrrhenian trough at the confluence with the Paglia below Orvieto. The second longitudinal reach extends south from near Orvieto to Torrita Tiberina, where the river leaves the foothills of the Apennines, and cuts transversely through the Roman Campagna to the sea (p. 279).

Above Torrita Tiberina the Tiber flows in the Tyrrhenian trough. Upstream as far as Castiglione the Tiber valley is deep, with hills rising more steeply in the east than in the west. It is for the most part  $1\frac{1}{2}$  to 2 miles wide, although it narrows at Borghetto and in a short gorge immediately above the confluence of the Nera. At Castiglione there is another gorge, 3 miles long, above which the Tiber comes in from Todi, and its tributary, the Paglia, continues along the Tyrrhenian trough. Orvieto stands on a lava platform high above the west bank of the Paglia, where it is joined by the T. Chiani. North of Orvieto the trough becomes indistinct for a short distance and is occupied by Pliocene hills. North of Fabriano the trough is better defined and is drained by the artificial Scolo Chianetta, which flows into the Chiani and so eventually to the Tiber. Near Chiusi this part of the trough joins the broad Val di Chiana (p. 284).

## CAMPANIA

THE name Campania is frequently applied to the part of western Italy on either side of the gulf of Naples. Here it is understood to extend from the Mi. Lepini and the Sacco valley in the north to the lower Sele basin, or Paestum plain, in the south, and to the foot of the Apennines in the east. This region is some 95 miles long and its greatest width is 20 miles. Its northern half, like the Pre-Apennines, is clearly separated from the Central Apennines by the broad trough of the Sacco, Liri, and Volturno valleys, which together make up



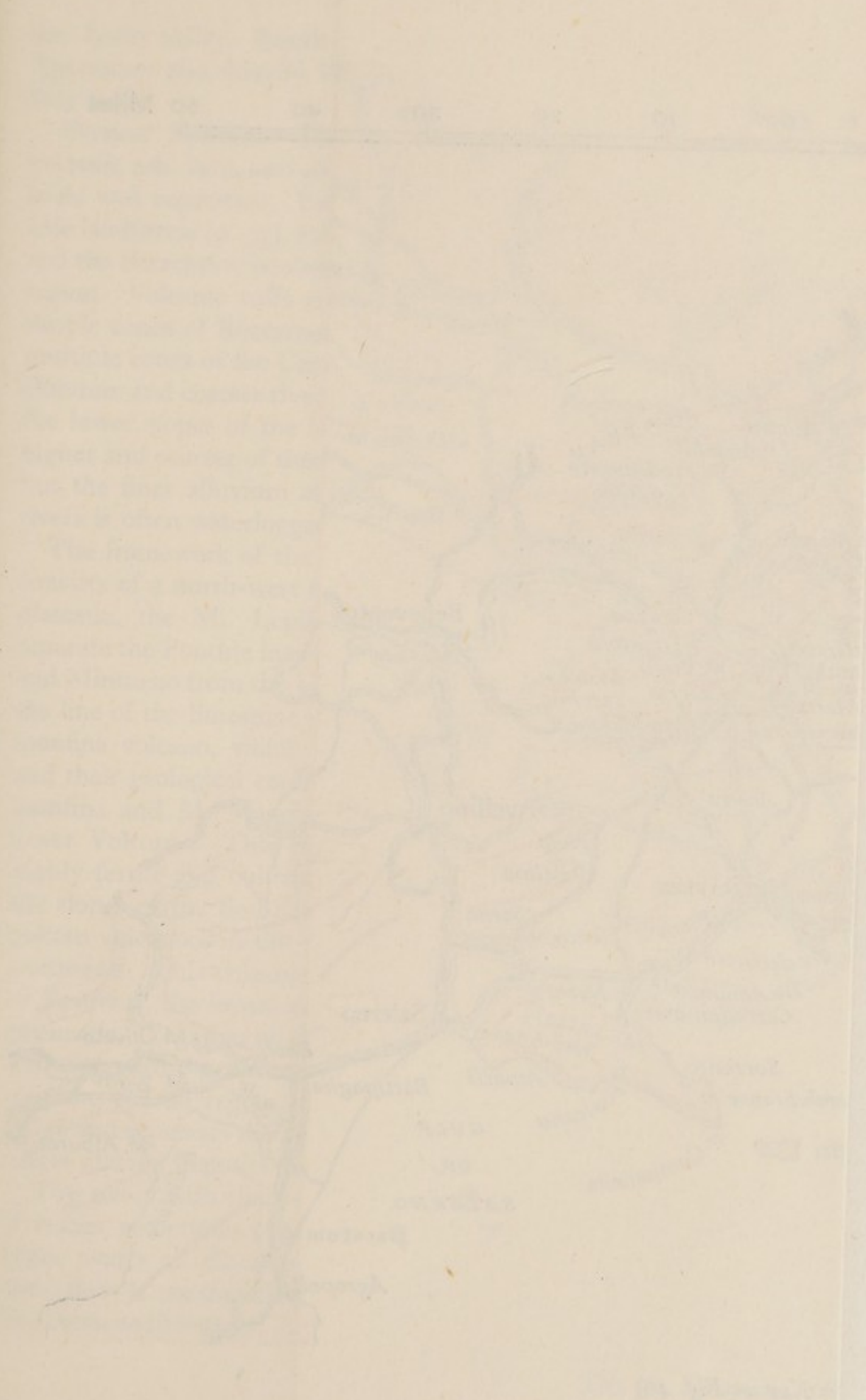






FIG. 50. Campania. (For Key see Fig. 40)



the Latin valley. South of the Volturno, however, the Southern Apennines rise directly from the plain of Campania and the lower Sele basin.

*Physical Features.* The variety of rocks, including limestones, volcanic ash, lava, and alluvium, is reflected in an equal diversity of relief and vegetation. Limestones, accompanied by their characteristic landforms (p. 37), form the mountains of the north, M. Massico and the Sorrentine peninsula, and the mountain backing of the whole region. Volcanic tuffs and lavas make up the remaining hills, the simple cones of Roccamonfina (M. S. Croce) and Vesuvius, and the multiple cones of the Campi Flegrei. Finer volcanic ash, mixed with alluvium and coarser river deposits, occupy the Latin valley and cover the lower slopes of the limestone hills surrounding the plain. The higher and coarser of these deposits are permeable and highly fertile, but the finer alluvium at lower levels and near the mouths of the rivers is often waterlogged.

The framework of the northern part of the region is simple, and consists of a north-west to south-east barrier of fractured limestone plateaux, the Mi. Lepini, Ausoni, and Aurunci, which together separate the Pontine marshes (p. 281) and the coastal plains of Fondi and Minturno from the Latin valley. South-east of the F. Garigliano the line of the limestone plateaux is continued by the extinct Roccamonfina volcano, which blocks the gap between the Mi. Aurunci and their geological continuation in M. Maggiore. South of Roccamonfina and M. Maggiore lies the swampy, alluvial plain of the lower Volturno. This plain is bordered on its landward sides by highly fertile and cultivated areas of volcanic ash which extend up the slopes of the Southern Apennines on the east, and of the Neapolitan volcanoes in the south, and into the Terra di Lavoro in the south-east. This volcanic plain penetrates broadly between the cone of Vesuvius, the limestone Southern Apennines, and the Sorrentine peninsula. Together all these plains make up the plain of Campania. The Sorrentine peninsula, an extension of the limestone Apennines into the coastal region, trends nearly at right angles to the main range and separates the plain of Campania from the lower Sele basin, where alluvial deposits are unmixed with volcanic ash.

The rivers with their alternate longitudinal and short, transverse stretches, sometimes in gorges, follow the usual Tyrrhenian pattern. Since nearly all the rivers drain through or from limestone areas, their flow is comparatively sustained, and their water is clear and free from sediment.



*Vegetation.* Campania includes some of the most naturally fertile parts of the country, but there are great contrasts between the often bare, or scrub-covered, limestone hills and the luxuriant volcanic plains at their foot. In some favoured places on the steep coasts, particularly near Gaeta and in the Sorrentine peninsula, there are orange groves. In the coastal plain of Fondi there are large pine-woods, and in the plains of the lower Garigliano, Volturno, and Sele there are marshes and pastures. The marshes have been partly reclaimed near the mouths of the Garigliano and Volturno. Farther inland, where not marshy, the lower plains often consist of dry sheep-pasture, as in the lower Sele plain. The plain of Campania, particularly to the south of the Volturno, is extremely productive. Wheat and maize are grown, but the mixed cultivation of vines, fruit trees, vegetables, and cereals is the chief form of agriculture. The vines are often trained between supporting trees to an exceptional height, and form great curtains of green which cut off the view. At Nocera there are exceptionally close plantations where walnuts, oranges, mandarins, and vegetables grow intermingled. The most luxuriant belt is at the foot of the bordering hills, near a line of springs. Up the hill-slopes fruit trees and olives are interspersed among grazing land. Vineyards cover large areas on the sides of both the limestone and volcanic hills. The olive occurs up to about 1,600 feet in the coastal region, and still higher in sheltered places inland. Chestnut groves flourish on the volcanic hills, especially Roccamonfina, and on the hills of the Sorrentine peninsula; otherwise they are scarce on the limestone hills. The Mi. Lepini, Aurunci, and Ausoni are practically treeless and deserted. On the recent lava-flows of Vesuvius prickly pear is grown to hasten the decomposition of the lava, which yields a very fertile soil.

*Communications.* The configuration of the coast of Campania tends to force routes inland. Consequently there are few coastal route-centres except for Naples, which has a network of roads and railways converging from north, south, and east across the plain of Campania. There are road and railway routes to Rome, either along the coast by Formia and Terracina (road 7, Via Appia), or by the Latin valley (road 6, Via Latina). From the latter, railways and main roads penetrate into the Central Apennines along the upper Liri (82) and upper Volturno (85) valleys. Other routes lead from the plain of Campania along small valleys into the Southern Apennines (p. 331) and southwards across the root of the Sorrentine peninsula to Salerno. This town controls the main routes from Naples to the south.



*Subdivisions**The Lepini Mountains*

The name Lepini is loosely applied to the whole limestone highland extending to the Alban hills on the north-west, to the Pontine marshes and the coast on the south-west, and to the Latin valley on the north-east. Strictly the name refers only to the northern section of this highland; the central part is known as the Mi. Ausoni, and the southern as the Mi. Aurunci. The highland is a plateau region reminiscent of the neighbouring Mi. Ernici in the Central Apennines, and composed like them almost entirely of limestone. The three component blocks have been separated from one another by valleys formed along transverse fault-lines. The Mi. Lepini and Mi. Ausoni are divided by the Amaseno valley; the Ausoni and Aurunci are less clearly separated by a trough, the southern end of which is occupied by the plain of Fondi; the Aurunci are limited to the south-east by the plain of Minturno and the valley of the Garigliano.

The *Mi. Lepini* proper fall rapidly both to the Pontine marshes (p. 281) and to the Latin valley. The tilt of the strata to the south-west, however, has resulted in the south-western slope collecting far more of the drainage than the north-eastern. Much of the drainage is, however, underground and has not greatly affected the topography. The Lepini form a number of plateaux, composed almost entirely of Cretaceous limestone, with some sandstone. Several ridges of medium height, parallel to the main north-west to south-east direction, stand out above the plateaux; M. Semprevisa (5,040 ft.) is the highest of these. The landscape is typical of limestone country, with steep-sided valleys, swallow-holes, and caves. Olives and cereals are grown on the foothills and in the valleys, but the higher parts are without trees, desolate, and unproductive. Settlement is closest along the larger river valleys, and near the foot of the mountains where there are copious springs. The towns and villages, such as Cori, Sezze, and Priverno, were built high up on the hill-side away from the swampy and unhealthy Pontine marshes. Isolated and lacking communications, the region is backward.

The lower *Amaseno valley*, between the Mi. Lepini and Mi. Ausoni, widens in the two basins of Priverno and Amaseno, which are connected by a short transverse gorge. Both basins have moderately steep, wooded sides, with a little cultivation on the lower slopes, especially of the Priverno basin. Although it is the main river of the Lepini, the Amaseno is perennial only below the village of Amaseno,



where it is fed by seven springs. Above this point the river only appears at the surface after heavy rain, especially in spring. The Priverno-Ceccano road uses the valley, and nowhere rises above 830 feet.

The *Ausoni* and *Aurunci* highlands are similar to, but lower than, the Lepini. Their plateau nature is more apparent, and they have few important ridges. M. delle Fate (3,576 ft.), with deeply furrowed southern slopes, is the highest point of the Mi. Ausoni, and M. Petrella, in the Mi. Aurunci, reaches 5,030 feet. Settlement is chiefly concentrated along the coast, particularly along the bay of Formia.

Part of the transverse trough across the plateaux between the Mi. Ausoni and Mi. Aurunci corresponds to an ancient gulf which has been filled with alluvium and now forms the *plain of Fondi*. A few lakes, the largest of which is that of Fondi, testify to the former nature of the plain. Road 82 connects the coast with the Latin valley, but does not directly follow the axis of the trough. The seaward end of the trough, which separates the Mi. Aurunci from M. Roccamonfina, coincides with the small *plain of Minturno*. This former bay, now filled with alluvium, contains considerable areas of marsh, particularly south of the mouth of the Garigliano, although reclamation has commenced. Above the plain the Garigliano winds its way for 10 miles through a steep-sided valley at the junction of the limestone of the Mi. Ausoni and the volcanic tuff of Roccamonfina. This valley is narrow in the south, but widens in the north where it meets the Latin valley, the floor of which, although 23 miles from the sea, is only at a height of 50 feet. There is no main road or railway along the Garigliano valley into the Sacco-Liri trough. The coastal railway and road (7) from Rome to Naples cross the plains of Fondi and Minturno well inland.

*Roccamonfina, M. Maggiore, and M. Massico*

These highlands, east of the Garigliano, are a continuation of the Mi. Aurunci. M. Maggiore and M. Massico are principally of limestone, while Roccamonfina consists of volcanic material superimposed on similar rocks. M. Massico stands out between the lower Volturno and Garigliano basins like a peninsula in a sea of alluvium. The Liri and Volturno sections of the Latin valley, which divides these highlands from the Apennines, are only separated from each other by the narrow sill of Mignano to the north of Roccamonfina.

The volcano of *Roccamonfina*, similar in shape to Vesuvius, consists of an almost perfect cone surmounted by a crater, within which rise a



main and a subsidiary cone. Geologists have been unable to agree about the exact age of the volcano, or even when it ceased to be active, although a final eruption may have occurred in 269 B.C. near Teano.

Clearly defined troughs separate Roccamonfina from the adjoining mountains. The volcano is cut off from the Mi. Aurunci in the west by the gorge of the Garigliano, from M. Massico in the south-west by the Sessa sill (689 feet), from M. Cesima (Meta, p. 326) in the north by the Mignano sill (820 ft.), and from M. Maggiore in the east by the Riardo sill (574 ft.). The main cone of Roccamonfina rises to an outer wall 3,038 feet high. This, corresponding to the M. Somma of Vesuvius, has a comparatively gentle outer slope, but falls very rapidly to the old crater, from which the small cone of M. San Croce rises to 3,297 feet, and the still smaller M. Lattani to 2,680 feet. The diameter of the two central cones together is only just over a mile. Although the outer slope is furrowed by many radial streams, only three, the Casto, Savone, and Selva, break through the high rim. Several lateral eruptions along the outer wall have opened up small craters, but despite this the wall is still fairly easily recognizable. Both M. San Croce and M. Lattani are of andesite and are uninhabited, but the main crater surrounding them is of basalt and is fertile and well populated. The town of Roccamonfina, within the crater, is connected by road through gaps in the outer wall with three towns, Mignano, Sessa, and Teano, which dominate the three passes on the north, south, and east of the volcano. The Riardo sill in the east is used by the inland road and railway from Rome to Naples to avoid the long detour round the middle and lower Volturno valley.

*M. Massico* (2,661 ft.), to the south-west of Roccamonfina, is a wooded and vine-clad limestone ridge (8 miles long and about 3 miles wide). Before the plains of Minturno and the lower Volturno were formed during Pleistocene times, M. Massico projected into the gulf of Gaeta, much as the Sorrentine peninsula does to-day between the gulfs of Naples and Salerno.

*M. Maggiore* is a block of limestone with its lower slopes, except the north-eastern, covered with volcanic ash. It rises steeply on all sides, on the west from the Riardo sill to the highest edge (3,402 ft.), and on the south-west from the plain of Campania through gentle lower slopes to over 2,000 feet. On the south it is separated by the deep valley of the Volturno from M. Tifata and M. Virgo (p. 332). The eastern part of the massif within the elbow of the Volturno consists of the gently undulating plateau of Caiazzo (average height, 900 ft.).

The lower slopes of M. Maggiore are fertile, well wooded, and



populated. The Caiazzo plateau is covered with olives and vines, and is a most productive and densely peopled region. All the higher ground is typical of limestone country, with steep-sided, flat-topped hills, numerous cliffs, little surface drainage, scattered trees, and scanty population.

### *The Latin Valley*

*The Sacco-Liri Valley.* Between the Lepini mountains, Roccamonfina and M. Maggiore on the south-east, and the Central Apennines on the north-east, the long trough of the Latin valley, which varies between 3 and 6 miles in width, is a continuation of the Tyrrhenian trough. The northern part of the Latin valley, now occupied by the lower Sacco valley, was formed simultaneously with Roman Campagna (p. 279). Volcanoes, now extinct, deposited material, especially along the edge of the trough where the crust had been weakened. On top of these deposits, and also on the limestones farther south, lie travertine and clays brought down by the Apennine rivers. Most of the rivers, including the Sacco, Liri, Rapido, and Volturno, rise in the Apennines to the north-east of the trough. In the north the trough is drained by the Sacco and then the Liri, which in former times probably continued south-east through the sill of Mignano, on the north of Roccamonfina, into the present Volturno valley. This course was blocked by volcanic material from Roccamonfina, and a lake was formed from which an outlet was eventually cut where the present F. Garigliano flows through a transverse gorge to the sea. The Latin valley is continued beyond the Mignano sill by the middle valley of the Volturno between le Tavernole and Castel Campagnano, where the F. Calore enters the main stream. The Volturno then adopts the east to west direction of the Calore, and cuts between M. Maggiore and Mi. Virgo and Tifata.

The Sacco valley is hemmed in by limestone masses on either side. On the south-west rise the steep-sided Mi. Lepini, and on the north-east the less steep flanks of the Mi. Ernici (p. 321). The valley is narrow above Sgurgola but broadens out before the junction with the Cosa above Ceccano. Below the confluence the Sacco flows through a gorge, 300 feet deep and  $2\frac{1}{2}$  miles long, in the floor of the trough. The town of Ceccano, on the right flank of the gorge, is a bridge-town controlling routes to the Amaseno and Cosa valleys. The other towns and villages, such as Castro, Pofi, and Falvaterra, are generally along the sides of the trough, well away from the river.

Near Isoletta the Sacco joins the Liri, which adopts the direction



of its tributary. The course of the Liri has, like the Tiber, two longitudinal and two transverse stretches, the lower longitudinal section being in the Latin valley. The river flows in a valley a little over half a mile wide along the south-west side of the trough, which is at its widest (about 7 miles) below the confluence. Some 8 miles below the confluence the tumultuous river flows through a gorge on both sides of which stands the bridge-town of Pontecorvo. Below Pontecorvo the Liri valley widens to over a mile, and the trough continues with a width of about 7 miles. Throughout this region the floor of the Latin valley consists of a gently undulating surface, scattered everywhere with farms. Above S. Ambrogio, the Gari (Rapido) joins the Liri, which then turns south and enters its final transverse stretch as the Garigliano. Both the Rapido and the Liri flow almost entirely through limestone country and consequently have a large and steady volume.

The Sacco-Liri trough is followed throughout its length by the Rome-Naples road (6) and railway. Important branch-roads follow the Cosa valley into the Mi. Ernici and upper Liri valleys (82) into the heart of the Central Apennines. Within the Sacco valley the railway runs close to the river, but the road remains on the higher ground. Both keep well to the north-eastern edge throughout the Liri section of the trough.

*The Middle Volturno.* It is believed that, before the eruptions of Roccamonfina, the upper Volturno continued southwards over the sill of Riardo, now occupied only in its southern half by the small F. Savone. When this exit was dammed up a lake was formed at the foot of the Matese plateau by the Volturno, which finally drained towards the Calore through a gorge cut in the low hills south of Alife. The floor of the southern part of the lake is now the plain of Piedimonte d'Alife.

Along the foothills of the Matese several towns indicate the position of springs where the limestone and impermeable strata meet, e.g. Ailano, S. Angelo d'Alife, Piedimonte d'Alife. There is similarly a line of settlements along the north-east edge of the Maggiore massif, e.g. Varrano, Pietra Vairano, and Baia e Latina. Otherwise, this part of the Latin valley has a very sparse population and is deserted by main routes.

### *The Plain of Campania*

The low, flat plain of Campania is surrounded by a steep semi-circle of highland, composed almost entirely of limestone. In the



north are M. Massico, isolated lava foothills of Roccamonfina, and M. Maggiore, in the east M. Tifata, M. Virgo, and the Campanian Apennines (p. 332), and on the south the Sorrentine peninsula and the Mi. Lattari. Within the limits of the plain rise the Campi Flegrei and Vesuvius. During Pliocene times the whole plain, and the sites of the Campi Flegrei and Vesuvius, were beneath the sea. Submarine eruptions gave rise to the Campi Flegrei, and the grey tuff of succeeding eruptions built up a flat volcanic plain of great fertility. This tuff spread right to the foot of the bordering mountains, but has since been covered by alluvium, in the north from the F. Volturno, and in the south from the F. Sarno. The present plain may be divided into three regions: the lower Volturno basin in the north, the Terra di Lavoro in the centre, and the Sarno plain in the south (p. 93).

The *Lower Volturno basin* is roughly rectangular in shape and has an area of about 190 square miles. Its northern margin along the foothills of M. Massico and M. Maggiore is composed of volcanic material, but farther south the Volturno has overlaid the tuff with alluvium, largely of limestone origin. The southern margin extends from Vico di Pantano in the west, along the Regi Lagni to the south of Marcianise. The limits of this region can approximately be estimated by the line of towns just outside its borders. Sand-dunes line the coast, and behind them stretches a flat, marshy, uninteresting plain, with scattered trees here and there on the higher ground. Considerable efforts are being made to drain the plain, but much has yet to be done. Castel Volturno, at the mouth of the Volturno, and Cancellò, some 6 miles upstream, are the only towns of any importance below Capua, 17 miles inland. This bridge-town at the foot of M. Tifata, and at the junction of the alluvium and tuff, is the only large settlement on the lower Volturno. The higher parts of the alluvial plain are now becoming inhabited, and as drainage improves population and cultivation increase.

Three or four miles above Capua the Volturno emerges from its transverse gorge between M. Maggiore and Mi. Tifata and Virgo. The gorge varies greatly in width and in the steepness of its sides between Triflisco and Limatola. It is on the whole, however, narrow and steep-sided, with a level floor over which the river meanders. Above Limatola the gorge widens into the small plain of Dugenta, where the river clings to the foot of M. Maggiore and leaves the greater part of the plain on its left bank (p. 292). The Calore enters the Volturno just above this plain, and opens up an





PLATE 107. *The Valdarno near Incisa*



PLATE 108. *The Terra di Lavoro: intensive cultivation with vines trained between trees*





PLATE 109. *The Campi Flegrei: the crater of Agnano*



PLATE 110. *Naples and Vesuvius*



important routeway which is followed by the main Naples-Benevento-Foggia railway.

The *Terra di Lavoro*, the most fertile part of Campania, surrounds Vesuvius and the Campi Flegrei on their landward side, and extends in the north along the foot of the Apennines to the Volturno. It is irregular in shape, wide in the north, and narrow in the south between Vesuvius and the Campanian Apennines. This region is one of the most intensively cultivated and most densely populated in Italy. Vines, fruit trees, cereals, and vegetables are grown throughout the Terra di Lavoro (Plate 108), and extend on to the slopes of the hills. Many of the vines are trained up the straight trunks of poplars. The intensiveness of the agriculture is remarkable; the plain looks like a well-cultivated garden the whole year round. The coast north and west of the Campi Flegrei is fringed with dunes and backed by a narrow zone of lakes and marshes. These two belts have been partly planted with pines, but are otherwise covered with *macchia*. Since, however, they together rarely exceed three-quarters of a mile in width, they detract little from the general appearance of prosperity throughout the Terra di Lavoro. Along the eastern edge of the plain springs line the junction of the limestone and tuff. To cope with the water thus released and to keep the plain drained, an artificial river, the Regi Lagni, has been constructed. This river provides water to irrigate the plain during the seven or eight dry months. The towns are, on the whole, above the general level of the plain, e.g. S. Maria, Caserta, Maddaloni, Nola, Palma. Along its inland edge the plain extends into the mountains in a series of short valleys which have been invaluable to communication between mountain and plain.

The *Sarno plain*, the southern extension of the Terra di Lavoro, is bordered on the west by Vesuvius and the coast between Torre Annunziata and Castellammare, on the east by the Mi. del Sarno (p. 333), and on the south by the Mi. Lattari. In this plain also the tuff is partly covered by alluvium brought down from the limestone Apennines by the F. Sarno. Although inferior in fertility to the Terra di Lavoro, the Sarno plain is nevertheless intensively cultivated with fruit trees, vines, and cereals, and is densely populated. Its southern half is the more thickly covered with trees. The most famous place in the Sarno plain is ancient Pompei, about half a mile to the north-west of the modern town. Nocera at the foot of the Mi. Lattari guards the entrance to the Cava valley and the routes from Naples to Salerno. Sarno, an important agricultural centre, stands at the junction of the limestone and tuff.



*Vesuvius and Campi Flegrei.* The plain of Campania is separated from the gulf of Naples by the volcanic masses of the Campi Flegrei and Vesuvius, between which is the low alluvial valley of the Fosso Reale. The city of Naples, famed for the beauty of its surroundings, lies at the foot of the Campi Flegrei and extends into the Fosso Reale valley, which has been drained and converted into a vast market garden. Although so close together, there is little similarity of form between Vesuvius and the Campi Flegrei. Both regions, however, contain very fertile, well-cultivated, and densely populated land, though the Terra di Lavoro surpasses them in all three respects.

The Campi Flegrei (p. 472) are the remnants of a much larger volcano, the greater part of which has disappeared into the gulf of Naples. Its whole area is studded with low, well-preserved cones with round crater walls partially broken down, and craters, some of which are lake-filled. Erosion has blurred their original appearance but little. It is in fact a model of volcanic activity. The Campi rise gently from the plain of Campania to the north and reach their greatest height (1,503 ft.) in Camaldoli, a little over 2 miles north-west of the centre of Naples. Campiglione, north-west of Pozzuoli, is 1,142 feet high, but, generally speaking, the west is lower than the east. Although volcanic activity has now practically ceased, it is not quite extinct. The last violent eruption occurred in 1538, when the 455-foot ash cone of M. Nuovo was built in a few days. Solfatara, behind Pozzuoli, is still active. The floor of the crater is comparatively cool, but there are occasional pools of boiling water from which jets of steam rise to 15 or 20 feet. Sulphurous and other gases are also exhaled. It is possible to walk inside the Solfatara crater during periods of activity, but it is inadvisable to stray too near the centres of eruption (Plate 109).

The Campi Flegrei, as already stated, are extremely fertile and are covered with vineyards, except for the northern slopes, where macchia predominates. In most instances the vines are trained up poplars rather than poles. Round Camaldoli chestnuts take the place of poplars. The Campi Flegrei are densely populated everywhere, but particularly along the south coast between Naples and Pozzuoli, where a narrow band of industrial towns and dockyards extends along the coast. Naples rises up the steeply sloping south-eastern face of the Campi Flegrei, at the head of the bay (Plates 16, 110).

The almost perfect cone of Vesuvius (p. 472), about 25 miles round the base and incised by many streams and seamed with lava-



flows, rises from the sea to 3,894 feet. From the south it seems to be a single cone, but from Terzigno, in the east, the volcano is seen to have two peaks divided by the Valle dell' Inferno, whence issues a long black line of recent lava which in 1929 destroyed the first sixty houses of the town. Seen from the centre of the Terra di Lavoro, in the north, the central cone of Vesuvius forms one peak, and M. Somma another. M. Somma is the highest point on the outer rim of the original crater, which dates from an earlier stage in the volcano's development. This wall is now intact only along the northern side. Within the old crater, which has a diameter of nearly  $2\frac{1}{2}$  miles, rises a newer cone, at present active. The Somma wall has proved invaluable to the inhabitants of the northern slopes of Vesuvius, since it prevents lava-flows from descending this face. The molten material descends only to the west, south, and east, where terrible devastation has been wrought. Pompei was buried in A.D. 79 by cinders and stones, while Herculaneum, beneath the present Resina, was covered by mud-flows. Despite the fact that Vesuvius is liable to erupt at any time, the foot of the mountain is densely populated, owing to the great fertility of the soil (Plates 110, 111).

The eruptions of Vesuvius are very different from those of Solfatara. Jets of steam rise continually from the main crater, and there are frequent minor eruptions of lava. Explosive eruptions are rare and usually occur after long periods of quiescence.

The beauty of the Vesuvian landscape is deservedly famous. The volcano rises steeply through a girdle of intensive cultivation, dotted with white villages, to barren upper slopes. During winter the cone is snow-capped. The younger material of Vesuvius is usually bare and hard, except where afforested with pine, holm oak, alder, beech, and chestnut; the older material of the lower slopes is covered with dense vegetation. Vines and olives alternate with prickly pear and fields of grain, with chestnut groves on the higher slopes, interrupted by desolate areas of recent lava planted with prickly pear. Vines are by far the most important crop, amongst which tomatoes are grown in summer and a green crop in spring. Every scrap of soil is used. The density of agricultural population is extremely high. There are over 2 million inhabitants on the lower slopes of Vesuvius, equivalent to a density of 4,400 per square mile. A ring of towns and villages surrounds the base below a height of 650 feet. The largest, Portici, Torre del Greco, Torre Annunziata, are also ports, and considerable numbers of their population are sailors.

In addition to a network of local roads and railways, the plain of



Campania is served by main routes radiating from Naples to (a) Cancello and Rome (main road and railway), (b) Capua and Rome (road 7-*bis* and railway), (c) the Caudine Forks and Benevento (road 7 and railway), (d) Nola and Avellino (road 7-*bis*), and (e) Nocera and Salerno (road 18, autostrada to Pompei, and main southern railway).

### *The Sorrentine Peninsula*

The Cava gap between Nocera and Vietri sul Mare separates the Sorrentine peninsula from the Campanian Apennines. The limestone on either side of the faulted valley is similar, so that the peninsula is a structural continuation of the Campanian Apennines.

The limestone peninsula, including the Mi. Lattari, is almost 25 miles long, only 3 miles wide in the south-west, but over 7 miles wide east of Positano. The narrow western part consists of a block rising from about 1,100 feet in the extreme south-west to 2,500 feet in the north-east. The wider, eastern block, which is flanked on the north by the Sarno plain, is composed of a much higher plateau, the Mi. Lattari, with many short, north-west to south-east ridges, separated by mountain basins (p. 91).

The north coast is steep, but contains several small, flat hollows (*piani*) ensconced among the mountains, and opening to the sea above rocky cliffs. The most fertile patches in the peninsula are provided by the tuff-covered floors of these *piani*, e.g. those of Vico Equense, Sorrento, and Massalubrense. The south coast between Point Campanella and Positano was formed by faulting, and is straight, steep, and uninhabited. East of Positano the coast is slightly less steep and more indented, with many settlements connected by a cornice road. Agerola, on a high *piano* (2,087 ft.), and Ravello (1,033 ft.) similarly placed behind Amalfi, are the only villages not on the coast. Both flanks of the Sorrento block are favourable to cultivation, which, round the coastal settlements, spreads up the steep hill-sides. Between the villages and on the higher slopes the country is bare and rocky, and only covered here and there with *macchia*. The density of population is very high in small intensively cultivated areas, such as the *piani* of Sorrento and Massalubrense with their orange groves and vineyards. The centre of the peninsula, however, consists of bare or scrub-covered limestone mountains, with occasional settlements in the intervening plateaux. The highest peak, M. S. Angelo (4,734 ft.), rises from Cape Sottile, and is flanked on the south-east by the fertile basin of Agerola. The sides of the Mi. Lattari are more densely wooded, especially with chestnuts. Where the mountains come down





PLATE 111. *The crater of Vesuvius*

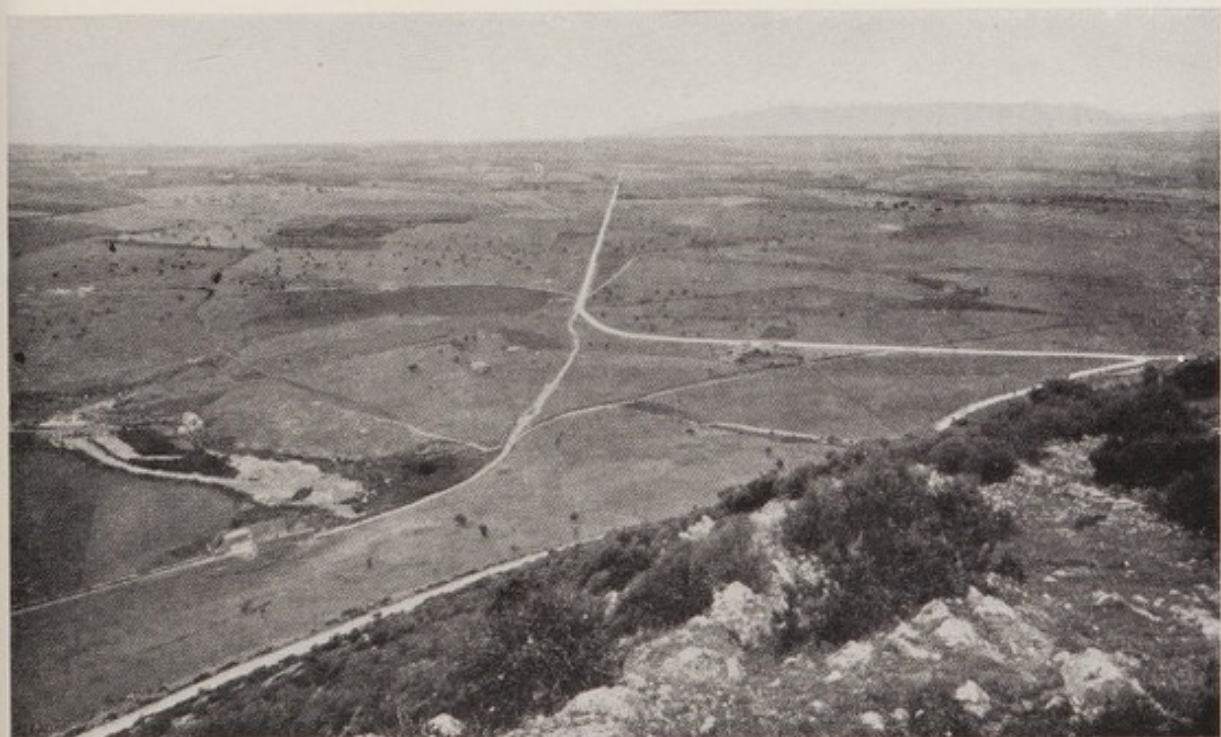


PLATE 112. *The plain of Paestum from Capaccio Vecchio*





PLATE 113. *The Langhe near Bossolasco*



PLATE 114. *Tavernelle and the Lagastrello Pass through the Cusna chain*



to the Sarno plain, small towns, such as Gragnano, Angri, and Pagani have developed along a line of springs, and the whole region is intensively cultivated (Plates 20, 21, 22).

Communications within the Sorrentine peninsula are difficult. The main railway from Naples to southern Italy follows the Cava gap. The only other railway is a branch from Torre Annunziata to Castellammare di Stabia and Gragnano, although Sorrento is served by electric tramway from Castellammare. A road, with several tunnels along the south coast, almost surrounds the peninsula and links the coast towns. A branch-road serves Sorrento and Massalubrense, and in spite of the steep gradients three roads cross the mountains from north to south. Much of the south end of the peninsula is, however, still inaccessible to wheeled traffic.

### *The Sele Basin*

The lower Sele basin (120 square miles; Plates 112, 126) extends in the north to Salerno and in the south to Paestum, and is roughly triangular in shape. The basin is composed of three plains, those of Salerno and Paestum in the north and south, and of Eboli in the east, and includes the surrounding foothills. The greater part consists of recent alluvium, but the plain of Eboli is slightly older and higher (150 ft.). A sandy beach fringes the Salerno and Paestum plains (p. 93).

The F. Sele has a remarkably even flow, since all its large tributaries (Calore, Tanagro, Bianco) rise in limestone country and are fed by large springs. The winding river is nearly 500 yards wide in places, and is dotted with islets.

Like so many coastal regions of western Italy, this lowland became a malarial swamp during historic times. The remains of the old Greek temple at Paestum (ancient Poseidonia) bear witness to a former prosperity. Only during the last decade were drainage and cultivation recommenced. The extreme north and parts of the plain of Eboli have been drained, but there is still much to be reclaimed. The northern part is now well cultivated with vines, olives, and cereals (wheat, maize, and oats). Elsewhere the land is partly cultivated but mostly in pasture, or covered with scrub, providing grazing for buffaloes and cattle. Despite the recent drainage there is practically no settlement on the plain, and the villages and towns remain on the lower slopes of the foothills, e.g. Portecagnano, Faiano, Battipaglia, and Eboli.

Above Ponte Sele the river basin is much narrower and is flanked on either side by limestone hills between 800 and 1,200 feet high, e.g.



M. Oliveto, 876 feet, and M. Zonzo, 1,171 feet, north and south of the river. Within the region thus shut in by the steep-sided mountains lie many small villages, situated on ancient alluvium.

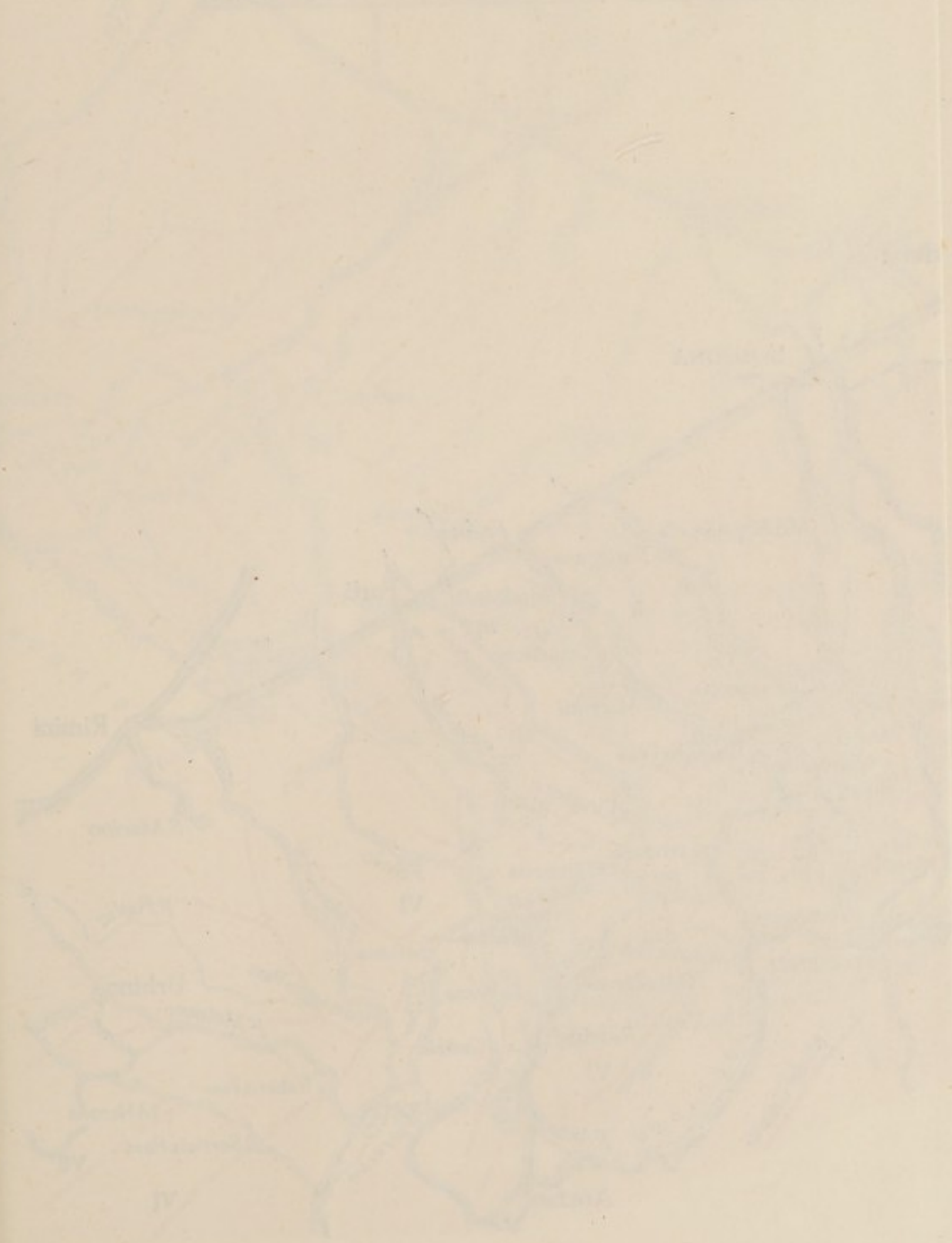
Communications as far as possible avoid the floor of the lower Sele basin, and cling to the foothills. The coastal road (18) and railway to Reggio keep near the inner margin of the plain, and at Battipaglia important routes branch off towards the east and south-east.

## THE APENNINES

THE range of the Apennines, which is continuous with the mountains of Calabria (p. 342), has been divided into three regions, mainly on the basis of their component rocks and of the consequent differences in their topography. The Northern Apennines are chiefly composed of weak sandstones and clays, the Central Apennines of limestone, and the Southern (or Campanian and Lucanian) Apennines of smaller limestone massifs set in a matrix of sands and clays. There are, however, further contrasts between different parts of the range which should be briefly noticed. The changes in the trend of the range (p. 28) are accompanied by a considerable difference in structure. The northern half of the range is simpler and, on the whole, narrower and straighter than the southern. Only the northern half (including about half of the Central Apennines) consists of continuous chains formed by simple folding. South of the F. Tronto these chains increasingly give way to great mountain blocks and basins, produced by fracturing and differential uplift and depression. It is due to this contrast in structure that the southern half has at the same time both higher summits than the northern, and also easier and, on the whole, lower passages between the mountain blocks. Furthermore, in the northern half the watershed roughly coincides with the highest mountains, but in the southern half this is seldom true, and the main rivers often break through the highest part of the range in comparatively narrow gorges. The main obstacle to movement across the range is, consequently, in the north the height of the passes and in the south the narrowness of the defiles through which many of the routes lead. Not only are the Apennines a serious and continuous barrier to communication between the two sides of the Peninsula, and between the continental and peninsular parts of the country, but they also tend to restrict communication along each flank to a single coastal route. This is most marked along the west coast in Liguria and in southern Campania and Calabria, and along the east



1811 M. 22. 25. 26. 27. 28. 29. 30.





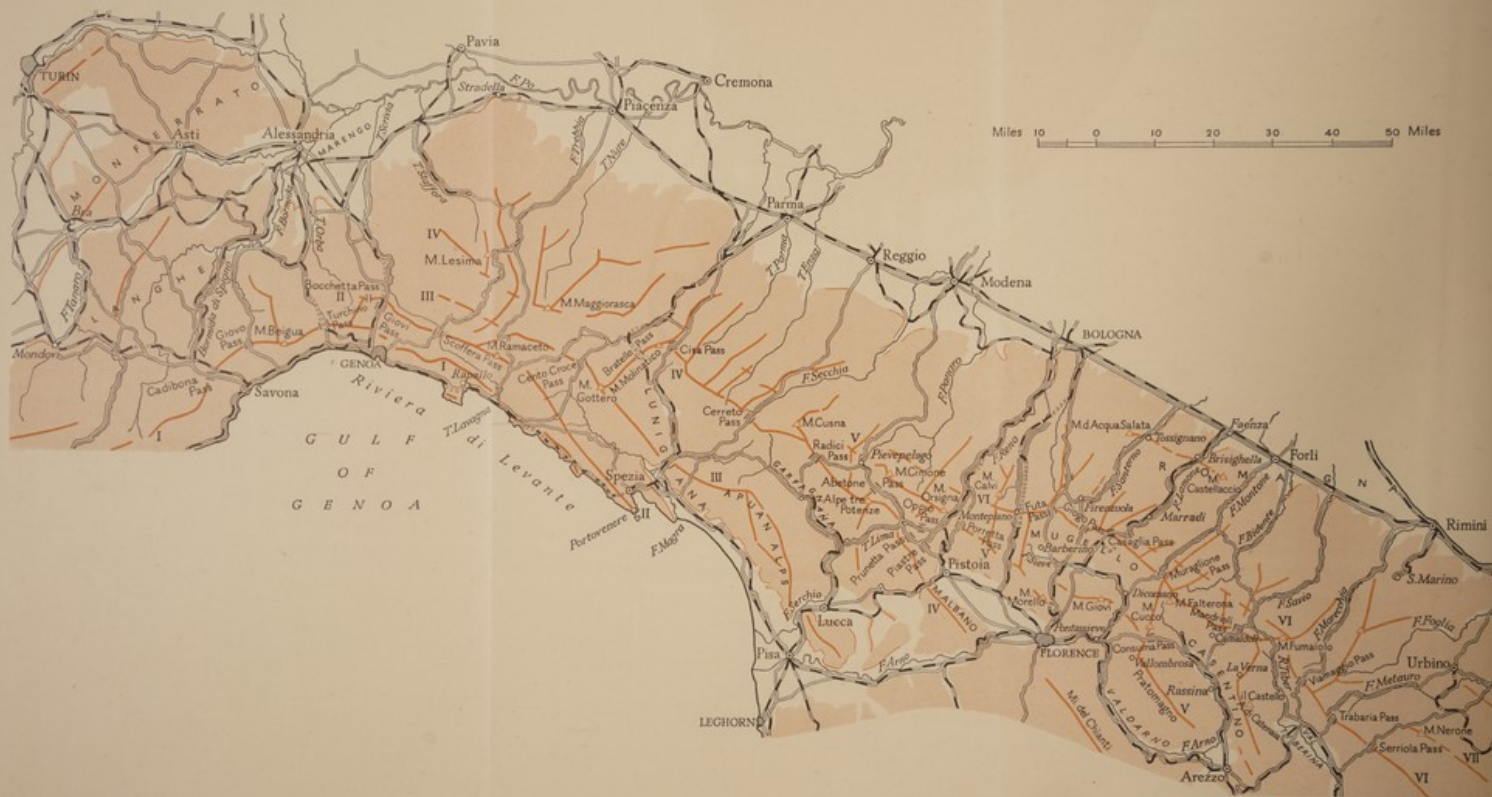


FIG. 51. The Northern Apennines. (For Key see Fig. 40)



coast in Calabria and throughout the Adriatic Coastland. It is also more true of the railways than of the roads. Alternative roads away from the coast have, except in Liguria, been constructed, but they are naturally handicapped by heavy gradients and circuitous courses.

### THE NORTHERN APENNINES

The Northern Apennines are a straight and fairly narrow range of mountains crossing the neck of the Peninsula from shore to shore. They are continuous with the Alps to the west and with the Central Apennines to the south-east, from neither of which are they divided by any outstanding break. The Northern Apennines are here regarded as stretching from the Cadibona pass south-eastwards to the Trabaria pass (p. 315), a distance of about 230 miles. In the west the road (29, 28) from Savona to Mondovi serves to divide the Apennines from the Maritime Alps, so that Monferrato is included within this region. The road (73) from Arezzo to Fano through the Trabaria pass and the Metauro valley marks the beginning of the Central Apennines (p. 310). On the north and east the Apennines rise from the Northern Plain (p. 265) along a well-marked line. On the Tyrrhenian side they are bordered by the sea to the west of the F. Magra, east of which they are separated from the uplands and basins of the Pre-Apennines by a line of depressions, including the Garfagnana, Florentine, and Valdarno basins, which are part of the Tyrrhenian trough. The average width of the Northern Apennines is about 40 miles.

*Structure.* The range is composed not of a simple chain of mountains corresponding to one upfold in the rocks, but of a series of short chains, about six in number, parallel to one another and to the direction of the range as a whole. The component chains are arranged in echelon, each one as it dies out south-eastwards being succeeded by another farther to the north-east. Between the chains are short north-west to south-east troughs or downfolds, which contain some Pliocene lake-basins (p. 36). The watershed, which usually coincides with the crest-line, follows each chain in turn, and passes eastwards from one to the other. The net result of this arrangement is that the watershed usually follows the highest and outermost (i.e. the north-easternmost) of the chains. The drainage on the Adriatic side, accordingly, is simple, and runs transversely down the slope to the north-east. In some places a minor outer chain rises between the watershed and the Adriatic,



but the rivers cut through it without deviation. These streams have cut the Adriatic slope into a large number of parallel ridges at right angles to the trend both of the range as a whole and of the component chains. The Tyrrhenian drainage is more complex. The rivers have alternate broad, longitudinal sections in the north-west to south-east troughs, all of which drain to the south-east, and narrow, transverse valleys where they cut across the intervening chains. This pattern of drainage and relief occurs everywhere east of the F. Trebbia, and is continued southwards in the Central Apennines. West of Genoa, where the watershed and the main chain are on the south side of the range and close to the sea, the arrangement is, if anything, reversed, for there is no room for any but short transverse streams on the Tyrrhenian side; in contrast there are longitudinal valleys on the northern side.

*Geology.* The mountains are composed almost entirely of rather weak Tertiary rocks, largely clays, marls, and rather more resistant sandstones. There are occasional comparatively thin limestones, and, in the western half, scattered intrusions of *pietre verdi*, both types of rock which tend to stand out in relief. The rocks are in roughly parallel bands, the youngest and softest Pliocene clays and Pleistocene sands on the outer, northern slopes being succeeded towards the south-west by clays and marls. Older, more resistant sandstones, together with most of the limestone beds, outcrop still farther to the south-west, near the margin of the range, where they form the highest mountains. The former lake-basins of the Tyrrhenian slope are floored with Pliocene and later sandy sediments. Generally speaking, rounded landforms characterize the outer hills on the Adriatic side, and more angular and accidented topography the higher mountains of the centre and west.

In the soft rocks of the Adriatic slope, the rapid erosion caused by the autumn and spring rainstorms has resulted in the widespread menace of landslips and *calanchi* (p. 489). Landslips occur among the interbedded sandstones and clays of the rugged central belt, mainly along the sides of deeply incised upper courses of the Adriatic rivers, particularly the Panaro and Secchia, and to a less degree the rivers to their west. *Calanchi*, on the other hand, occur mainly in the clays and sandy clays of the Pliocene and Eocene, towards the foot of the mountains, where there is a greater concentration than anywhere else in the country. They are particularly common in an area including the Langhe and the valleys of the Scrivia and Staffora, and in an almost continuous belt from the F. Taro to the F. Metauro.



*Vegetation.* The vegetation of the Northern Apennines forms a transition between that of the Alps and of the Central Apennines. The change from the predominance of conifers in the higher forests of the Alps to beech in the Apennines occurs in the Maritime Alps. Firs and some other conifers, however, are still common in the Northern Apennines and even constitute some important forests. This is in contrast to the Central Apennines, where mountain conifers are rare. There is also a transition between the almost Central European flora of the Northern Plain and the more distinctly Mediterranean flora of Liguria and Tuscany. The olive is absent from the northern side of the range to the west of Bologna. The contrast is marked between the rich, tree-clad, agricultural valleys and wooded slopes of the Tyrrhenian side and the bare pastures and cornfields of the northern side.

Considerable areas in the intermontane basins and on the lower slopes of the mountains are within the lowland and hill zone of Mediterranean crops and vegetation (p. 442). The upper limit of the olive on the Tyrrhenian side is roughly 1,600 feet, in some places 2,000 feet. On the Adriatic side at Bologna it is as low as 300 feet. These Mediterranean areas are among the most fertile and highly cultivated parts of the region; olives, fruit trees, mulberries, and vines are intimately mixed with cereals.

Above this zone, especially on the Tyrrhenian side, there are forests, brushwood, or pasture. Chestnut groves and coppices cover a considerable area between 1,000 and 3,000 feet, particularly on the eastern slopes of the Garfagnana and in the Casentino. The beech, with lower and upper limits of 3,000 feet and 5,300 feet, next becomes dominant. The areas above the tree-line are very small. True forest, however, is relatively restricted, as it is throughout the Peninsula. Much has been coppiced and is from time to time recut by charcoal burners, and much has given place to mountain pastures. Comparatively few forests of full-grown trees remain. Nevertheless, this is one of the best wooded parts of the country outside the Alps, and some of the most famous forests in Italy have been preserved in the eastern section of the range. Among these the chief are those of Vallombrosa on the western Pratomagno (beech, chestnut, and fir), la Verna in the south-eastern Casentino (beech and fir, with some trees up to 130 feet in height), and Camaldoli in the north-eastern Casentino (9 sq. miles; fir, beech, oak, &c.), all preserved by monasteries, and Boscolungo, near the Abetone pass (15 sq. miles; beech, fir, spruce, larch, Scots pine, and maple). In general, the smoother



hill-tops and saddles are open pasture, the steeper slopes and the valleys wooded.

*Communications.* The pattern of communications is simple. Nearly all the routes are across the range, and movement along it is confined to the lowlands and basins on either side. Even the intermontane basins within the same longitudinal trough (e.g. Mugello, Casentino, Val Tiberina) communicate directly with each other only with difficulty, and do not obviously aid movement across or within the region. The barrier presented by the range, although formidable, is simple. The chief obstacle, apart from those caused by the all too frequent instability of the slopes, is the height of the range itself. In contrast to the Central and Southern Apennines, the watershed coincides for the most part with the crest-line, so that the main passes are high and cannot be avoided. Once they are crossed, however, no great barriers remain. The outstanding importance of Bologna and Florence is based largely on the number of remarkably low passes in the part of the range separating them.

### *Subdivisions*

It is usual to divide the Northern Apennines into two parts, the Ligurian Apennines in the west, and the Etruscan or Tuscano-Emilian Apennines in the east, separated at the Bratello or Guelfo pass (Bratello tunnel) by the Magra and Taro rivers.

#### *The Ligurian Apennines<sup>1</sup>*

The Ligurian Apennines, in which the watershed is never far from the coast, form a symmetrical curve round the gulf of Genoa. Behind Genoa itself the chain turns nearly through a right angle from south-west to south-east. In view of this change it is advisable to describe the chain in two parts, one to the west of the Giovi pass due north of Genoa, and one to the east.

*West of Genoa* the Ligurian Apennines do not differ from the rest of the Northern Apennines in their trend alone. The rocks are older and rather more resistant. Immediately west and north of Genoa comparatively hard *pietre verdi* occupy most of the surface. In addition there is a series of longitudinal valleys and subsidiary ridges, the Langhe and Monferrato, on the northern side of the main chain.

The main range, the Apennines proper, is a simple low ridge, about 50 miles long, only about 15 miles wide, and so close to the gulf of Genoa that, although the summits rarely exceed 3,000 feet

<sup>1</sup> See also Chapter III.



(M. Beigua 4,222 ft.), the southern slopes are very steep indeed. The T. Orba, draining north to the F. Po, rises only 3 miles from the Ligurian coast. The watershed follows this single main chain from the Cadibona pass to Genoa. Just west of the Bocchetta pass a second chain commences to the north and immediately becomes the watershed. North of the Apennines proper, but structurally continuous and topographically similar, a great northward projection of the range juts out like a large bastion between the two southward extensions of the Northern Plain in the neighbourhood of Cuneo and Alessandria. This projection consists of the Langhe between the F. Bormida di Spigno and the F. Tanaro, and Monferrato, including the Turin hills, between the rivers Tanaro and Po. North of Genoa, between the lower courses of the Bormida and the Scrivia, the Apennines fall immediately to the Marengo plain, and this short passage over the Turchino, Bocchetta, and Giovi passes, is, with its three railways, two main roads, and autostrada, the most important crossing of the whole Apennine range.

The Langhe and Monferrato are hilly regions made up of lightly folded, late Tertiary clays and marls, corresponding to the outer slopes of the Apennines farther east, and like them suffering from landslips. Each is a district of innumerable rounded, grassy hills, the relics of a former peneplain (p. 36), now thoroughly dissected. The Langhe are joined south of the Savona-Mondovi road with the Maritime Alps. In the south-west they rise to 2,500 feet and descend gradually north-east to about 1,000 feet near Alessandria. On the south they are separated from the Apennines by the broad valley of the Bormida di Spigno, followed by roads 30 and 29 and by a railway (Plate 113). The longitudinal valley of the Tanaro between Bra and Alessandria divides the Langhe from Monferrato, and is important for communications, since it passes through this northerly extension of the Apennines and directly joins the plains of Cuneo and Marengo. Several roads and railways, centring mainly on Asti, make use of this passageway. The Monferrato plateau has an average level of about 1,000 feet, rising westward and northward. Its southern slopes, particularly round Asti, are famed for their wine.

*East of Genoa* the Northern Apennines between the Giovi pass and the Bratello pass form a transitional region made up of four parallel north-west to south-east chains, between the first three of which two small, south-easterly draining, longitudinal valleys (F. Lavagna, T. Vara) intervene. This section of the range is more complex than usual, since all four chains are found one behind the



other instead of being spread out in echelon, and because the direction of the drainage north of the watershed changes from north-west to north-east owing to the abrupt bend in the range. The first chain (I on Fig. 48), which forms the watershed west of Genoa, continues along the coast, but is low and dies out near Rapallo. The second chain is followed by the watershed from the Bocchetta pass to M. Ramaceto (4,413 ft.), where it moves to the third chain. This is followed as far as M. Gottero (5,381 ft.), where it diverges along a transverse ridge to M. Molinatico (5,082 ft.) in the fourth, the Cusna chain. This transverse ridge is crossed by the Bratello tunnel, which connects the Magra and Taro valleys. It is notable that although the highest passes are along the watershed chain, nearly all the highest summits are in the chains to the north of it, e.g. M. Maggiorasca (5,840 ft.) and M. Lesima (5,656 ft.). The second and third chains continue south-east at considerably lower heights, after ceasing to form the watershed. The second backs the coast as far as Portovenere. The third is continued beyond the Magra in the high, limestone Apuan Alps (p. 269).

This is one of the portions of the Apennines least well provided with roads and railways. The passes between the Scoffera (2,224 ft.) and the Cento Croci (3,455 ft.) are not so high as those farther east, but the climb from the gulf of Genoa is very steep and the width of the chain (50 miles) is greater than usual. The presence of one or two chains actually higher than the watershed, although cut through by streams, also makes for greater difficulty of passage. There are, indeed, four roads across the watershed, but only two independent crossings of the range. The only railway passes through the Bratello tunnel. Longitudinal communications are practically restricted in the south to the coast road (Via Aurelia, 1), and in the north to the foot of the hills where the road (9, 10) is forced close to the Po, particularly near Stradella (p. 261).

### *The Etruscan Apennines*

East of the Bratello pass the trend of the range continues nearly east-south-east, but the mountains leave the west coast at the mouth of the Magra and cross towards the east coast. South of the mouth of the Magra the Pre-Apennines are interposed between the Tyrrhenian Sea and the Apennines.

In comparison with the Ligurian Apennines, the Etruscan Apennines are longer (250 miles), of more uniform width (about 40 miles), and higher (M. Cusna, 6,959 ft.; M. Cimone, 7,096 ft.). Although the





PLATE 115. *The Lima valley at Bagni di Lucca*



PLATE 116. *La Verna in the Alpe di Catenaia*





PLATE 117. *Lake Scaffaiolo in the Cimone chain*

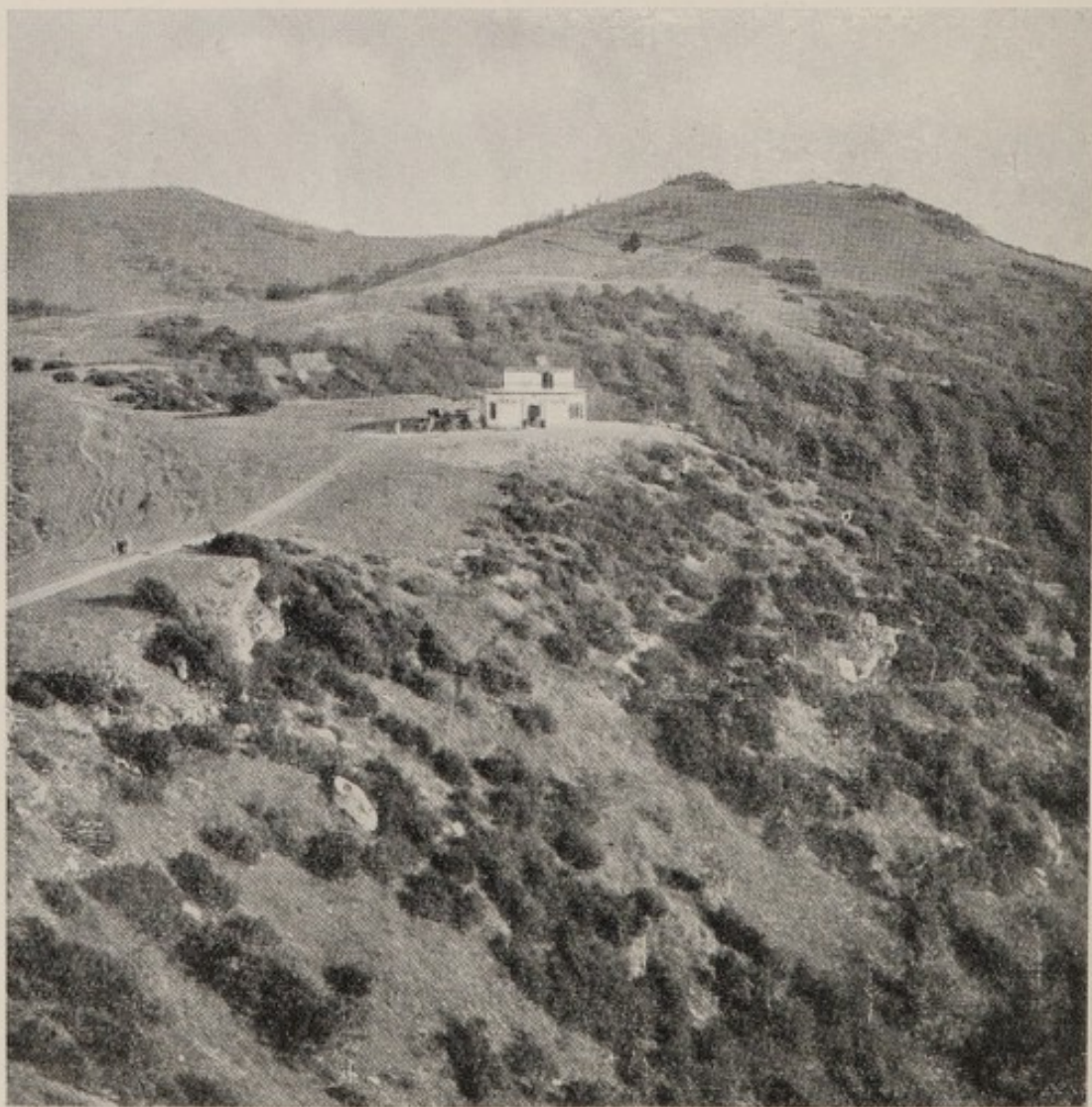


PLATE 118. *The high Pratomagno*



summits are surpassed farther south in the Abruzzi, the crest-line is the highest in the whole Apennine system. The component chains continue in echelon, but are spaced out so that there are not more than two parallel chains in any cross-section. The longitudinal valleys on the Tyrrhenian side are larger than farther west.

The range is composed of three main chains: the Cusna (IV), Cimone (V), and Falterona (VI). The first two are separated by a short and shallow depression, and the last two by a longer and deeper one. The Cusna chain, which farther west includes the highest summits of the Ligurian Apennines, becomes the watershed at M. Molinatico (5,082 ft.) and continues as such through M. Cusna for 80 miles along the crest-line of the range (Plate 114) to the Alpe tre Potenze (6,365 ft.). This crest-line is crossed by a series of high passes: Cisa, 3,415 feet, road 62; Cerreto, 4,237 feet, road 63; Radici, 5,013 feet, main road; Abetone, 4,554 feet, road 12. South-east of the Alpe tre Potenze the chain is crossed by the Lima valley (road 12; Plate 115), but it continues, rapidly losing height, to M. Albano and the Mi. del Chianti (pp. 273, 275). At the Abetone pass the watershed crosses along a high, transverse ridge to the fifth, the Cimone chain. The short intervening depression, which is traceable south-eastwards from Pievepelago towards the Florentine basin, is followed by roads 12 and 66 over the Abetone and Oppio (or also the Prunetta) passes. The Cimone chain (Plate 117), which rises from this depression and, farther south, from the Florence and Valdarno basins, starts near M. Cimone (7,096 ft.) itself and is followed for a short distance (20 miles) to the F. Reno by the watershed, which never drops below 5,550 feet. The Reno forces the watershed temporarily back to the Cusna chain and affords a wide opening through the main chain. Around its headwaters the Oppio (2,694 ft.; road 66), Piastre (2,497 ft.; road 66), and Porretta or Collina (3,058 ft.; road 64) passes offer alternative and comparatively low routes across the watershed. This crossing of the Northern Apennines is by far the easiest east of Genoa. South of the Porretta pass the watershed returns to the Cimone chain, only to cross almost immediately to the sixth, the Falterona chain. The Cimone chain, however, continues south-east, forming first the comparatively low hills culminating in M. Morello (3,064 ft.) and M. Giovi (3,255 ft.) between the Arno and the Sieve rivers, and then the higher, continuous ridge of the Pratomagno (Segnale di Pratomagno, 5,224 ft.; Plate 118). Farther south it is prolonged in the belt of hills (p. 315) which divides the Val di Chiana from the Tiber valley.



Between the Cimone and Falterona chains a long depression stretches from near Barberino di Mugello south-eastward through the upper Tiber valley into the Central Apennines. This depression is crossed by transverse ridges which cut it into short, isolated sections. These contain the former lake-basins of the Mugello, Casentino, and Val Tiberina, which now form relatively low, flat, and fertile areas in the midst of the mountains.

The Mugello (15 miles long, up to 7 wide, alt. 600–1,000 ft.) lies about 1,000–2,300 feet below the bare, brown, and rounded tops of the surrounding mountains. It is drained by the F. Sieve, which has dissected the weak Pliocene and later sediments. The river, bordered by a narrow plain, flows close to the south-west side of the basin and has left on its north-west bank long, flat-topped ridges and hills which are clothed with vines and fruit-trees. The Sieve drains to the Arno by the gorge followed by road 67 between Pontassieve (p. 283) and Dicomano. The hills to the west of the Mugello are not high (*c.* 3,000 ft.) and are crossed by main road (65) across the Pratolino pass (1,562 ft.) and the secondary Florence–Faenza road across an adjacent pass (1,706 ft.). There are also, through the Falterona chain on the east, the comparatively low passes of the Futa (road 65; 2,963 ft.), and il Giogo (main road, 2,884 ft.) leads to the small clay basin of Firenzuola (1,385 ft.), the Casaglia (main road, railway; 3,025 ft.) to the Lamone valley, and the Muraglione (road 67; 2,976 ft.) to the Montone valley.

The Casentino (11 miles long, up to 4 wide, alt. 1,100–1,600 ft.) is separated from the Mugello by a high ridge (M. Cucco, 3,730 ft.), which connects M. Falterona with the Pratomagno, and from the Val Tiberina by the Alpe di Catenaia (4,641 ft.; Plate 116). The surrounding mountains, which contain some limestone, are considerably higher than those surrounding the Mugello, and the basin is more isolated, both on the west (Consuma pass; 3,471 ft.; road 70) and on the east (Mandrioli pass; 3,848 ft.; road 71; Plate 119). The Arno flows south-eastwards along the south-west side of the deeply dissected floor of the basin. The river leaves the basin at Rassina by a gorge (road 71 and railway) to the Arezzo basin (p. 284). It is notable that intercommunication between these three basins is prevented by the high transverse ridges; there is no road from the Casentino to the Mugello, and only a roundabout secondary road to the Val Tiberina (p. 315).

East of these three Pliocene basins rises the Falterona chain. This is the longest of all the chains, and is followed for 110 miles by the



watershed from M. Calvi (3,880 ft.), near the northern end of the chain, to the Trabaria pass (3,425 ft.; road 73) and beyond, in the Central Apennines, to the Scheggia pass (p. 316). The Falterona chain is rather lower than the preceding ones; between M. Orsigna (5,099 ft.), just west of the Reno, and M. Nerone (5,007 ft.), at the beginning of the next chain, the Catria chain, in the Central Apennines, no peak exceeds 4,900 feet except for M. Falterona (5,426 ft.) and some of its neighbours which dominate the northern end of the Casentino. The passes, however, of which nine are crossed by main roads, are surprisingly high, being mostly at about 3,000 feet. Between the Casaglia pass, at the north-western end of the Alpe di S. Benedetto, and M. Fumaiolo (4,619 ft.), the source of the Tiber, a short subsidiary chain to the north-east is dissected into a line of summits nearly as high as the main chain.

North-east of the outermost chain the Adriatic slope of the Northern Apennines consists of long ridges between the transverse valleys. The nature of the ridges, however, changes as they pass through the different geological belts (p. 28). First there is a zone, consisting mainly of Eocene clays, marls, and sandstones, of modulated upland relief and deep valleys, and then, especially in the Pliocene deposits of the eastern margin, a very dissected zone of rounded ridges between the flat-bottomed valleys of the main streams. Thus in the region of the Santerno and Lamone valleys, each of which is followed by a main road, the crest zone of the Falterona chain is of comparatively rugged sandstone mountains, but these give way northwards in the neighbourhood of Firenzuola and Marradi to broad, rounded hills. The latter have a general summit-level falling north-eastward from about 2,600 feet to 1,500 feet, and are deeply incised by the main valleys which have narrow flood-plains with vestiges of terraces along their sides. At the junction of this Miocene zone with the Pliocene a thin but resistant gypsiferous bed stands out in a ridge, which is traceable from M. dell'Acqua Salata (1,601 ft.), west of the Santerno, to M. Castellaccio (1,667 ft.), south of Faenza, and causes a restriction of the valleys near Tossignano and Brisighella. Nearer the plain the soft clay of the Pliocene has a general summit-level of 800 feet, falling to 300 feet at the edge of the plain itself. This Pliocene country is highly dissected by small, tributary valleys, and is crossed by the wide, flat-bottomed valleys of the main streams, which have well-marked terraces along their sides.

The Etruscan Apennines, to the east of the Abetone pass, are



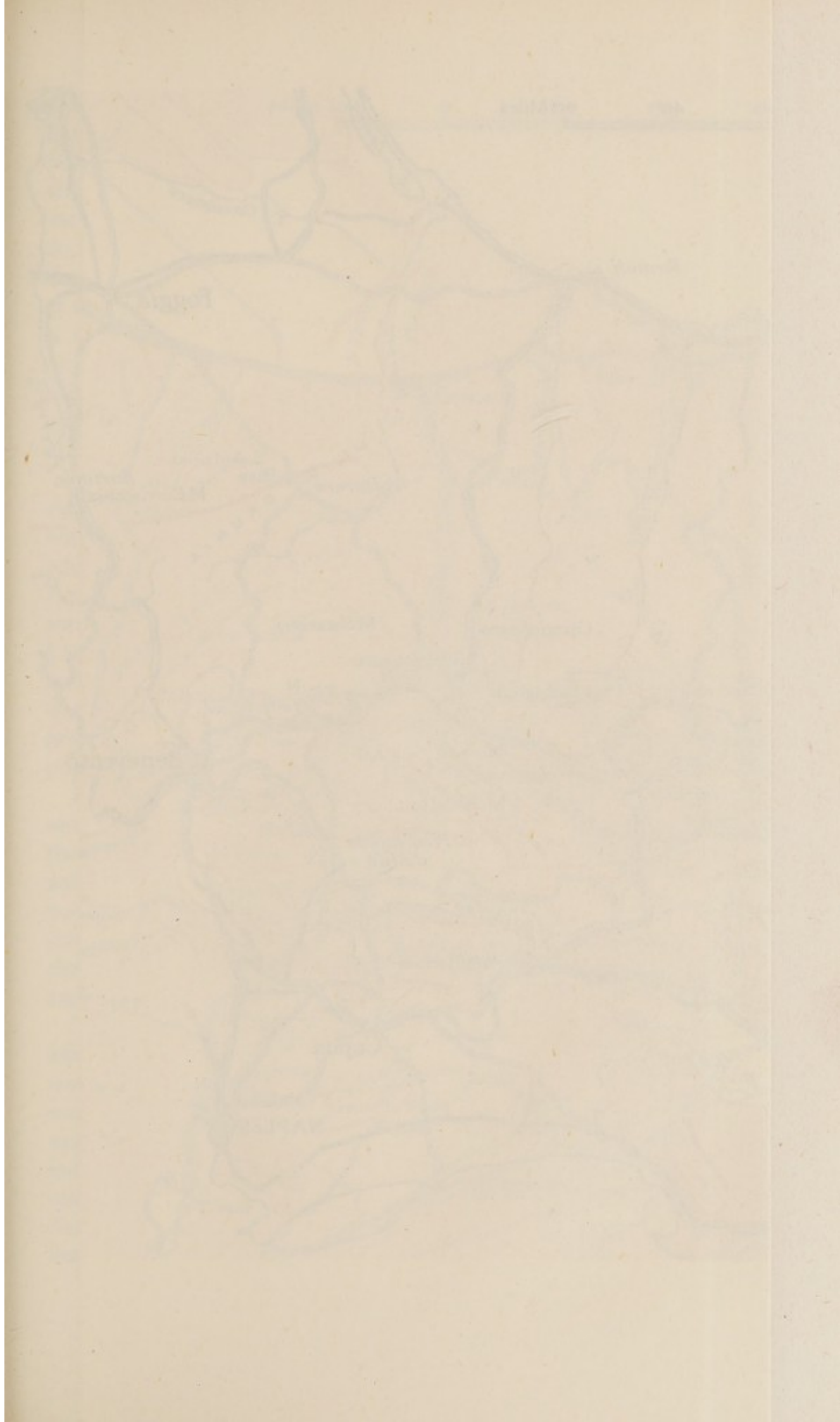
comparatively well endowed with transverse routes. Passes are lower than farther west, and the danger from landslides rather less, so that most of the roads keep to the valley bottoms, except the Futa road (65; Plate 120) and other short stretches. West of the Abetone pass, ridge-roads are the rule in the middle sections of the northern slopes. The group of six passes in the short space between the Oppio and il Giogo, all converging on Florence and on Bologna, have undoubtedly contributed to the importance of these two cities. Three of the four railways crossing the Northern Apennines east of Genoa are also concentrated in this short stretch.

### THE CENTRAL APENNINES

There is no clear dividing line between the Northern and Central Apennines since there is no break in the continuity of the range. The road (73) from Arezzo to the Trabaria pass and thence along the Metauro valley roughly marks the division. To the north the rocks are largely of sandstones and marls, and to the south increasingly of limestone. In the south the general level of the mountains drops to the Benevento gap where the Calore and Cervaro valleys serve as a boundary. In the west the Apennines extend to the eastern margins of the Tyrrhenian trough (Val di Chiana, middle Tiber, Sacco, Liri, and middle Volturno valleys; pp. 282, 292) which separates them from the Pre-Apennines. Along its eastern side the region falls gradually to the Adriatic Coastland (p. 385). The Central Apennines, which are much nearer to the eastern than the western seaboard, stretch about 200 miles from north-west to south-east, and are roughly 70 miles wide in the north and centre of the range, but only about 40 miles in the south. The direction of the main range, almost north-west to south-east in the Northern Apennines, changes to almost north and south near the Esino valley, and then reverts, south of the Tronto, to north-west to south-east.

*Physical Features.* The Central Apennines contain several contrasting types of country. The major contrast is between the series of high, folded chains parallel to the coast in the east, and the region of lower chains and high plateaux in the west. The eastern chains contain the highest mountains of the Apennines, e.g. Corno Grande (9,560 ft.) and M. Vettore (8,130 ft.), while the west presents a landscape of more uniform and tabular relief. Within the limits of the eastern chains there is a further contrast north and south of the F. Tronto. In the northern half the general arrangement of the











chains is a continuation of that of the Northern Apennines. Four continuous mountain chains, the Cimone, Falterona, Catria, and Sibillini chains, succeed one another in echelon from west to east, and are separated by deep troughs. The watershed follows each of the chains in turn, and the deep river valleys of the Adriatic flank do not cross the chains but lead up to high passes in the crest-line. South of the Tronto the watershed is everywhere west of the line of the highest mountains, and the continuation of the Sibillini chain is dislocated into a series of high, limestone blocks, such as the Gran Sasso d'Italia, the Morrone, and the Maiella, separated by eastward draining valleys eroded along fault-lines. These occasional gaps provide relatively easy means of communication between the interior of the country and the Adriatic coast.

There is a further contrast between the rounded outlines of the clay and sandstone districts and the massive limestone peaks, which, with steep, bare sides, characterize the Central Apennines as a whole (Fig. 49). The clays and sands spread south from the Northern Apennines and give place gradually to limestones, which south of Rieti and Aquila make up the great majority of the range. Farther south still, in the Molise, limestones again give way to clays and sandstones. Where limestone occurs on a large scale, surface water is scarce, the regime of the rivers greatly affected (p. 50), and the area on the whole comparatively bare of trees and sparsely populated.

Finally, additional diversity is introduced into the scenery by the semi-enclosed basins which commonly occur between the ridges of the western plateau region. These basins, such as those of Aquila and Rieti, were occupied in Pliocene times by lakes, which have been filled-in and drained. They are on the whole the flattest, most fertile, and densely populated areas of the western plateaux, since they are floored with recent alluvium and do not share the aridity and poverty of the surrounding limestone areas.

The length and nature of the Tyrrhenian and Adriatic rivers are affected by the disposition of the watershed and by the greater average steepness of the Adriatic slope. In the east the rivers are numerous and the majority are short, straight, and swift. Their upper valleys are rugged and dissected and often pass through an outer chain in narrow, transverse gorges. Their lower valleys are more open as they are cut in the soft sands and clays at the foot of the mountains. In summer the rivers may be mere trickles of water, but in winter are raging torrents. The rivers, with their main trend



at right angles to the chains, are of great importance in east to west communication across the high chains, e.g. F. Esino, F. Pescara.

The Tyrrhenian rivers, as in the Northern Apennines, are longer than those of the east, and often flow for considerable distances in the north-west to south-east longitudinal valleys between the ridges of high land, through which they break in transverse gorges towards the south-west, e.g. the Corno, Salto, lower Marroggia, upper Liri, and middle Volturno. The Tyrrhenian rivers, in contrast to those of the east, have no dominant trend, and are gathered together in three large drainage systems. The Tiber is the master stream north of the Aniene, in the latitude of Rome. South of the Aniene the Liri is the main river, and farther south still the Volturno. The Tyrrhenian rivers have a more regular regime than those of the Adriatic slope, especially those which flow through the limestone plateaux and are fed by underground water-supplies.

*Communications.* Throughout the Central Apennines the river valleys have been, since Roman times, of paramount importance to communications between the east and west coasts, and to a lesser extent between the north and south of the country. The transverse valleys aid the former, and the longitudinal valleys of the Tyrrhenian rivers the latter. Where the watershed coincides with the highest chains, as it does north of the Tronto, the rivers of the western and eastern slopes rise close to one another and provide a number of passes, e.g. Scheggia pass between the Sentino and the Chiascio. South of the Tronto, however, the main streams are parallel to one another and there are no distinct passes, e.g. the Salto, Liri, and Aterno rivers are separated by the Aquila plateau. In addition the high eastern chains lie on the Adriatic side of the watershed and are crossed not by passes but by river valleys eroded deep into the mountains, where tectonic activity has produced breaks in the chain, e.g. between Gran Sasso and the Morrone, and south of the Maiella. South of the Sangro, in the sands, marls, and conglomerates of the Molise, 'calanchi' (p. 489) occur over wide areas, and consequently roads and railways avoid the valleys as far as possible, and remain on the higher ground, e.g. road 87 and railway from Campobasso to Termoli. Although, in comparison with the Northern Apennines, the roads and railways are not forced to climb such high passes, the obstacles presented by the very wild relief, especially by some of the gorges and precipices in the limestone districts, make the Central Apennines at least as great an obstacle to cross. Nor has the economic incentive to construct good roads and railways across the



Central Apennines been so great as in the Northern Apennines. In spite of some very important transverse lines such as the Via Flaminia (road 3) and the railway from Rome via Terni to Ancona, the Central Apennines are an area of few routes, and are crossed by only 4 railways and about 14 main and 5 second-class roads.

*Vegetation.* As in the other parts of the Apennines, the vegetation is very clearly differentiated into altitudinal zones. In addition, the prevalence of limestone accounts in part for the relative absence of chestnuts, the abundance of Aleppo pine, and the great extent of pasture.

The usual types of vegetation succeed one another. The scope of the Mediterranean zone is, however, restricted owing to distance from the coast, the comparatively extreme climates of the interior basins, and the high average altitude. Mediterranean plants and crops (p. 442) extend higher than in the Northern Apennines or Sub-Apennines, but areas of closely cultivated mixed tree and ground crops are confined to the basins and lower hill slopes of Umbria and Sabina and scattered depressions elsewhere. The upper limit of the olive is normally about 1,600–2,000 feet, but in the Marsica, on the protected sides of the Fucino basin, the tree flourishes at as much as 2,750 feet. It is absent, however, from the Aquila plateau. Almond trees are cultivated to over a height of 3,000 feet in the Abruzzi. The depressions, where irrigation is often practised, are intensively cultivated with fruit trees and cereals. In the Sulmona basin, where the annual rainfall is less than 20 inches, there are important irrigated vineyards, whilst the floor of the Fucino basin is mainly under rotation grasses.

The broad plateaux and higher mountains are mostly within the zone of natural forest, oak below and beech above, but the remains of forest at the present day are quite small even in the inaccessible Abruzzi. Bare rock, thin scrub, and pasture occupy the larger part of this zone. The lower and upper limits of the oak are roughly 1,000 and 4,300 feet, and of the beech 3,300 and 5,900 feet. Juniper and pine extend above the beech, in some places up to 8,000 feet, but the majority of summits over 6,600 feet are above the tree-line. The white fir and other mountain conifers, common in the Alps and even in the Northern Apennines, are rare. The meadows above the tree-line, and the broad open pastures which replace forests over large areas of the plateaux or *piani*, are dry and thin compared with the alpine meadows. Many of the high *piani*, such as the Piano delle Cinquemiglia, are open pastures, valuable in summer for the



great flocks which move up into the mountains from the scorched plains below.

### *Subdivisions*

The Central Apennines fall, topographically, into two main regions, the high chains of the north and east, and the lower plateaux of the west and south. The eastern chains are roughly divided into two along the F. Tronto, and the western plateaux into three blocks by the Nera-Velino and the transverse Liri and Sangro rivers. The two southernmost of these blocks can be again subdivided into east and west portions. These units will be considered in belts across the Peninsula from the Tyrrhenian trough in the west to the Adriatic Coastlands in the east.

In the north, (1) the Roman Apennines cover the whole width of the country and consist of four distinct mountain chains, the last two of which continue south as far as the F. Tronto. Flanked by this region to the north and east, and by the Tyrrhenian trough to the west, lies (2) Umbria, the most northerly of the western plateau-regions. South of the Nera, Velino, and Tronto rivers lie three further sub-regions: (3) Sabina between the Tiber and the Liri; (4) the great Aquila plateau between the Liri and the Aterno; and east again of this (5) the Abruzzi Apennines (Gran Sasso d'Italia, Maiella, Morrone), the high extension of the Roman Apennines south of the Tronto. South of the Sangro and the upper transverse section of the Liri lie (6) the plateaux of Meta and Matese in the west, and (7) of Molise in the east.

### *The Roman Apennines*

The northern region of the high eastern chains is about 130 miles long, 60 miles wide in the north, but only 30 in the centre and south. The region contains four parallel mountain chains, the continuations of the Cimone and Falterona chains of the Northern Apennines, and the Catria and Sibillini chains, separated from each other by three lower troughs. East of the Sibillini chain transverse ridges lead down to the Adriatic Coastland. The bulk of the west and north of the region is of sandstones and clays similar to those of the Northern Apennines. In the Catria and Sibillini chains limestones form the higher portions and increase in importance southwards, until beyond the F. Chienti they dominate the range. Pliocene sands and clays floor the lake basins of the Tiber and of Gubbio.

The most westerly of the mountain chains, the Cimone chain



(p. 307), rises abruptly from the flat Val di Chiana and extends southwards from the Pratomagno to Perugia. It is comparatively low (M. Favalto, 3,550 ft.). In the north the ridge is broad and cut by a number of parallel, north-eastward flowing streams, but in the south it narrows, becomes more accidented, and higher and steeper on the eastern side. Here the isolated, grey, limestone peak of M. Tezio (3,150 ft.) rises north of Perugia. This chain is succeeded to the east by the upper Tiber valley, most of which was occupied by three Pliocene lakes, and is now a low, wide valley. The northern lake-basin (12 miles long, 6 wide; alt. 920 ft.) between Borgo San Sepolcro and Citta di Castello is largely floored with Pleistocene alluvium, but Pliocene deposits reach up to the west side to 650 feet above the floor. The central basin between Citta di Castello and Umbertide is considerably smaller (7 miles long, just over 1 wide; alt. 860 ft.). The southern (13 miles long, 2 wide; alt. 790 ft.) extends between Umbertide and Perugia. The basins are separated from each other by narrow barriers of low spurs. All the lower mountain slopes and the floors of the basins are cultivated and thickly populated. The higher land is forested and practically uninhabited.

The Val Tiberina is flanked on the east by the southern end of the Falterona chain (p. 315). This divides into two branches which enclose the basin of Gubbio. From the Trabaria pass the chain extends about 12 miles south-east to M. Mancinare (2,605 ft.) and, although losing height, forms the main watershed. Thence the principal branch continues east of Gubbio and swings south towards Assisi. The western branch passes south and then south-east through M. Urbino (2,831 ft.) to rejoin the principal branch across the Chiascio valley at M. Subasio (4,232 ft.; p. 318). The small, faulted Pliocene basin of Gubbio (12 miles long, 5 wide; alt. 1,500 ft.) stands some 650 feet above the level of the Tiber, to which it is drained through narrow ravines by the T. Assino in the north-west and by the F. Chiascio in the south-east. The floor of the basin, covered with Pleistocene deposits, is marshy, and the two rivers are linked across it by canal.

Separating the Falterona chain from the Catria chain farther to the east is a depression, indistinct in the north, but marked south of the Scheggia pass (p. 316) by the very important trans-Appennine road 3 and railway from Fossato to Foligno. In this part of the depression lies the small Gualdo Tadino basin (9 miles long, 1 wide; alt. 1,400 ft.), which is connected with the Gubbio basin, less than 5 miles away, by railway and secondary road via the Chiascio valley.



On either side of the Gualdo Tadino basin the depression is traceable, northwards in the upper Chiascio valley leading to the Scheggia pass, and southwards in the Topino valley which gives access to Foligno.

Near Gubbio the main watershed turns east to the Catria chain, which begins in the north at M. Nerone. Its highest peaks, including M. Nerone (5,010 ft.), M. Catria (5,384 ft.), and M. Pennino (5,158 ft.), are of hard limestones, in contrast to the sandstones and marls of the lower slopes and more westerly chains. South of M. Cavallo (4,921 ft.), where the watershed passes farther east, the chain loses height and turns to the south (p. 320). The eastern slope of the chain is, throughout, very steep, and the rivers have incised the rugged country with deep, narrow valleys. These streams are similar to those draining the Adriatic slopes of the Northern Apennines, but are more torrential, almost dry in summer, and subject to terrible floods after rain.

The Falterona and Catria chains together form a single barrier where the watershed is crossed by four chief passes. In the north the Serriola pass (2,395 ft.) forms an alternative route to road 73 and the Trabaria pass (p. 309). The two chains are linked along the watershed by a transverse ridge which is notched by the saddle of the Scheggia pass (1,887 ft.; road 3), similar to the Abetone and Bratello passes farther north (p. 306). South of the Scheggia two passes, the Fossato (2,428 ft.; road 76) and the Colfiorito (2,503 ft.; road 77), directly cross the Catria chain.

East of the Catria chain lies a depressed zone, the northern part of which between Urbania and Sassoferrato is only separated from the Adriatic Coastland by the minor, discontinuous beginnings of the Sibillini chain. South of Fabriano the Camerino depression, in which soft sands and clays have been preserved, stretches for about 25 miles and is limited on the east by a more continuous and higher ridge. The floor of the depression is cut into ridges by the Adriatic rivers which have cut back to it. Camerino (2,159 ft.) stands on one of these ridges. South of Camerino the depression continues, clearly marked by the road to Visso on the F. Nera, and so to the high basin of Norcia. The railway and some roads make use of this longitudinal passageway.

The final chain of the Central Apennines hems in this depression on the east and culminates in the Mi. Sibillini. This chain (Plate 122) is traceable from Urbino, but only becomes fairly continuous south of Arcevia. This northern section of the chain to the east of the



Camerino depression rises to 4,972 feet in M. San Vicino, and is intersected by the F. Esino (road 76 and railway to Ancona), F. Potenza (secondary road and railway to Macerata), and F. Chienti (road 77). Farther south, from M. Rotondo (6,900 ft.) to the F. Tronto, the Mi. Sibillini become the principal watershed and are much higher (M. Vettore, in the south, 8,130 ft.). This chain, a massive wall of bare and rugged limestone, is only crossed by the Canapine pass (5,062 ft.; main road), but can be circumvented on the north by the Visso pass (2,677 ft.; main road) and the Chienti valley, or in the south by the Torrita pass (c. 3,235 ft.; road 4) and the Tronto valley.

East of the chain lies a belt of hilly country composed largely of Tertiary clays and sandstones, with lens-shaped beds of gypsum and sulphur, especially common in the south. The country, which merges into the Adriatic Coastland (p. 385), is highly dissected, and the Adriatic rivers cut narrow valleys through the minor chains east of the Sibillini. The sandstones are in contact with the limestones of the main chain and the mixture of the two produces a fertile soil. Much of the region is given up to comparatively intensive, mixed cultivation, and the population is fairly dense. Calanchi (p. 489) occur in the clays here and there and contrast strangely with the rest of the countryside, being infertile, uninhabited, and a danger to communications. Fortunately they only affect a small area.

Between the deep Chiana-Tiber-Sacco-Liri trough, which separates the Tyrrhenian Pre-Apennines from the Apennines proper, and the longitudinal Catria and Sibillini chains there extends a mountain zone of medium height, forming several small ridges, some low and flat, others more lofty and rugged. The frequent rough uniformity of general levels gives the impression of a series of plateaux, crowned by higher ridges and cut into blocks by deep river valleys and wider basins. The ridges and blocks follow the dominant direction of Apennine folding, and so the rivers have been forced to flow in long north-west to south-east reaches. The two most characteristic landforms are the high, monotonous, gently ridged plateaux, and the wide Pliocene lake-basins such as those of Foligno and Aquila.

The region is largely composed in the north of sandstones and clays, in the south of highly permeable limestones, with fertile soil only in the depressions. Consequently the higher parts are relatively deserted, and the population tends to concentrate in the basins and



river valleys, where water is available. The settlements, however, are usually on the hill-sides, above the valley floors, whence, before their marshes were drained, malaria spread.

For all the region, with these common characteristics, there is no comprehensive name, nor any satisfactory name for its component parts. The northern part may be termed Umbria. Farther south Sabina in the west is divided from the high plateau of Aquila by the Salto and upper Liri valleys. Finally in the south-west are the two limestone masses of Meta and Matese.

### *Umbria*

Umbria includes all the country south of Lake Trasimeno, east of the Tiber, west of the main (Catria) chain, and north of the Nera-Velino valley. Although most of the ridges clearly trend north-west to south-east, some have a more north-to-south direction. The main valleys (e.g. Tiber, Nera, upper Topino, and Chiascio) are mostly alined from north-north-east to south-south-west.

The structure of Umbria is rather like that of the Apennines in miniature. In the north it is composed almost entirely of folded sandstones, while to the south limestone becomes increasingly prominent, and introduces a note of ruggedness into an otherwise gentle landscape. The countryside is on the whole one of undulating hills, with low, flattened domes in the north. Limestone becomes more and more predominant south of Assisi, and rises out of the sandstone ridges in isolated, high, grey, steep-sided hills, e.g. M. Subasio (4,232 ft.; p. 315) near Assisi. In the east the limestone predominates over the sandstone south of Foligno, and south of Spoleto it is practically the sole rock. Here the Mi. Reatini (M. Terminillo, 7,261 ft.) are much higher than the rest of Umbria.

The framework of Umbria comprises four main highland blocks, three of them roughly parallel: (1) the Trasimeno-Narni ridge, (2) M. Martano-M. Torre Maggiore, (3) the western flanks of the Catria chain with the indistinct termination of the Falterona chain between M. Spinosa and M. Maggiore. These three parallel blocks are separated by two interconnected depressions, one containing the Todi, Terni, and Rieti basins, and the other the Foligno-Spoleto depression. The third of these ridges curves round in the south and unites with the southern end of the second, the M. Martano ridge, thus forming a serious transverse barrier along the north-west flank of the Nera valley. Finally (4) the massive block of the Mi. Reatini rises between the upper Nera and Velino on the north and south,





PLATE 119. *The Mandrioli Pass*



PLATE 120. *The Futa Pass through the Etruscan Apennines*





PLATE 121. *The Foligno basin and the Martano ridge from Assisi*



PLATE 122. *The limestone gorge of the Candigliano (Gola di Furlo) and the Via Flaminia in the Roman Apennines*



the Rieti basin on the west, and the Norcia basin at the foot of the Sibillini on the east.

The lake-basins of the depressions are the centres of cultivation, population, and routes in Umbria. They have fertile floors surrounded by terraced slopes, and appear as closely cultivated and settled regions, in spite of the comparative prosperity of the whole sandstone highland (average density 200 per sq. mile).

Through the centre of Umbria flows the Tiber, collecting all the drainage of the northern part. Its tributary the Nera drains the limestone region of south Umbria and the Terni and Rieti basins. These valleys are, on the whole, deeply sunk in the surrounding country, making the mountains penetrable. Near Perugia the Tiber flows through a constriction from the Umbertide basin and enters the Todi and Foligno-Spoleto basins near their junction. The Foligno-Spoleto depression continues the south-east direction of the upper Tiber, but the river turns south through the Todi basin towards the narrow transverse gorge across the Trasimeno-Narni ridge.

The dissected, sandstone ridge of hills between Trasimeno and Narni rises from the Chiana-Tiber trough to roughly 1,650-2,300 feet and is cut into a northern (M. Peglia, 2,746 ft.) and a southern (M. Croce di Serra, 3,261 ft.) block by the Tiber gorge, 7 miles long. In the north-east the Nestore valley, with the drainage from Lake Trasimeno, separates the northern block from the hills near Perugia. On the east the ridge slopes down in the north to the Todi basin and in the south to the comparatively narrow Naia valley, which is connected over a low watershed (railway and road 79) with the Terni basin. Four main roads cross the ridge, though the Tiber gorge is avoided.

The Todi basin (20 miles long,  $2\frac{1}{2}$ -3 wide; alt. 650 ft.) extends from Perugia to Todi. Between Perugia and Marsciano the basin obliquely crosses the prevailing north-west to south-east trend and forms a broad lowland connexion with the Foligno depression to the east. The floor of the basin is cultivated, but the sides, on which Pliocene deposits reach up to 1,000-1,300 feet, are covered with scrub. A line of settlements follows the foothills on either side, and along the edge of the hills springs occur.

The line of the hills north of Perugia (p. 315) is continued south of the transverse section of the Todi basin by the sandstone ridge of M. Martano. This rises from the Todi-Naia depression for the most part to about 1,300 feet, but in the south to 3,589 feet in M. Martano and 3,578 feet in M. Torre Maggiore.



The Foligno depression (28 miles long, 3-6 wide; alt. 650 ft.) to the east of the Martano ridge is very similar to the Todi basin but is parallel to the main Apennine chains. It was at one time followed by the Tiber, but the Spoleto end was uplifted by Pleistocene earth movements and the drainage reversed to the north, the direction still followed by the Topino and Marroggia tributaries of the Tiber. A low ridge in the north separates the Foligno from the Todi basin and is crossed by the Topino in a gorge at Torgiano. The once swampy and malarial floor, which slopes gradually to the north, has been drained and is now fertile. There are numerous villages on the valley bottom, but the largest settlements, with the exception of Foligno, are along the foothills, e.g. Assisi, Bevagna, Trevi (Plate 121).

The western slopes of M. Subasio (4,232 ft.; p. 315) and the limestone mountains behind Foligno (Catria chain, p. 316) rise rapidly from the basin and culminate at about 4,300-4,600 feet. South of the deep valley of the Topino (Foligno-Ancona railway and road 3) the ridge continues about 3,000 feet high round the south end of the basin south of Spoleto, and connects with the M. Martano ridge at M. Torre Maggiore, thus cutting the northern Umbrian basins off from the Nera valley. This southern part of the ridge is crossed by road 3 at Somma (2,195 ft.) and by another main road and narrow-gauge railway east of Spoleto at the Cerro pass (2,408 ft.).

The deep, and usually narrow, transverse valley of the Nera, the most important tributary of the Tiber, cuts off the southernmost of the Umbrian highland blocks and collects the drainage of the Terni, Rieti, and other lake-basins. The last 7 miles of the Nera valley, between Orte and Narni, consist of a gorge through the comparatively low hills of the Trasimeno-Narni ridge on the north and the Mi. Sabini on the south. Above Narni the valley opens out into the Terni basin, which is connected on the north by a fairly low sill with the Naia valley (railway and road 79). The Terni basin (7 miles long, 4 wide; alt. 300 ft.) is much smaller than those of Todi or Foligno. It is well cultivated, but is primarily important because of the convergence of routes upon it from all directions.

Three and a half miles above Terni the Nera is joined by the F. Velino, which comes in from the Rieti basin and continues the line of the Naia-Terni depression. The two basins are separated by the Cascate della Marmore (Marble Falls; width 66 ft., height 525 ft., to which adjacent minor falls add a further 300 ft.). Travertine encrusted both sides of the falls to such an extent that the passage



of the water was impeded, and the valley above was frequently flooded. An artificial outlet had to be made at the end of the sixteenth century. There is great potential hydro-electric power of which only part has been used.

The Rieti basin (10 miles long,  $4\frac{1}{2}$  wide; alt. 1,300 ft.), about 5 miles above the falls, is the collecting centre of an extraordinarily large drainage area, including the F. Velino from the Mi. Sibillini, the F. Salto, and F. Turano. The extremely fertile and highly cultivated plain contains several small lakes, and the inflowing rivers constantly tend to cause floods. Natural terraces at more or less uniform levels (up to 2,600–2,950 ft.) line the sides of the basin. Rieti itself stands on the Velino at the head of the basin.

East of the Rieti basin rise the steep slopes of the high Mi. Reatini (M. Terminillo, 7,261 ft.). North-east of this is a highland region, mostly over 3,000 feet, which includes the high, shallow basin of Leonessa (about 4 miles wide, alt. 3,000 ft.). The highland region stretches as far as the Sibillini in the north, from which it is imperfectly separated by the small, high basin of Norcia (about 3 miles wide; alt. 2,000 ft.) and the gorge of the F. Corno (road and railway). In the east the highland stretches to the lower region round Amatrice at the foot of M. Gorzano, where the Tronto gathers its headwaters before breaking through between the Mi. Sibillini and the Mi. della Laga. On the south the transverse Velino valley (road 4) separates the Mi. Reatini from the Aquila plateau.

### *Sabina and the Aquila Plateau*

*Sabina.* The rectangular Sabina is bounded on the south-west by the central Tiber valley, the Roman Campagna, and the Sacco valley, on the north-west by the F. Nera, on the north-east by the Velino–Salto valley, and on the south-east by the F. Liri. The region is divided into two blocks, Mi. Sabini to the north, Mi. Ernici and Simbruini to the south, by the middle Aniene, which is followed by the Via Valeria (5) and the main railway from Rome to Pescara. Both are undulating limestone highlands trenched by longitudinal valleys (F. Turano, F. Aniene). Of the two the Sabini are the lower, but rise in the west to 4,488 feet in M. Pellechia. Here the limestone is flanked by Pliocene hills along the Tiber, Nera, and Aniene valleys. South of the Aniene the land often rises to over 5,000 feet and the wooded ridges of the Mi. Simbruini, which form the steep west flank of the upper Liri valley (Val Roveto), have many peaks over 6,500 feet (M. Viglio, 7,074 ft.). Apart from



these ridges the southern section consists of massive blocks of limestone with almost flat summits. Throughout the whole area limestone is the dominant rock and resembles a great sieve through which the water filters, to reappear at the foot of the mountains in copious springs. From earliest times the Aniene springs provided Rome with abundant, clear drinking-water. This water contains in solution much carbonate of lime from which travertine is formed (e.g. the enormous mass of rock at Tivoli, Plate 123). Small solution basins are another feature of the plateau; the two largest are at Carsoli (2,000 ft.), where the F. Fioio joins the F. Turano, and at Roviano (1,000 ft.) above the elbow of the Aniene.

*The Aquila Plateau.* The Aquila plateau, the largest and highest of the limestone plateaux of the Apennines (71 miles long, about 25 wide), extends to the east of Sabina as far as the lower slopes of the Gran Sasso, Morrone, and Maiella, and between the F. Velino and F. Sangro, on the north and south. This region, which has always formed a considerable barrier between the fertile country of Latium and Campania and the Adriatic coast, is shut in by a rim of mountains, the high wall of the Abruzzi in the east, and the Mi. Sabini, Simbruini, Ernici, and the Meta in the west, where communications are restricted to gorges. Except for Calabria it has been the most isolated part of the Peninsula, and this, coupled with an infertile soil and a severe climate, still keeps it backward and sparsely populated.

There are large areas in the centre of the plateau with no surface drainage, so that it forms a continuous barrier. A large percentage of the precipitation, however, is collected in underground channels and it is quite probable that Adriatic rivers, such as the Tronto, Vomano, Aterno, and Sangro, have cut back beneath the surface into the core of the plateau. Some of the present gorges in the plateau probably originated as underground streams. The heavy springtime precipitation is retained in the limestone and provides throughout the year abundant springs along the junction of the limestone and impermeable rocks, usually at the foot of the mountains.

The bulk of the plateau is a bleak, rolling, limestone highland, seldom dropping below 3,000 feet. Its western sides rise comparatively gently from the broad Salto valley, and much more steeply from the narrower Val Roveto. At the northern and particularly the southern ends it is furrowed by longitudinal valleys (e.g. upper Sangro) into slightly lower, sometimes wooded ridges. The central part and the tops of the ridges rise to flat or rounded summits,



about 6,500 feet or more (M. Velino, 8,160 ft.), and contain large, comparatively flat expanses at high levels. These high *piani*, of which the Piano delle Cinquemiglia (c. 4,000 ft.) is one of the largest, afford summer grazing for sheep from the Apulian lowlands. Finally, a number of basins, large and small, some with and some without surface outlets, are sunk to varying depths in the surface, and are much more densely populated than their surroundings. The largest are those of Fucino, Aquila, and Sulmona.

In the northern part of this wild plateau the average altitude of the furrowed surface and of its settlements (e.g. Petrella, 2,526 ft., Borgocollefegato, 2,362 ft.) is somewhat lower than farther south. One deep, longitudinal through-valley connects the Velino with the Aterno valley and is followed by road 17 and the railway from Rieti to Aquila. Farther south, nearer the Fucino basin, is an almost deserted plateau, with some villages often in high basins above 3,000 feet, e.g. Rocca di Cambio (4,705 ft.), Rocca di Mezzo (4,361 ft.), and Ovindoli (4,511 ft.). M. Velino (8,160 ft.) to the west and M. Sirente (7,707 ft.) to the east, both overlooking the Fucino basin, are separated by a saddle crossed at Ovindoli by a road from the Fucino basin to Aquila.

The oval Fucino basin (16 miles long, 10 wide; alt. 2,100–2,300 ft.), near the south-western corner of the plateau, lies athwart the trend of the ridges. Its flat, alluvial floor is surrounded by high and mostly steep mountain-sides, on the north by M. Velino and M. Sirente, and on the west, south, and east by three precipitous north-west to south-east ridges. In the south near Trasacco a rocky wall,  $1\frac{3}{4}$  miles long and 1,000 feet high, forms the truncated end of the central of these ridges, which rise to about 6,000 feet. The basin was occupied by the Lago di Fucino, which was drained in the years 1854–1876 by tunnel to the Liri valley. The central part of the floor is, therefore, characteristic, flat, reclaimed, alluvial land, which rises to the older, terraced deposits round the sides.

In the north-west corner, cut off by a very narrow ridge (3,629 ft.), is a subordinate basin, extending east and south of Scurcola. This basin lies 150 feet above the bottom of the Fucino basin and is drained by the upper Salto through a gorge to the north. In Pleistocene times, however, Lake Fucino extended over the low sill (2,362 ft.) on which Avezzano now stands, and occupied this smaller basin, whilst in modern times, during periods of greatest flood before the reclamation of Lake Fucino, the whole region drained this way to the Salto.



Marsica, the wildest part of the whole Aquila plateau, extends east and south of the Fucino basin as far as the Sulmona basin and the Piano delle Cinquemiglia. It has an average height of over 5,000 feet, with summits exceeding 6,500 feet, and contains the Parco Nazionale d'Abruzzo in the south. Narrow, parallel ridges with wooded sides are separated by open valleys of which those of the Sangro and Sagittario are the most important. As usual there are many streams which disappear only to reappear and join the Sagittario above the gorge through which it descends to the Sulmona depression. The climate has added to the topographical difficulties which impede communications. The roads from Scanno to Villetta Barrea (up to 5,095 ft.) and from Opi over the Acero pass (5,036 ft.) to S. Donato Val di Comino are the only main or secondary roads between the Alps and Calabria which are regularly closed by snow in winter (Nov.-Mar.).

The Marsica ridges are crossed between the Fucino and Sulmona basins by the Via Valeria (5) over the Caruso pass (3,575 ft.) and by railway through the Carrito tunnel (2,854 ft.). The only route (83) southwards from the Fucino basin crosses the Diavolo pass (4,747 ft.) to the Sangro valley in its upper, longitudinal section. The Sangro flows through a series of gorges and finally enters a very deep canyon, 3 miles long, from which it emerges at Scontrone and turns sharply north-eastwards into the small Castel di Sangro basin (5 miles long, 1 wide; alt. 2,600 ft.). Road 83 keeps close to the Sangro all the way except for the Scontrone canyon, which it avoids by climbing to the Colle della Croce (3,819 ft.). Below Castel di Sangro the gorges of the lower Sangro cross the high eastern chains (p. 326), and through this basin Sulmona and Aquila communicate with the Volturno valley and Naples (road 17).

Near the eastern limits of the Aquila plateau the long Aterno-Sulmona-Castel di Sangro depression (road 17) stretches all the way from near the Velino to the Sangro. For 40 miles it is followed by the Aterno (upper Pescara) in one of the largest longitudinal valleys of the Apennines, and within it occur the large basins of Aquila and Sulmona.

The Aquila plain is alined north-west to south-east along the middle Aterno. Unlike most of the basins its sides are fairly gentle. The average height of the floor is about 2,000 feet, with terraced sides rising to between 5,000 and 6,500 feet; its length is 18-21 miles and width not more than  $2\frac{1}{2}$  miles. The plain is composed of three, smaller connected basins, below the third of which at Fagnano



Alto the river enters a gorge (main road and railway) as far as the Sulmona basin. The sides of the gorge rise steep and high to M. Sirente on the west, but on the east to a narrow ridge only about 4,000 feet high, separating the gorge from a broad, flat, dry through-valley. This valley is followed by the main road 17 from Barisciano to above the Pescara near Popoli, to which it descends rapidly some 1,600 feet down the twists and turns of the Strada delle Svolte.

The Sulmona basin (11 miles long,  $4\frac{1}{2}$  wide; alt. 1,300 ft.) is similarly alined north-west to south-east. It is almost encircled by steep mountains 3,000–5,000 feet high, through which, however, valleys give access from the west, north-west, north-east, and south-east. Here the rivers Aterno and Sagittario meet before crossing the Abruzzi through the Popoli gorge as the F. Pescara. The basin is an important crossing-place of longitudinal and transverse routes. The general direction of the Aterno–Sulmona depression is followed by road 17, which climbs over the high Piano delle Cinquemiglia (4,206 ft.) on the south to the Sangro valley. On the east of the basin rise the steep slopes of the lofty Morrone.

### *The Abruzzi Apennines*

East of the Aquila plateau, the Abruzzi Apennines are separated from the Roman Apennines on the north by the Tronto valley, and from the Molise on the south by the F. Sangro. Limestone predominates in this region, and the landscape is more tabular than farther north. This is a transition zone between the long, uninterrupted chains of the Northern and the isolated and faulted mountain-blocks of the Southern Apennines. The belt of high eastern chains becomes rapidly narrower, and consists solely of the continuation of the Sibillini chain south of the Tronto.

The Mi. della Laga, between the F. Tronto on the north and the F. Vomano on the south, are composed entirely of sandstone. They are highest in the west and sink gradually to the east to form the Teramano hills. The high crest of M. Gorzano (8,054 ft.) is connected, south of the Vomano valley, with the Gran Sasso d'Italia, where the highest peaks of the Apennines rise.

The limestone Gran Sasso, between the Aterno valley to the west and the gorges of the F. Vomano and F. Pescara to the north and south, consists of two parts separated by the upper F. Tavo; the northern and higher is alined west-north-west to east-south-east, the southern and lower more nearly north and south. The chain rises, high and isolated, from a relatively low platform. The north-eastern,



outer slope is very steep, while the inner slope is gentle. The Gran Sasso was glaciated in Pleistocene times and the steep, hollow-sided peaks and enormous masses of debris are evidence of this. The highest peak of the Apennines, Corno Grande (9,560 ft.), with a summit of steeply sloping limestones, rises near the centre of the northern part. Several other limestone peaks exceed 8,000 feet, e.g. M. Intermezzo (8,682 ft.), M. Prena (8,419 ft.), M. Corvo (8,616 ft.).

South of the Popoli gorge of the Pescara, the high, straight north-west to south-east back of the Morrone (6,759 ft.) continues the Gran Sasso and connects it with the imposing limestone mass of the Maiella (M. Amaro, 9,170 ft.), which extends south-west to north-east directly across the general trend of the Apennines. Deep ravines have been carved in the sides of the Maiella, especially on the north, where the valley of the F. Orte has been formed along fault-lines. The outer, southern slope is gentle near the summit, but very steep sides lead down to the Aventino valley, which has been excavated in laminated clays; Casoli, just over 10 miles from the summit of M. Amaro, is 8,620 feet lower. The Maiella and Morrone show signs of glaciation and are similar in form to the Gran Sasso. All three consist of bare limestone, with some birch-trees on their eastern flanks, which rise steeply from the Adriatic Coastland (p. 385).

In this region the main watershed lies well inland of the highest chain, through which some longitudinal troughs are drained eastward. Thus in the north the Tronto (road 4) penetrates into the Amatrice (p. 321) basin, west of M. Gorzano. The Vomano (road 80) only just fails to cross the chain. The Aterno, on entering the Sulmona basin, collects the waters of the Sagittario and turns at right angles through the Popoli gorge (road 5 and railway) to reach the sea as the F. Pescara. Farther south the F. Sangro (secondary road and railway) follows much the same pattern. The valleys are narrow and steep-sided, but form the only means of communication between the coast and the interior.

### *Meta and Matese*

The massifs of the Meta and Matese, divided by the Volturno valley, continue the direction and limestone composition of Sabina towards the south-east. North-east of them lies the discontinuous depression, indicated by road 17, separating them from the sandstone Molise.

South of Marsica, and roughly delimited by the main roads from Sora to Caianello (82 and 6) and from Opi to Caianello (83,



17, and 85), is the comparatively small limestone mass of La Meta (30 by 20 miles), with a surprisingly large number of peaks over 6,500 feet. The mass contains two short, parallel, north-west to south-east ridges, one in the west (average height 2,500–3,000 ft.) rising to 5,476 feet in M. Cairo, separated by an indistinct depression (Fibreno–Mollarino–la Rava rivers) from the higher Mi. della Meta (7,352 ft.) in the east. The western ridge is a continuation of the Mi. Ernici, from which it is cut off by the valley of Liri; the eastern is continuous with the Marsica ridges. The whole has been deeply dissected by the F. Melfa, the F. Rapido, and smaller tributaries of the Liri. Typical limestone landforms are common and there are many dolines (p. 37). A notable one near Alvito has a swallow-hole at least 300 feet deep and a perimeter of over half a mile. To the south-east the height of the block diminishes as it falls to the transverse, but broad valley of the Volturno, south of which rises the Matese.

The Matese, a plateau roughly 28 miles long and 10 wide, with a general north-west to south-east trend, is composed of dolomite and limestone, much of which is similar to the Murge, M. Gargano, and Carso. The sides of the plateau rise from the valleys of the Volturno and Calore in white cliffs at the foot of which many springs break out. The Matese has a high outer rim, within which lies the higher ridge of M. Miletto (6,726 ft.), surrounded by a series of depressions. A typical depression is occupied by Lake Matese, which, surrounded by trees, stands at 3,304 feet and  $3\frac{1}{2}$  miles distant from Piedimonte d'Alife (p. 293), some 2,700 feet below. The area of the lake was normally just over one square mile, but has been increased to 2 square miles by closing the subterranean outlets (Plate 124). On the north-east the Matese is separated from the Molise by the Sannio depression, which contains the Tammaro valley, and the Boiano basin (1,650 ft.), where the Biferno collects its headwaters before flowing north-east to the Adriatic. These are joined by the two passes of Castelpetroso or Pettoranello (2,411 ft.; road 17) and Vinchiatturo (2,057 ft.; road 87) and form one passageway from the F. Volturno at Isernia to the F. Calore at Benevento. Communications over the plateau are very poor, but it is surrounded on all sides by main roads.

### *Molise*

The last division of the Central Apennines comprises Molise, Mi. del Sannio, and Mi. della Daunia. This region stretches south-east



of the Abruzzi Apennines and east of the Matese plateau, with the Molise in the north between the Sangro and Fortore valleys, the Mi. del Sannio to the south-east of Campobasso, and the Mi. della Daunia between the Fortore and Cervaro. In the south the Benevento gap formed by the Calore and Cervaro valleys makes a clear limit (p. 333).

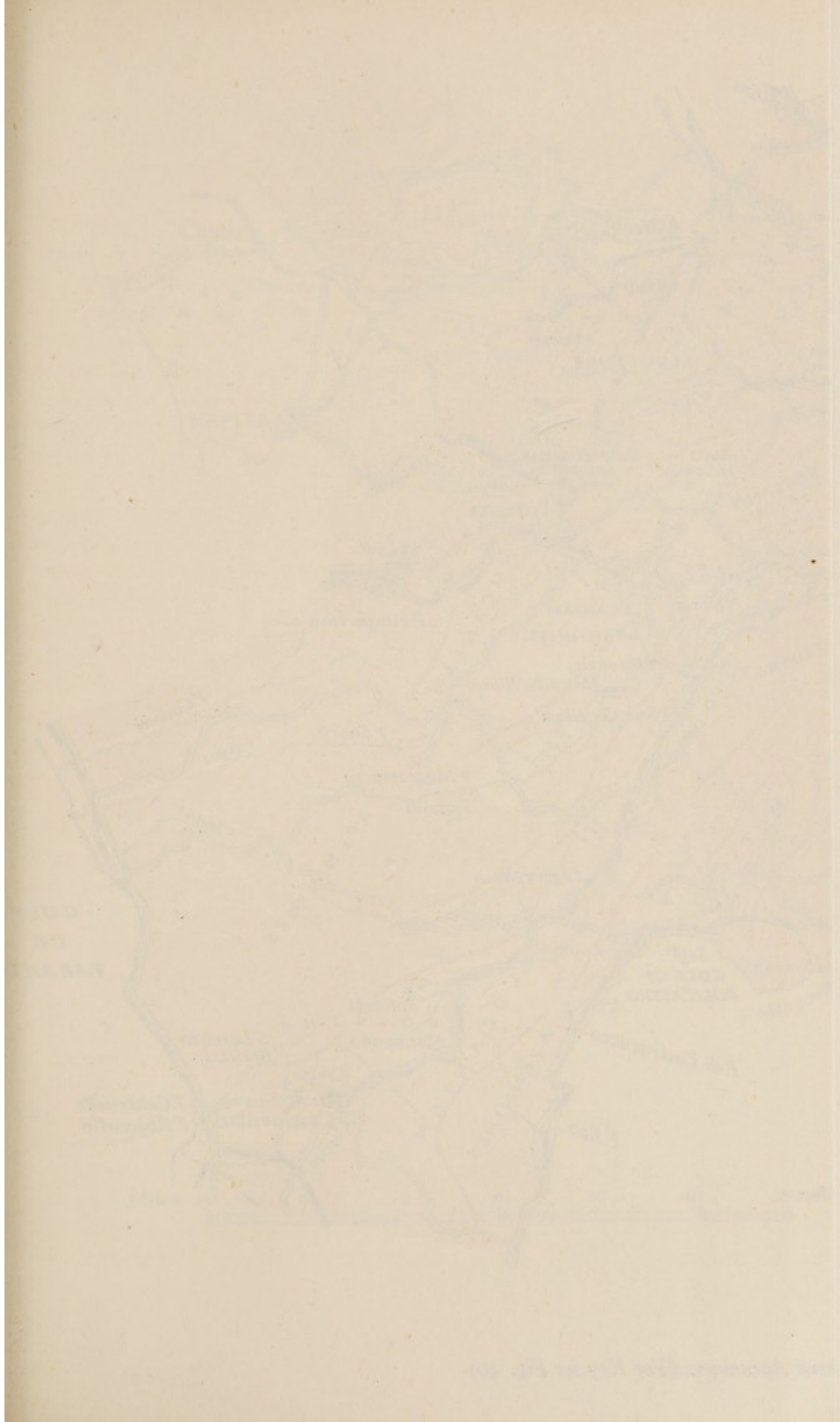
In contrast to the rest of the central plateaux, sandstones and marls predominate in this area. These have given rise to a wide, undulating plateau, 2,000–3,000 feet high, with somewhat higher peaks, M. Capraro (5,645 ft.) and La Montagnola (4,685 ft.), which show the characteristic direction of the Central Apennines. The outline of the country is far more gentle than north of the Sangro, although the sandstones, clays, and marls have been deeply dissected by streams. There are few trees in this hilly country, but the population is fairly dense. In spite of the penetration of the F. Biferno through the mountains into the Sannio depression, all the principal river valleys, including the Trigno, Biferno, and Fortore, are avoided by routes owing to the occurrence of landslips. The main roads and densest areas of population are on the higher ground between 2,500 and 3,500 feet. Roads 86, 87, and 17, as well as the Benevento–Vulturara road and Campobasso–Termoli railway, follow ridges. The Mi. del Sannio (M. Saraceno, 3,563 ft.) are very similar to Molise, with outcrops of clay-schists, laminated clay, and variegated clay, in all of which landslips are widespread. The Mi. della Daunia, which mark the extreme easterly and southerly limit of the Central Apennines, rise abruptly from the Tavoliere (p. 380) in the east to as much as 3,000 feet (M. Cornacchia, 3,776 ft.). The chain, which trends nearly north to south, is sufficiently high to restrict communications between the west and Foggia to one road (17) over the S. Antonio pass (2,592 ft.) and a road (90) and railway round its southern end through the Cervaro valley.

#### THE SOUTHERN APENNINES

(or CAMPANIAN AND LUCANIAN APENNINES)

The trough drained by the F. Calore, a tributary of the Volturno, together with the upper valley of the Cervaro form a convenient and not entirely arbitrary dividing line between the Central and Southern Apennines. This line coincides with the Benevento gap, the only well-defined break in the range north of Catanzaro, and forms one of the less difficult passages between the west and east coasts of the











Peninsula. The Southern Apennines extend southwards for about 120 miles to the low Scalone pass (2,441 ft.) and to the lower slopes of the high mass of Pollino, which overlooks the Crati Basin in Calabria. In width the region averages about 50 miles; on the north-west it is bounded by the plain of Campania (p. 293), but reaches the coast south of the gulf of Salerno; on the east, the often abrupt edge of the Apennines overlooks the Taranto-Tavoliere lowlands (p. 380).

*Physical Features.* The Southern Apennines consist entirely of dissected folds and intermontane basins with the general north-west to south-east trend of the range as a whole. They do not form a continuous mountain range, but a series of isolated masses and up-standing, oblong blocks of resistant limestone, alternating with younger marls and sands. Generally speaking, though the mountains are of only moderate elevation, heights increase southwards from the block of M. Taburno (4,570 ft.), west of Benevento, to the culminating point of Serra Dolcedorme (7,451 ft.), in the Pollino group. The majority of the higher peaks fall rather short of 6,000 feet, e.g. M. Terminio, M. Cervialto, Pizzo Palermo, and M. Sacro. All these are in the west of the region, in contrast to the high peaks of the Central Apennines, which are near the Adriatic coast. In the east, where younger and softer clays and sands have been eroded into comparatively long and narrow ridges, the country presents a gentler though often desolate appearance, and rarely exceeds 4,000 feet in height.

A line from Benevento south-eastwards to Potenza and thence to the mouth of the F. Crati broadly divides the west, where high, rugged, limestone blocks predominate, from the east, an area of unconsolidated Tertiary sands and clays and more recent sediments. Along this dividing line are scattered a number of depressions, such as the upper Calore and upper Ofanto (near S. Angelo de' Lombardi) valleys, and the basins of Muro Lucano and the upper Agri. In these depressions streams collect before draining either westward through narrow limestone valleys or eastward through broad troughs in the clays. The extinct volcano of M. Vulture (4,354 ft.), with its flat, wooded crater, is an alien feature among the surrounding clays and sands. It is the sole example of vulcanism on the eastern flank of the Apennines (p. 31).

In the west, dolomitic limestones, older than those of the Central Apennines, can be traced mainly along two discontinuous bands, one extending from the Sorrentine peninsula eastwards to M. Cervialto, the other southwards from Costa Squadro to the Scalone pass.



These rocks produce a particularly harsh and violent type of scenery, characterized by angular peaks and crests of fantastic shape and by precipitous ridges of bare rock. The chief material, however, of which the Campanian and western Lucanian Apennines are built is the younger and less rugged limestone of Cretaceous age. Where the limestone is pure and porous, the dry surface yields a mere vestige of soil and plant-covering. These features are present only in parts of the higher zones owing to bands of sandstone and other impermeable rocks, which constitute an important element even in the highest and boldest limestone country. A particularly good example of this mingling of rocks is to be found in the Cilento district (p. 335), where in the west gentle and smooth sandstone hills covered with a scrub of mastic trees and broom, contrast with the bleak and harsh limestone country in the south.

The south of Italy was extensively submerged by the Pliocene sea (p. 30).<sup>1</sup> Faulting and rifting accompanied the subsequent uplift of the land-surface, so that some areas became lake basins, such as the Vallo di Diano and the upper Agri basin. These are now partly filled with material derived from the surrounding mountains. Other, smaller basins in limestone country here and there form prominent topographical features, such as the enclosed Piano del Dragone in the northern Mi. Picentini. The chief significance of these basins is their effect on the communications in difficult mountainous country; they are not as agriculturally productive as similar basins in the Central Apennines.

Landslips are especially common in Lucania, where it has been calculated that rather more than 70 per cent. of the surface is menaced (p. 491). Hence it is common for roads to run along the crests of ridges and for villages to stand on hill-tops, where the surface is more stable. As a result, fantastic zigzags and narrow hairpin-bends mark the approach to many of the towns and villages, and notably to Potenza, the chief route-centre of the region. In some districts, as, for instance, south-east of M. Vulture and, farther south, in the Sinni valley, beds of laminated clay produce *calanchi* or 'badlands' (p. 491), though these are not so widespread as in the Northern Apennines. Earth tremors (p. 478) are common throughout this region and particularly in the district around Potenza. Between 1841 and 1857 about 12,000 people are stated to have lost their lives

<sup>1</sup> Near Ariano Irpino, east of Benevento, the Pliocene rocks at about 4,000 feet are clearly of marine origin, affording evidence of the former existence of a strait, now uplifted.



as the result of earthquakes; and, more recently, on 23 July 1930, as many as 25,000 persons are estimated to have been killed or injured and 10,000 houses destroyed in the district north-west of M. Vulture.

The rivers of the western and eastern parts of the Southern Apennines differ in both direction and regime. The western rivers, such as the F. Sele and its tributaries, make their way through longitudinal north-east to south-west valleys among the limestone ridges before breaking transversely through narrow valleys to the Tyrrhenian coast. The main watershed, which runs south-eastwards from near Ariano Irpino towards Potenza and then due south to M. Sirino, is, much of the way, well behind the main line of limestone peaks. The principal rivers, therefore, have cut right back through the limestones to the clays and sands, and this fact exercises a profound influence on communications, settlement, and human activity. In the east of the region, where younger and softer rocks compose a lower relief, a simpler drainage system prevails. North of M. Vulture the streams flow transversely to the Adriatic, but in the south-east they drain to the gulf of Taranto through broad, mainly longitudinal furrows between long ridges (p. 369).

All the rivers have a great range of volume (p. 51), and, although they may be dry for a large part of the year, are extremely vigorous after heavy rain. The western rivers, however, have their summer flow maintained by the water which is gradually released from the porous limestone. Each limestone block tends to produce its own independent regime. Surface water is scarce, and underground streams are common. The eastern rivers, draining impermeable districts, shrink during the summer to a mere trickle over stony or sandy beds.

The difficulties and imperfections of both road and rail communications are noteworthy. In the west they are largely due to the involved and rugged nature of the topography, in the east to the risk of landslides, the poverty of the region, and the sparseness of the population.

*Vegetation.* The vegetation varies according to height and soil. The flat, low-lying basins and valleys exhibit either closely cultivated mixed crops or poor pasture and cereal land. Mediterranean vegetation and crops extend far up the limestone slopes; the olive grows up to 2,500 feet in the Avellino basin. Chestnuts are comparatively uncommon, but forests of oak and beech are found particularly on the higher and more inaccessible parts of the western mountains



(Mi. Avella, Picentini, Marzano, Alburno, Pollino). Some fir and pinewoods grow on Pollino, the highest parts of which penetrate into the high mountain (alpine) zone. Snow covers the higher mountains during winter and continues into spring.

The eastern part of the region is less well forested, mainly with oaks. Vines and tree crops are also less common. Poor grazing and arable land cover most of the country except some of the less accessible areas which have escaped deforestation (e.g. the Bosco S. Domenica on the south side of the Basento valley, p. 341). The volcanic soils of M. Vulture with their forests and tree crops recall the vegetation of the richer parts of the Tyrrhenian coast.

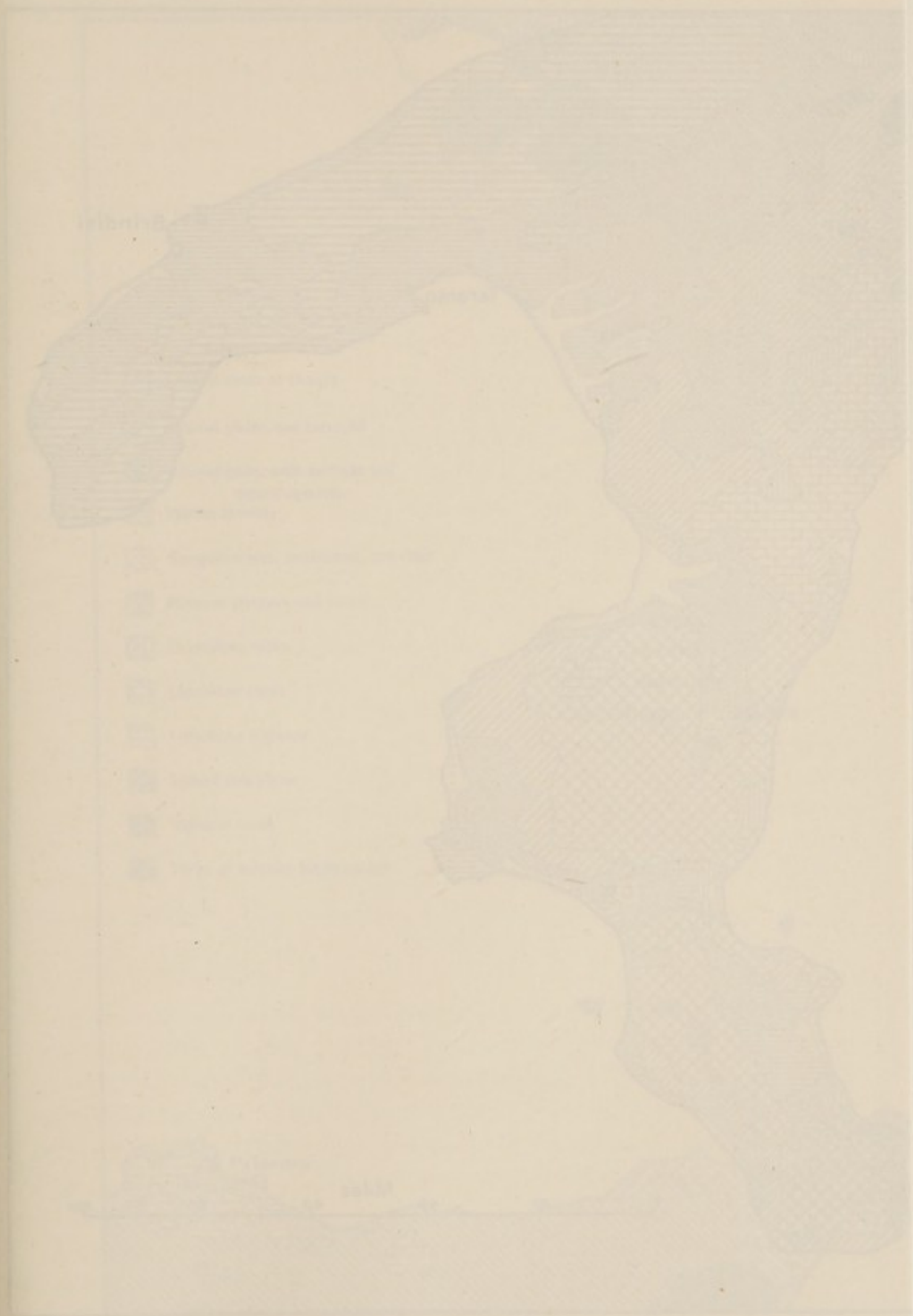
### *Subdivisions*

The two major subdivisions of the Southern Apennines in the west and east are broken up into a number of smaller units, mountain blocks, basins, and valleys. The western limestone ranges include (1) the Avella-Taburno highlands and (2) the Benevento basin in the north, separated by (3) the Avellino basin from (4) the Mi. Picentini. The F. Sele divides the latter from (5) the Marzano plateau on the east and from (6) the Cilento in the south. (7) The Vallo di Diano separates the Cilento from (8) the North Lucanian Apennines, within which lies (9) the upper Agri basin. In the extreme south the limestones terminate in (10) the South Lucanian Apennines. The eastern sand and clay area is divisible only into three: (11) the Neapolitan Apennines, separated by (12) M. Vulture from (13) the East Lucanian Apennines.

### *The Avella-Taburno Highlands*

The Avella-Taburno highlands consist of a number of dissected limestone masses and ridges set in lower clays, sands, and volcanic ash. Immediately behind the plain of Campania rises a barrier of steep hills, stretching for 40 miles from the Volturno valley near Capua in the north-west to the valley followed by the Nocera-S. Severino-Avellino road in the south-east. This barrier is cut into four main blocks of hills by important gaps followed by roads or railways. The north-westernmost block, M. Tifata, is an isolated peak rising to 1,982 feet. It is separated by a narrow valley (road 87) from the barren heights of M. Virgo (2,034 ft.), which has thickly populated foothills above the plain of Campania. This block is divided by a low col (less than 500 ft.; main Naples-Benevento railway) from M. Saucolo (2,520 ft.), a similar mass. South of the





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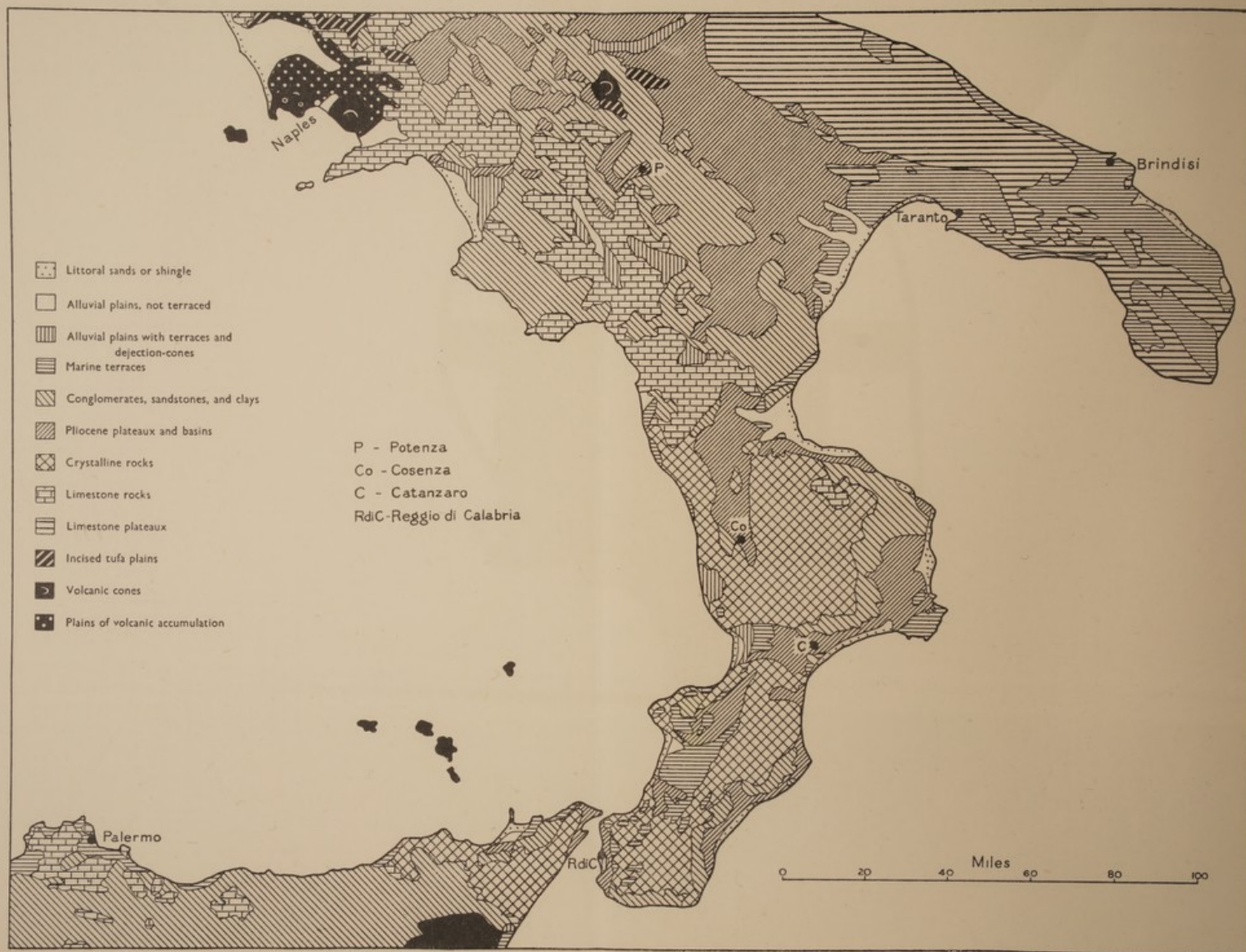


FIG. 54. Landform types: Southern Italy



important defile of the Forche Caudine (Caudine Forks, alt. 902 ft., road 7; traditional site of the famous battle) the hills are higher and more wooded. The high, narrow ridge of the Mi. Avella (Acerone di Avella, 5,220 ft.) stretches without a break for 17 miles to the neighbourhood of Avellino. To the south of the col (alt. 2,074 ft.) followed by road 7-*bis*, the mountainous limestone surface becomes more broken and uneven, with blocks and ridges trending north-west to south-east, and rising in the Mi. del Sarno (Pizzo d'Alvano) to 3,710 feet. These ridges are separated by small basins and valleys, some of which are filled with volcanic ash. The most notable of these is followed by the road and railway between S. Severino Rota and Nocera.

The limestone barrier is bounded on the east by the wide basin of Limatola below the confluence of the Volturno and Calore, the narrow Isclero valley, the small, flat basin of Montesarchio (5½ miles long, 3 miles wide, alt. 850 ft.), and the Avellino basin. The basins, which are floored mainly with Pliocene deposits enriched with volcanic ash, are well cultivated. To the north-east rise the steep, bare sides of the flat-topped limestone masses of M. Taburno (4,570 ft.) and the adjacent Camposauro (4,554 ft.), which occupy the northward bulge of the F. Calore. The vine-clad valley of this river limits the region on the north and separates it from the Matese plateau.

Several main roads pass from Naples through the natural gaps offered by this broken country. The important road 7 (Via Appia) and the secondary railway from Naples to Benevento, cross the highlands by the Forche Caudine, the Montesarchio basin, and the Corvo valley, in preference to the more roundabout Calore valley (road 87 and the main railway).

### *The Benevento Basin*

The Benevento Basin, to the east of the Avella-Taburno highlands, is a relatively low-lying area at the junction of limestones and clays. It lies between the Sabato and Calore valleys, and has Pliocene soils yielding vines, olives, wheat, and maize. The majority of settlements are on the rising ground to the south at heights of approximately 1,300 to 2,000 feet. The hill-slopes are clad with thickets of hazel and groves of chestnut.

The ancient town of Benevento stands on a hill, 443 feet high, on the south bank of the F. Calore at the confluence of the F. Sabato. It commands the one relatively easy west to east line of communication from Naples to the Adriatic coast and is an



important route-centre. From the west alternative routes by the Caudine Forks and the Calore valley converge. To the east the railway follows the river upstream and tunnels through the Neapolitan Apennines to the Cervaro valley. The roads, on the other hand, change at Benevento from valley to ridge lines.

### *The Avellino Basin*

The Avellino Basin ( $5\frac{1}{2}$  miles long, 4 miles wide; alt. 1,150 ft.) is cut off from the plain of Campania by the Mi. del Sarno and drains north by the narrow Sabato valley (main Avellino-Benevento road) to Benevento. The floor of the basin is composed of clays and volcanic material, largely planted with vines, whilst oaks, beech, and Judas trees clothe the slopes. A ring of villages surrounds the basin at the foot of the steep, encircling hills, which rise, except on the north, to over 4,600 feet. The town of Avellino, near the centre of the basin, is an important road and railway junction.

### *The Monti Picentini*

South-east of Avellino the Mi. Picentini extend as far as the F. Sele, and are separated from the long spur of the Sorrentine peninsula by the valley between S. Severino Rota and Salerno. This valley coincides with a fault which forms part of a line of weakness marked farther north by the Sabato valley and Avellino basin. Besides affording an important routeway (road 88 and railway) this valley is thickly populated. The Mi. Picentini constitute an outstanding barrier of massive blocks and confused ridges of limestone, everywhere over 2,000 feet high. Several summits exceed 5,000 feet, e.g. M. Terminio 5,860 feet, in the north, the precipitous peak of M. Cervialto, 5,936 feet, in the north-east, and M. Polveracchio, 5,873 feet, in the south. Numerous small basins (e.g. Piano del Dragone, alt. 2,125 ft.; 3 miles long, 2 miles wide) are scattered in and around these mountains. There is little surface water and the whole area is practically deserted. Although beechwoods cover much of the mountains, the highest zones are bleak and barren, and especially inhospitable in winter when capped with snow. On the north-western and north-eastern sides a series of lower areas form the gathering grounds for the headstreams of the Sabato, Calore, and Ofanto. On the northern slopes of M. Cervialto the F. Sele rises in springs near Caposele, where water is collected for the great aqueduct<sup>1</sup> which serves Apulia. The conduit pierces the

<sup>1</sup> The work of construction, begun in 1906, was finally completed in the autumn of 1939.



watershed to the north-east of Caposele by a tunnel about 9 miles long and continues in the same north-east direction to beyond Spinazzola in Apulia (p. 366). This fertile, upper valley of the Sele between the Mi. Picentini and M. Marzano is wooded and grows irrigated crops. It is eight times more densely populated than the lower Sele plain (p. 299). The Conza pass (2,297 ft.; road 91) leads to the valley of the F. Ofanto.

### *The Marzano Plateau*

The Marzano Plateau, a broad, tabular limestone block more than 3,000 feet high (M. Marzano, 5,020 ft.), extends east of the upper valley of the F. Sele to the T. Platano. Its steep, southern slopes lead down to two, small limestone basins, the Alveo del Lago di Palo and the Pantano S. Gregorio. To the north-east the T. Platano collects the drainage of a wide area in the impermeable and relatively low-lying basin of Muro Lucano (between Muro Lucano and Avigliano; Plate 125) before it cuts through the narrow gorge of Romagnano (Naples-Potenza railway) between M. Marzano and la Rotonda, at the northern end of the North Lucanian Apennines (p. 337). The basin is limited on the north-east by the ridge of Costa Squadro (4,403 ft.) and M. S. Croce (4,675 ft.) which is here the main watershed. The Platano usually has a small flow, but becomes remarkably swollen after heavy rain.

### *The Cilento*

The Apennines come down to the west coast in the hilly mass of the Cilento. This extends between the gulfs of Salerno and Policastro and inland for 26 miles to the Vallo di Diano, which separates it from the main range of the Lucanian Apennines. The Cilento contains a number of north-west to south-east limestone or sandstone ridges, with intervening longitudinal valleys. The crests of the ridges, particularly of the central ridge, are long and narrow with wooded slopes, which fall steeply to both south-west and north-east. The country generally is much broken by numerous streams which drain north to the F. Sele or south to the coast (p. 97; Plate 126).

The coast of the Cilento is varied and beautiful with vigorous olive trees. In the extreme west the sandstone block of M. della Stella is almost isolated by the Alento valley (main west coast road (18) and railway), which widens near its mouth to a small coastal plain. Behind this valley and the comparatively low country



around the town of Vallo di Lucania (1,263 ft.), a second, central line of short ridges and peaks, mostly of limestone rising above the basic sandstone, stretches from M. Vesole (3,937 ft.) to M. Sacro (5,593 ft.). It is continued beyond the Mingardo valley by the outlying limestone M. Bulgheria (4,019 ft.), spurs of which end abruptly in steep cliffs east of Cape Palinuro. The main road avoids the coast throughout, and the railway follows it only for a short distance before turning eastward through the col to the north of M. Bulgheria.

These western ridges and peaks are in turn divided by parts of the valleys of the Lucanian Calore, T. Pruno, and F. Bussento from an eastern line of limestone hills including the massive block of M. Alburno (Pizzo Palermo, 5,716 ft.) in the north and M. Cervati (6,231 ft.), the highest peak of the Cilento, in the east. The imposing tabular limestone mass of M. Alburno, 15 miles in length, between 5 and 6 miles in breadth and averaging more than 3,000 feet in height, rises from the deep lower valley of the Lucanian Calore. The northern edge is steep and jagged, with vast clefts and terraces. The slopes are gentler on the southern side. Chestnuts and oaks clothe the lower slopes, and the undulating surface is also partly wooded. Surface water is, generally speaking, scarce, but the higher parts are snow-covered for much of the year. Where springs emerge at the base a number of settlements have arisen, e.g. Castelvita. Much of the subterranean drainage of M. Cervati collects in the upper valley of the F. Bussento, which itself drains partly below ground to the gulf of Policastro.

### *The Vallo di Diano*

The Vallo di Diano (23 miles long, 3 miles wide; alt. 1,475 ft.) forms the boundary between the Cilento and the North Lucanian Apennines. This longitudinal depression is drained by the T. Tanagro, which is the main tributary of the F. Sele and rises on the northern flank of M. Cervaro (3,836 ft.), only 13 miles distant from the gulf of Policastro. The approach to the northern end of the Vallo di Diano from the F. Sele (road 19) is difficult owing to the narrowness and depth of the gorge of the lower Tanagro. After heavy rain the river flows swiftly, especially for the 3 miles above Pertosa where the gradient averages 1 in 20. In the dry season the river in the section between Pertosa and Polla flows underground. The Vallo di Diano, the site of a former lake, lies between parallel faults and is still subject to earthquakes (p. 485). The impervious sands and clays lining the valley-floor are a handicap to drainage,





PLATE 123. *Tivoli: the Falls and travertine outcrops*



PLATE 124. *Lake Matese and M. Miletto*





PLATE 125. *Muro Lucano above a limestone gorge entering the basin*



PLATE 126. *The Cilento mountains from Paestum*



hence some of the surface tends to be marshy in spite of reclamation. Where this has been successful the land has proved fertile and there are vineyards scattered along the lower slopes. The population, nevertheless, remains small. The rim of the basin is marked by a number of highly dissected gravel terraces. On the drier slopes, at about 500 feet above the valley floor, a number of settlements are to be found, the largest of which is Sala Consilina (2,014 ft.). Both railway and road (19) follow the Tanagro gorge and valley towards Calabria.

### *The North Lucanian Apennines*

The North Lucanian Apennines line the north-east side of the Tanagro valley and extend 30 miles from the Platano gorge at Romagnano south-eastwards to the road (103) linking the Vallo di Diano with the gulf of Taranto. On the east they approach close to Potenza and include M. Volturino. The narrow but deep longitudinal valley of the Bianco-Melandro stream and the upper Agri basin divide the region into two unequal parts, west and east.

The western section consists of a bare, steep-sided limestone ridge, exceeding 3,000 feet in height, and trending south-east through M. Sierio (4,219 ft.) to Lo Serrone (4,928 ft.). Its dry, rugged surface is in bold contrast to the well watered, low-lying Vallo di Diano. From Atena Lucana (2,107 ft.), on the east side of the Vallo di Diano, a railway and road (95) climb tortuously across the ridge to the small Brienza (2,339 ft.) basin, the widest and most fertile part of the Bianco-Melandro depression. A col (3,074 ft.) followed by both railway and road connects this depression with the upper Agri basin.

The broader, eastern part is composed of narrow, dissected but more scattered limestone ridges and claylands, the general orientation of which is from north-west to south-east. The altitudes rise southwards from la Rotonda (4,068 ft.) and M. li Foi di Picerno (4,429 ft.) to M. Maruggio (5,174 ft.), whence streams radiate in all directions, and M. Volturino (6,024 ft.). This region, like the western, is sparsely populated, and contains only small and widely scattered villages. Two main roads (94, 95) cross the grain of the country and meet just west of the important saddle of S. Aloia (2,789 ft.; immediately to the south of M. li Foi di Picerno), which is also crossed by the railway from the Romagnano gorge to Potenza.

### *The Upper Agri Basin*

The Upper Agri Basin (15 miles long, 3 or 4 miles wide; alt. 1,850 ft.) intervenes between the two parts of the north Lucanian



Apennines. The basin, which is probably Pleistocene in age and has a flat floor of lacustrine clay and marl, is partly wooded and partly planted with vineyards. As in the Vallo di Diano (p. 336), the few villages are not in the valley itself but near the foot of the surrounding slopes. Marsico Nuovo, connected with Brienza by road and rail, guards the western end of the basin. Near the eastern end road 103 crosses the basin at right angles. Still farther east, at a point where the valley narrows considerably, the two towns of Spinoso (2,156 ft.) and Montemurro (2,273 ft.) occupy corresponding positions high up on either side of the river.

### *The South Lucanian Apennines*

To the south of the F. Agri the South Lucanian Apennines are composed of dissected ridges of old Triassic limestone, in part overlaid by more recent limestones (p. 26). These ridges, whose lower slopes are clothed with patches of beech-wood, are arranged in two more or less parallel north-west to south-east bands. The more westerly band is a continuation of the eastern Alburno-Cervati ridge of the Cilento from Serralunga (4,866 ft.), behind the coastal town of Sapri, to Cozzo Pellegrino (6,516 ft.) and Montea (5,850 ft.), and still farther south to the crystalline Catena Costiera of Calabria. The other continues the line of the north Lucanian Apennines and carries the watershed from M. Sirino (6,578 ft.) through M. la Spina (5,411 ft.) to Pollino (Serra Dolcedorme, 7,451 ft.). These two ridges are separated by an irregular depression, through which runs the road from Naples to Castrovillari (19).

South-east of the tiny, fertile coastal plain of Sapri, mountains rise steeply and steadily inland from the cliff-bound shore up to the Serralunga-Montea ridge. This is broken only by the Castro-cucco and Lao valleys and incised by canyon-like ravines, which, south of the Lao, are thickly wooded. The slope is modified to some extent by a narrow, discontinuous terrace, varying from 165 to 265 feet above sea-level, as well as by small remains of higher terraces. The road (18) and railway to Calabria follow the coast with difficulty. The main road (104) across the ridge avoids the Castro-cucco valley and climbs to over 2,000 feet behind Sapri (p. 101).

The irregular depression behind the coastal ridge is drained by the upper courses and tributaries of the F. Noce-Castrocucco and F. Lao, and includes a number of disconnected basins and small high plains (*campi*). In the north the dissected basin of Lauria (1,000 ft.) has an arm extending northwards along the river to Lagonegro, but is



only skirted by the main road. This basin grows irrigated tree crops, including citrus fruit (Plate 127). South-east of Lauria, separated by a pass (3,166 ft.), is the small, flat, limestone basin of the Campo del Galdo (2,360 ft.) which tends to be marshy near the centre. The large basin of Rotonda (about 6 miles across) is much incised by the headwaters of the Lao, and has extensions towards the east into the Sirino-Pollino ridge and in the south to Mormanno. Thence the line is continued south-eastward through the flat Campo Tenese (3,120 ft.), which has no surface outlet, the tiny Morano Calabro basin (2,133 ft.; Plate 128), and the Coscile valley to Castrovillari. Road 19 and a narrow-gauge railway, alternatives to the coastal routes, wind their way from one basin to another. The final descent to Castrovillari is very steep.

East of the basins of Lauria and Rotonda, scrub-covered slopes rise steeply to the gullies and scree of the Sirino-Spina-Pollino ridge, which is partly composed of dolomite. To the east of M. Sirino (6,578 ft.) high, deserted country with limestone peaks extends to M. Raparo (5,777 ft.) and the F. Agri. South of M. Sirino a low pass (c. 2,800 ft.; road 104) leads from the Lauria basin to the Sinni valley. South-east of Rotonda the surface gradually rises to the confused limestone-mass of Pollino with its series of bare, precipitous ridges, steep, narrow gorges, and high, flat, basin-like valleys where meadow-covered floors are sheltered by beech woods. The steep southern slopes between the Cupola di Paolo (6,263 ft.) and La Manfria (6,499 ft.) appear from Castrovillari as a great, bare wall rising out of a vast forest. For half the year the Serra Dolcedorme (7,451 ft.) is covered with snow, which lingers in hollows throughout the summer. The northern slopes of M. Pollino, Serra Dolcedorme, and M. Ciavola in the coastal ridge (4,293 ft.) bear traces of glaciation in cirques and morainic deposits.

East of Dolcedorme and La Manfria is a large basin-like area of clays around S. Lorenzo Bellizzi (2,726 ft.), a village constantly threatened with landslides. In the centre of this basin the limestone precipices of the south-western side of Tempa di Conca (6,086 ft.) tower more than 3,000 feet above the gorge of the T. Raganello. A southerly continuation of this spectacular gorge extends downstream between sheer limestone walls from S. Lorenzo to Civita. East of this gorge M. Sellari (4,722 ft.), dominating the T. Caldanelle, marks the eastern limit of the limestone ridges, beyond which Tertiary sandstone mountains descend in steps to the gulf of Taranto.



*The Neapolitan Apennines*

To the east of the F. Calore and north of the Mi. Picentini, the Neapolitan Apennines continue the sands and clays of the Molise (p. 328) as far south as the F. Ofanto. This rounded, hilly country, rising above the Tavoliere (p. 380) on the east, does not in general exceed 2,000 feet, though M. Crispiniano rises to 3,625 feet and M. Trevico to 3,576 feet. The rivers Cervaro, Calaggio-Carapelle, and Ofanto flow eastwards to the Adriatic in deep and mostly straight valleys. In summer these rivers practically cease to flow, but in winter, owing to the rapidity of the run-off, they become torrential, and the soft rocks yield a heavy load of debris. The valley of the T. Cervaro, straight, narrow, and steep-sided, is followed by the Naples-Foggia road (90) and railway which cross the watershed near Ariano Irpino (2,680 ft.), a town which has grown up on a narrow ridge of Pliocene sands. On each side of the valley there is a line of villages at about 2,500 feet, among which the town of Bovino, over 1,000 feet above the valley floor, commands the narrow passage known as the Vallo di Bovino.

South of Ariano the F. Ufita, F. Calaggio, and other streams have dissected the country into long, low ridges. Roads and settlements follow the tops of these ridges to avoid the landslips which are common here and farther south. The Ofanto, which rises near the Calore in a basin-like area between M. Cervialto and S. Angelo de' Lombardi, has cut a deep trough in the soft clays. Its middle course, however, appears to have been deflected to the north by lava-flows from M. Vulture. Here low, tabular spurs come down to the west of the valley and the broken undulating volcanic surface on the east is furrowed by streams draining direct to the Ofanto or south to the narrow gorge of the tributary Fiumara d'Atella. Save for the railway, the valley of the Ofanto is practically deserted and the population confined to scattered settlements along its upper edges at heights of 2,000-3,000 feet.

*M. Vulture*

Around the flat cone of M. Vulture (4,354 ft.), which has not erupted in historic times, volcanic rocks occupy a small area east of the northward bend of the F. Ofanto. The outer crater is dissected by radial streams, and the two small, picturesque lakes of Monticchio mark the double crater of the inner cone. The slopes of the mountain are clothed with forests of beech and oak. On the rich, volcanic





PLATE 127. *Lauria on the edge of its fertile basin: view south-east along the irregular depression followed by road 19*

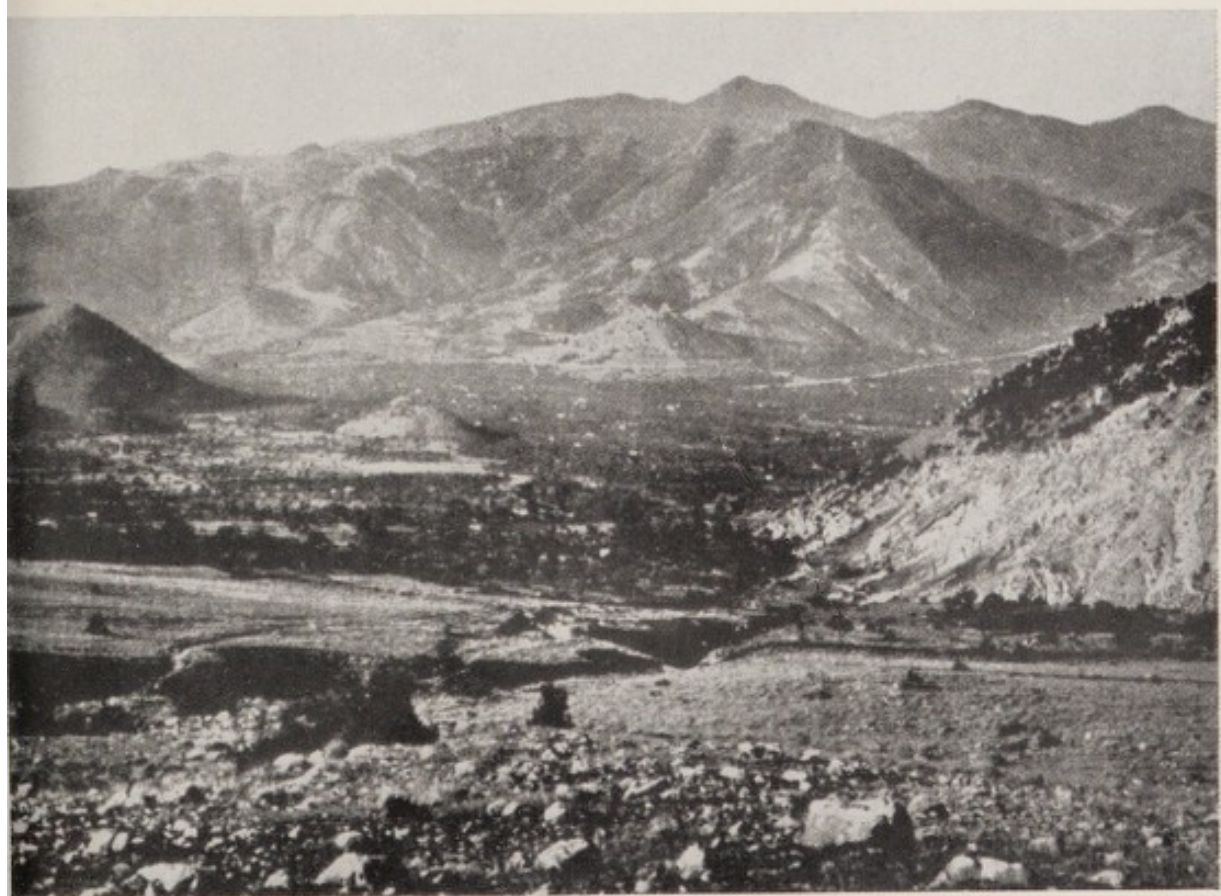


PLATE 128. *The basin of Morano Calabro and M. Caramolo*





PLATE 129. *The Sinni valley near Episcopia*

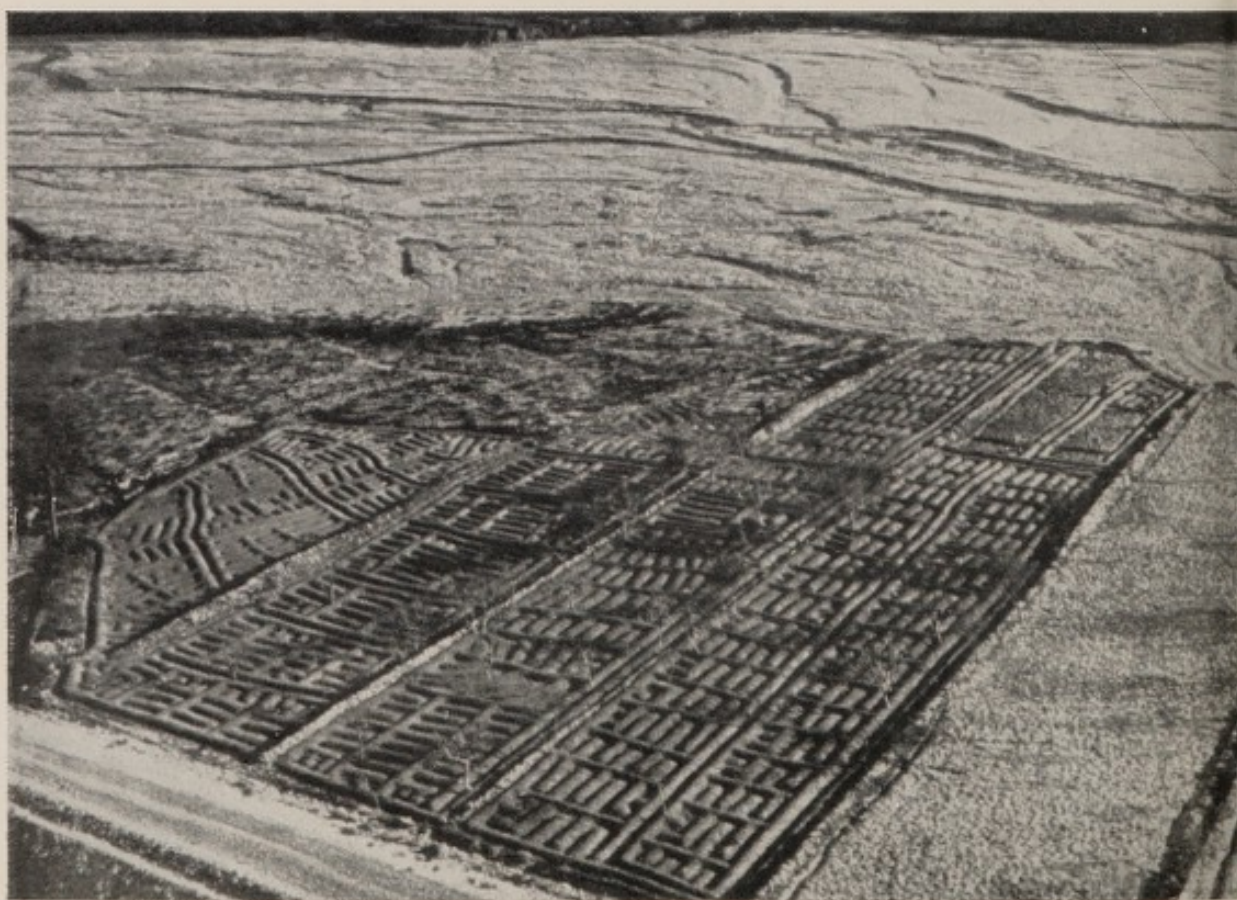


PLATE 130. *An irrigated patch in the bed of the T. Turbido*



soils towards Melfi on the north and Venosa on the east vineyards, olive groves, and luxuriant chestnut trees abound. The population is relatively dense. Melfi, a small town trading in wine and oil, was ruined by the earthquake of 1851, but has since been rebuilt.

### *The East Lucanian Apennines*

The east Lucanian Apennines extend south-east of the upper Ofanto and of M. Vulture. The sandy marls and clays which reappear south-east of Melfi are in distressing contrast with the fertile volcanic soils of M. Vulture. Forests have been ruthlessly destroyed and soil erosion has continued without hindrance. To-day the whole stretch of dissected plateau-like country as far as Potenza is poor and deserted. The denuded slopes support a population barely exceeding 130 to the square mile, and falling in some clay districts to as little as 18 per square mile. The Bradano, Basento, Sauro, Agri, and Sinni rivers drive their broad, steep-sided valleys through the country towards the lower, tabular lands of the Taranto-Tavoliere corridor, on entering which they turn south-east to the sea. Of these valleys the Basento is the most important, as it is followed by the main railway from Naples to Taranto. All the roads keep to the ridges or the upper edges of the valleys, where the villages are also found, perhaps as much as 1,000 to 1,300 feet above the streams. The Bradano and Basento flow in broad, flat-bottomed valleys lined by a distinct flood-plain. The Sauro, Agri, and Sinni valleys have occasional narrow sections, but normally their floors are completely occupied by the broad courses of the rivers with their multiple channels (Plate 129).

Seven miles from the source of the Basento, Potenza (2,700 ft.) occupies a commanding position near the watershed on a patch of Pliocene sandstone 720 feet above the river. The town is one of the largest route-centres for roads and railways. Seven main roads, which keep with difficulty to the ridges, and four railways converge on the town. The Basento valley here has uniform slopes of compactly folded beds of shale and sandstone. Near Albano di Lucania, however, about 12 miles to the east of Potenza, the river cuts through a ridge of harder sandstone in a narrow gorge amid rocks of bizarre and fantastic shapes, clothed with gnarled, deciduous trees. This ridge continues south to the T. Sauro and rises to 4,298 feet near Pietrapertosa. East of Albano the Bosco S. Domenica, one of the best forest and game preserves of south Italy, covers the south side of the valley. Elsewhere the valley sides, along which



there are a few scattered settlements, afford rough grazing land for sheep and goats.

South of the upper basin of the F. Basento, the sandy-clay ridges have been dissected by longitudinal streams draining to the T. Sauro, the chief tributary of the F. Agri. To the south of the Sauro, steep, dissected slopes from Tempa Candore (2,953 ft.) lead down to the middle valley of the F. Agri, which, after leaving its upper Pleistocene basin (p. 337), has a peculiarly deserted valley, marshy in winter, and without road, railway, or settlement. Farther to the south almost the whole of the Sinni basin is composed of Tertiary sands and clays. Here the laminated clays give rise to calanchi (p. 489). The soil is unproductive and the population density low.

## CALABRIA

THE Calabrian peninsula, often referred to as the 'toe' of Italy, consists almost exclusively of the southern continuation of the Apennine range. The mountains, however, differ from any of the others in the country, except for the Mi. Peloritani, just across the Straits of Messina. Unlike the continuous chains in the soft rocks of the Northern Apennines, or the rugged limestone blocks of the centre and south, the Calabrian Apennines consist of a series of impermeable, crystalline rock-masses, formed of rolling plateaux or peneplains (p. 36), up to about 3,000 feet above sea-level, with very steep, faulted sides. In these hard rock-masses the powerful erosion of the streams has only begun to gash the edges with deep ravines and gorges, and has left the central parts of the plateaux unaffected. In between and surrounding these massifs comparatively narrow strips of quite recent (mainly Pliocene and Pleistocene) soft sands, clays, and gravels occupy a coastal strip on the east, and the downfaulted depressions elsewhere.

The general direction of the Calabrian mountains is almost exactly north to south with a slight eastward bulge. This alinement is transitional between the north-west to south-east of the Southern Apennines and the east to west of the northern Sicilian highlands. It is not, however, followed by the trends of the component mountain chains or blocks, most of which scarcely have any definite trend at all. The relation between relief and folding, notable in the Northern Apennines, but gradually diminishing in the Central and Southern Apennines, disappears in Calabria, where the influence of fault lines



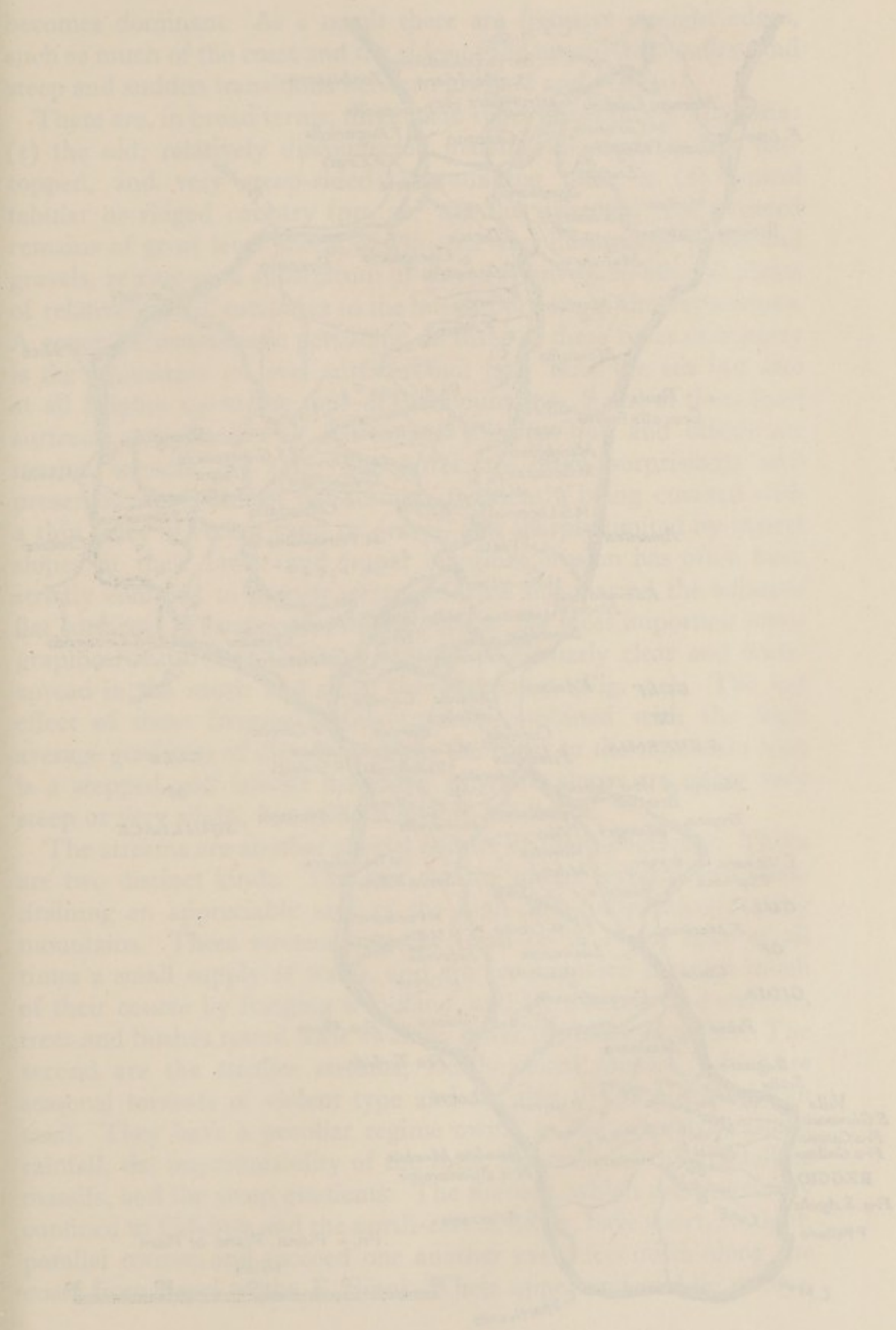


Fig. 15. Cistus (No. 100 in Fig. 10)







becomes dominant. As a result there are frequent straight edges, such as much of the coast and the sides of the upper Crati valley, and steep and sudden transitions between lowland and plateau.

There are, in broad terms, three main types of country in Calabria: (1) the old, relatively disconnected massifs, all more or less flat-topped, and very steep-sided; surrounding these is (2) typical tabular or ridged country (pp. 30, 36), the dissected and terraced remains of great level sheets of Pliocene and Pleistocene sands and gravels, resting on a substratum of clay; (3) low-lying alluvial plains of relatively small total area in the lowest portions of the depressions. A general characteristic pervading all three of these types of country is the abundance of level surfaces, not only near the sea but also at all heights up to the tops of the mountains. Some of these level surfaces are plateaux or flat-topped hills (p. 36), and others are marine terraces (p. 35). The latter are often surprisingly well preserved, their almost flat surfaces frequently being covered with a thin layer of recent sand or gravel, and sharply limited by abrupt slopes at their lower and upper margins; erosion has often been strictly confined to narrow gorges and has not marred the adjacent flat surfaces. Terraces are, indeed, one of the most important topographical features of Calabria and are particularly clear and widespread in the south and along the west coast (Fig. 54). The net effect of these frequent level surfaces combined with the high average gradients of the ascent from the coast to the mountain tops is a stepped and tabular landscape in which slopes are either very steep or very slight, but seldom merely moderate.

The streams are another special feature of the topography. There are two distinct kinds. The first are the longer streams and those draining an appreciable area of the high and comparatively rainy mountains. These streams (e.g. F. Crati or F. Neto) have at all times a small supply of water, and are accompanied through much of their course by fringing woodland, and by thickets of deciduous trees and bushes round their swampy lower courses and deltas. The second are the smaller streams, locally called *fumare*, which are seasonal torrents of violent type and are akin to the north African *wadi*. They have a peculiar regime owing to the severely seasonal rainfall, the impermeability of the rock, especially of the crystalline massifs, and the steep gradients. The *fumare*, which are practically confined to Calabria and the north-east of Sicily, have short, straight, parallel courses and succeed one another every few miles along the coast from Sapri to the F. Sinni. Their upper and middle valleys,



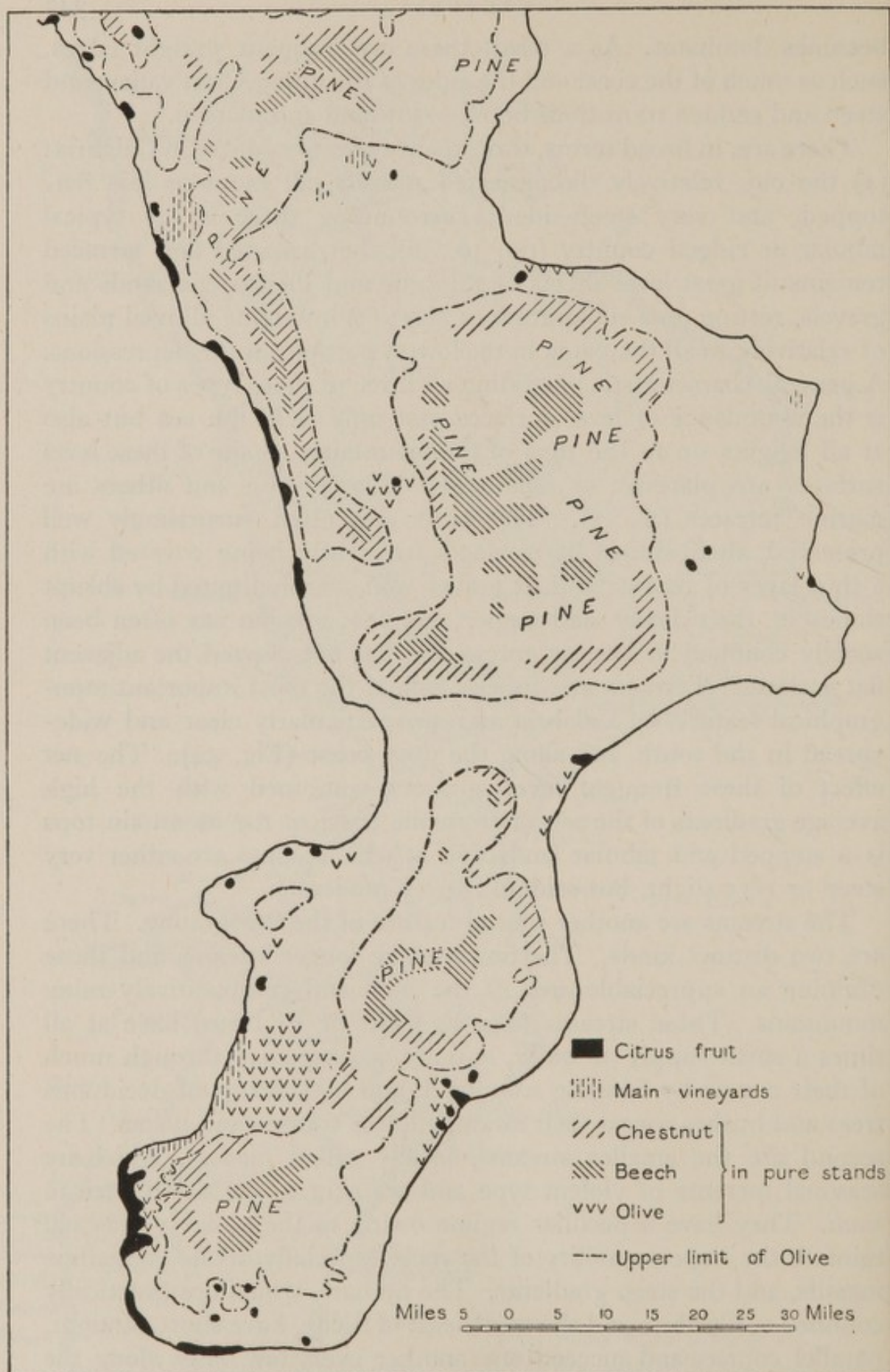


FIG. 56. Calabria: Vegetation



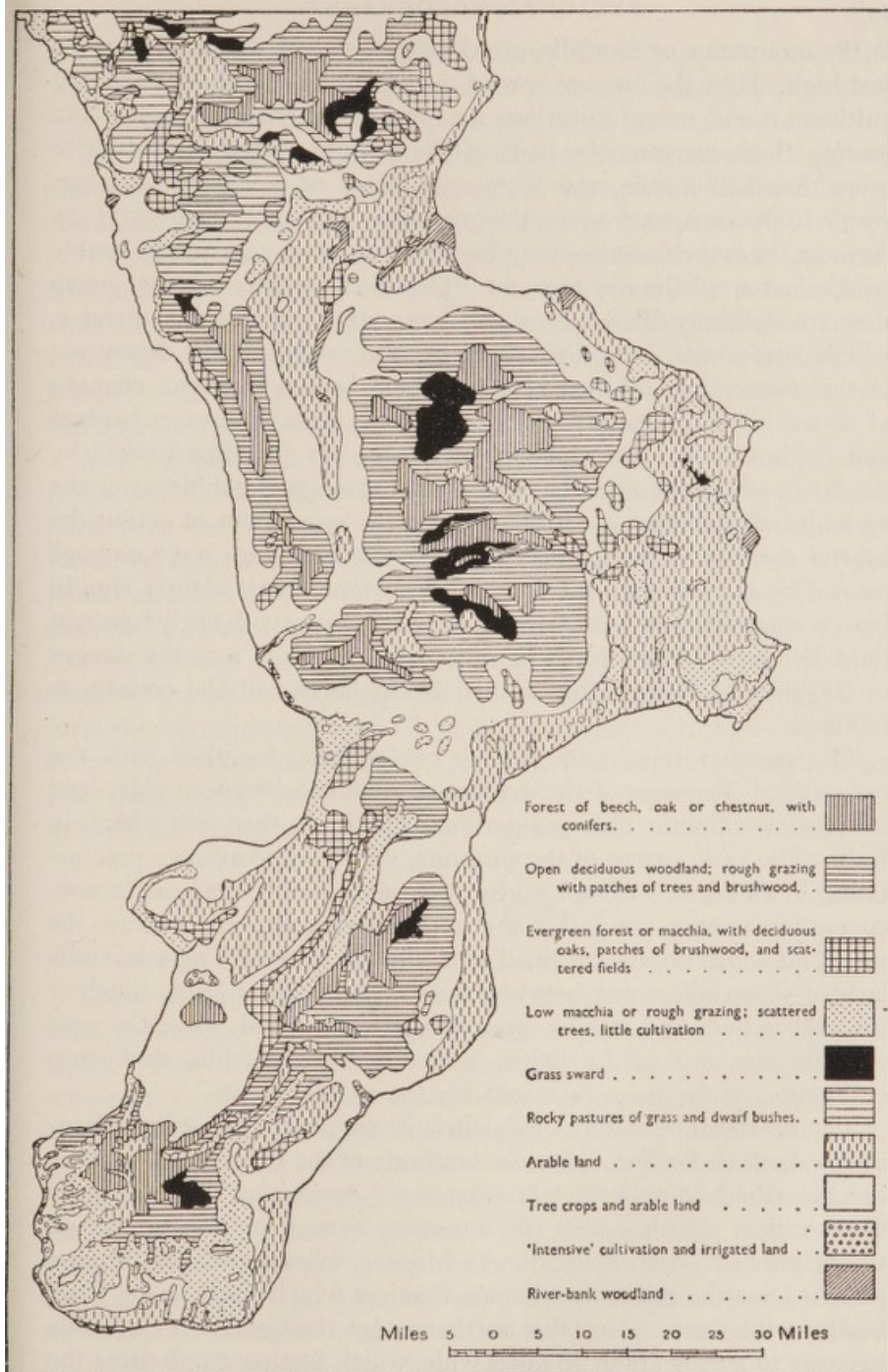


FIG. 57. Calabria: Vegetation



in the mountains or foothills, are deep gorges with walls up to 1,600 feet high. Here the *fiumare* spread over the whole valley floor so that cultivation and communications are pushed up the steep sides. On leaving these canyons the beds of the streams widen out, often to more than half a mile, and form vast bands of dry pebbles, great, white, lifeless stripes crossing the green coastal plain (Plates 130, 132). At most times the *fiumare* are quite dry, or in winter carry a miserable trickle lost amid the dry channels. Occasionally after a heavy storm they are suddenly filled for a short time with a raging mass of water, which carries with it prodigious quantities of debris. The deposition of this material in the bed of the *fiumara* causes frequent changes of course over the coastal plain. Retaining walls to protect bridges and fields line the sides of many *fiumare*, but are often broken by the flood, which spreads a layer of infertile sand and pebbles over the agricultural land and is very apt to destroy or put out of action the coastal road and railway. Owing to the sudden and grave damage caused by the torrents it is highly important that Calabria should have coastal roads on both the east and on the west with fairly frequent links between them across the mountains. In this way the danger of Reggio and Sicily being cut off from the rest of the country is reduced.

The peculiar relief and geology of Calabria, together with the exceptional steepness of the average slope on the western side, lead to greater climatic and vegetational contrasts than elsewhere in Italy. The wide spaces of the summits, which receive heavy precipitation in all seasons except midsummer and are continuously snow-covered in winter, are within the beechwood zone. In contrast the west and south coasts are lined with orange groves. There is, similarly, a sharp difference between the east and west coasts; much of the east is bare and treeless grazing and arable land, while the west exhibits the typical intensive, mixed tree, vegetable, and crop cultivation of the most favoured Mediterranean coasts.

The northern boundary of Calabria is marked by the steep, 6,500-foot wall of M. Pollino, the most southerly of the Lucanian limestone blocks, which dominates the east-west depression of the lower Crati valley. Farther west the limestone barrier continues through the heights of Cozzo Pellegrino to Montea, where, near the Scalone pass, it joins the crystalline Catena Costiera which shuts in the Crati basin on the west. Along this northern edge the Calabrian peninsula narrows to a neck about 30 miles wide, which further emphasizes the individuality of the region. From Castrovillari, south of M. Pollino,



Calabria stretches for 137 miles to Cape Armi, narrows about half-way to the 18½-miles wide isthmus of Catanzaro, and has a greatest width between Amantea and Point Alice of about 60 miles.

The peninsula is built round the five crystalline massifs of (1) the Catena Costiera, which is parallel to the western side of the Sila and forms an unbroken link with the Lucanian limestone Apennines; (2) the Sila in the north-east; (3) the Serre, separated by the Catanzaro trough from the Sila on the north, but connected by a narrow ridge with the southernmost massif; (4) the Aspromonte, which fills the extremity of the peninsula; and, finally, (5) M. Poro or Vaticano, a smaller and lower granite massif which forms the peninsula between the gulfs of S. Eufemia and Gioia on the west coast.

At lesser altitudes than these massifs are the areas of more recent rocks, which normally rise little above 1,000 feet and, for the most part, owe their present aspect to the incomplete destruction of formerly flat surfaces. These areas include (6) the Crati valley, which consists of a long north to south trough between the Sila and the Catena Costiera, and a much wider, lower east to west section between the Sila and M. Pollino; (7) the Tertiary hill-land flanking the south and east sides of the Sila and spreading out to form the Marchesato; (8) the floor of the Catanzaro trough stretching across the Calabrian isthmus; (9) the Mesima trough and Gioia plain west of the Serre; and, finally, (10) the narrower Tertiary strip flanking the Serre and Aspromonte on the east.

### *Subdivisions*

#### *The Catena Costiera of Paola*

These mountains, although they are similar in origin to the other massive blocks of Calabria, form a narrow, almost perfectly continuous chain. This chain stretches southwards, without interruption or noteworthy cols, along the coast from the Scalone pass (2,441 ft.), at the junction with the high limestone mountains of southern Lucania (p. 339), to the deep valley of the F. Savuto, a distance of 40 miles. At this valley the chain ends in M. Faeto (3,635 ft.) which dominates the Savuto about 3,000 feet below. The Savuto valley is connected with the Crati valley across the flat and easy watershed of the Piano del Lago (2,057 ft.; p. 353), and separates the Catena Costiera from the Sila and its south-west extension in the M. Reventino massif (p. 353). On the west the chain rises precipitously from the sea, and on the east falls steeply again to the younger and softer rocks of



the upper Crati trough. The width of the chain varies from 12 miles at the two ends to as little as  $5\frac{1}{2}$  miles east of Paola, and yet the crest line averages 3,600 feet and scarcely drops below 3,000 feet. The watershed and crest line are never more, and usually less, than 6 miles from the shore. M. Cocuzzo (5,055 ft.) is only  $3\frac{3}{4}$  miles from the sea, and east of Paola, where the road (107) and railway cross the Crocetta pass, the ground rises to 3,700 feet within as little as  $2\frac{3}{4}$  miles. The bulk of the chain is formed of schists of varying degrees of hardness, which give rise to steep but not rugged scenery. Granites occur, and a few outcrops of limestone near the southern end produce more rugged scenery in M. Cocuzzo and M. S. Lucerna (4,124 ft.).

The western slopes rise immediately behind a narrow coastal strip of sand and gravel (p. 105). The hill-sides are deeply scored with many steep ravines, most of which have large, steeply inclined dejection-cones (p. 35) at their mouths, and are occupied by dry *fiumare* beds (Plate 132). All along this coast, but especially near Paola, marked terraces occur in scattered remnants mainly at levels below 1,000 feet. The remarkably uniform crest line, with few outstanding summits, is flat and generally narrow, but widens in some places, particularly in the Serra delle Grandini. The eastern slopes are steep and similar to the western, but do not descend so far and are comparatively deserted and uncultivated. The recent rocks of the upper Crati trough, with their associated tabular landforms (pp. 36 and 343), rise comparatively gently up the mountain sides to a line marked roughly by a string of villages from Malvito in the north through Fagnano Castello, Rota Greca, and S. Fili to Mendicino. This line rises fairly steadily from rather under 1,300 feet in the north to over 2,000 feet south of Cosenza, and marks the break of slope where the steep sides of the chain dip beneath the later sediments.

The very steep slopes and considerable altitude of the chain mean that there is very rapid change in the vegetation from place to place. The seaward slopes up to about 2,300 feet are densely populated in scattered settlements and covered with trees and gardens. Where the slopes are too steep, and above this limit, a scrubby growth covers the ground. Chestnut groves are scarce, but the summit is covered throughout most of its length with large and vigorous beech forests. On the eastern slopes the higher parts are clothed with beech forest and scrub, interspersed with patches of bracken, and the lower parts, practically down to the line of villages mentioned above, with magnificent chestnut groves.

Communications are hampered by the steep slopes. The coastal



road (18) is for the most part slightly higher up the slope than the railway. The repeated crossings of the *fiumare* are a grave obstacle to both. Three main roads, 105 at the Scalone pass, 107 at the Crocetta pass, and 108 on the north side of F. Savuto at a height of 2,625 feet, and only three other roads cross the range. The deep valley of the Savuto itself is carefully avoided.

### *The Crati Valley*

The Crati valley consists of two differently orientated portions. In the north, extending from east to west at the foot of the limestone mountains of Pollino (p. 339), is the plain of the Esaro, Coscile, Raganello, and lower Crati rivers. This lowland is barred from the west coast by the junction of the Catena Costiera with the limestone mountains to the north. Almost due south from the western end of this plain stretches the upper valley of the Crati.

The *Lower Crati Plain* extends about 25 miles east and west and between 12 and 16 miles north and south. It consists of a flat expanse of Pliocene (and later) loose conglomerates, sands, sandy clays, white and blue clays, and a few harder, calcareous sandstone beds, all incised and dissected by the flat, steep-sided valleys of the streams into broad, low tablelands or narrower ridges. Between this region and the sea extends the low plain of Sibari, formed of the combined flood-plains and deltas of the rivers mentioned above. Towards the mountain flanks of the basin the surface of the Pliocene rocks rises gently to the abrupt slopes of the mountains. In the north the transition to the bare and rugged limestone takes place along a line from Trebisacce to Francavilla, and thence roughly follows the road (105) to Castrovillari and S. Sosti. The southern boundary against the Sila is marked by another line of villages from Corigliano west to S. Demetrio. A long, narrow, Pliocene tableland, stretching north-east from S. Martino di Finita to Spezzano, divides the upper from the lower Crati basin.

The broad, flat plain of Sibari rises imperceptibly from the coast (p. 121) to 125 feet at various places in finger-like extensions up the main valleys, at the foot of the scree-covered slopes between Trebisacce and Francavilla in the north, and along road 106 in the south. The ancient Greek colony of Sybaris is now completely buried under river deposits. The flood-plain is bordered by a broken crescent of Pleistocene terraces at about 160 feet, and, where the mountains are close at hand in the north and south, by wide dejection-cones (p. 35). In the west and centre of the basin there extends



a Pliocene region of steep-sided, sandstone-capped hills and of more subdued clay lands. The flat surfaces are best preserved near the centre of the depression, where, between Spezzano station and Tarsia, there are wide flat areas at a number of levels (Plate 131). Towards the rim, however, the degree of dissection increases as the level rises from 1,000 to 1,300 feet and more in the west, and even to 2,000 feet near Lungro.

The Pliocene area, between the Coscile and the Follone rivers, is occupied by great tabular blocks of hilly land between 300 and 650 feet high and divided by rivers. It is bordered on all sides by higher ground. East of the Coscile there is a transitional region where faults here and there bring limestone masses to the surface. Southwest of the F. Coscile, as far as the Catena Costiera, the Pliocene rocks have been highly dissected into ridges. Finally in the south and east, between the Esaro and the Crati, is the plateau-ridge of Spezzano which rises to 1,385 feet but has a general level of about 1,000 feet.

The lower Crati plain is for the most part treeless and given over to arable and grazing land. Along the main watercourses of the plain of Sibari, and in the marshy coastal strip and the delta, thickets of willows and other deciduous trees flourish, whilst on some of the hill-sides of the dissected Pliocene lands there are olive groves and vineyards, particularly between Cassano and Castrovillari. The richest vegetation is along the junction between the plain and the surrounding mountains, and especially along the northern margin.

The *Upper Crati Valley* is a north to south trough about 22 miles long, but narrow in proportion to its length. It is enclosed on the east and west by the steep but rounded mountain-sides of the Catena Costiera and the Sila Grande, and on the north by the Spezzano plateau-ridge across which the Crati has cut a narrow gorge. In the south the trough ends near Cosenza, but the Piano del Lago provides relatively easy access to the Savuto valley and the coast at Amantea (road 19).

The Spezzano plateau-ridge is crossed by the Crati in a narrow gorge from near Tarsia to the bridge on road 106, where the river emerges on to the plain of Sibari. The gorge, which is some 4 miles long and 800 feet deep, cuts through a bar of crystalline schists and later conglomerates which underlie the Pliocene rocks of the plateau-ridge. South of Tarsia the bottom of the Crati trough as far as Cosenza consists of horizontal, unconsolidated, and highly dissected Pliocene deposits (mainly yellow sands with some blue clays beneath)



and is deeply sunk between the faulted mountain-sides. The axis of the trough is formed by the F. Crati which flows in a flood plain,  $\frac{1}{2}$ – $1\frac{1}{4}$  miles broad, incised in the Pliocene deposits. Although the flood plain rises rapidly from 165 feet above sea-level at the entrance to the gorge to about 800 feet at Cosenza, it is marshy, especially in its lower reaches, and mainly covered with thickets (*Macchia della Tavola*) which are gradually giving way, after drainage, to cultivation. The F. Mucone (*Moccone*) coming down from the Sila causes a considerable widening of the valley bottom and pushes the Crati over towards the west side of the trough. Above Montalto station the valley bottom is less marshy and less deeply incised.

About 300 feet or more above the flood plain the upper surface of the Pliocene sands rises, sometimes in steps, to about 1,300–2,000 feet along the sides of the trough, and is dissected into ridges and hillocks by torrents descending from either side. The belt of sands, which is much wider on the west than on the east of the river, but rises to about the same height on both sides, is closely cultivated with arable fields, olives, and vines, and dotted with large villages as well as numerous isolated dwellings. Cultivation also covers the lower slopes of the crystalline massifs, which are not so highly dissected, but are deeply ravined by torrents at regular intervals.

At its southern end the trough ends in an amphitheatre which gathers together a fan of tributary streams. These have dissected the country, the general level of which rises to 2,000–2,300 feet, into a number of larger hills. Cosenza, at the focal point of the amphitheatre, stands on a semi-detached spur above the confluence of the F. Crati with the F. Busento, beneath the waters of which lies the traditional grave of Alaric.

Communications are comparatively unhindered apart from the obstacle of the Crati gorge. This is avoided by the road over the Spezzano plateau-ridge and by the railway which follows the Coscile and Follone valleys and then tunnels through the ridge. There is a tendency for roads to keep away from the unhealthy and sometimes marshy valley bottoms (e.g. 105 and 106). The plain of Sibari is served by railway but by few roads. In the dissected Pliocene country movement is not altogether easy, and roads sometimes take advantage of the flat surfaces of the plateaux and terraces (e.g. 19 between Tarsia and Castrovillari). Most roads run near the margins of the depression, although this involves frequent gradients and bridges over the torrents draining the mountain-sides. The western slopes of the Sila have practically no roads at all.



*The Sila*

The Sila, the largest of the crystalline massifs of Calabria, is in outline like a D. Steep edges, except in the north-east, surround the massif, which has a gently rolling surface, sloping away from Botte Donato (6,332 ft.), the highest point near the middle of the western edge, and is crowned by a number of east to west ridges and basins. The eastern half is composed mainly of granites, the western of softer schists. The Tacina valley divides the massif into the Sila Grande in the north and the Sila Piccola in the south. West of the Rogliano-Tiriolo road (19) the offshoot which culminates in M. Reventino (4,613 ft.) extends to the Tyrrhenian coast. Altogether the massif stretches about 40 miles from north to south, and its greatest width is over 30 miles.

The sides of the Sila rise out of a setting of Tertiary rocks which ascend to varying heights up its slopes (pp. 350, 354). In the west, south, and south-east the sides are very steep and clear; but less so in the north-east where the Tertiary rocks rise to as much as 1,650 feet; in the north a series of transverse ridges descend to the Pliocene country around Corigliano and Rossano (650-1,000 ft.; p. 363).

The centre and highest part of the Sila Grande is a rolling country of gently sloping, east to west ridges which rise some 2,000 feet above the intervening broad, basin-like valleys of the upper Duglia, Trionto, Mucone, Neto, Garga, Arvo, and Ampollino (Plate 134). The average height of these valleys rises from about 3,500 feet in the north to about 4,000 feet in the south. The highest ridges and most ample of these high vales (F. Neto, F. Arvo, F. Ampollino) are in the south, where reservoirs have been constructed in the upper valleys of the Arvo and Ampollino to regulate the flow of these rivers for power stations on the eastern edge of the Sila. The streams draining the high basins fall abruptly near the edge of the massif into narrow gorges down which they dash to below the level of the Tertiary rocks. On the larger streams these gorges extend well back into the plateau, but are useless for communications. The upper Mucone, for example, drains north-eastward towards the Trionto in a particularly flat and featureless valley as far as the Piano di Cecita (about 4,000 ft.). Here it makes a sudden turn to the north-west and drops rapidly down towards the Crati through a steep-sided canyon particularly noticeable for its depth (1,500 ft.) and length (16 miles).

South of the Ampollino basin the surface of the Sila Piccola is





PLATE 131. *Spezzano Albanese station: the flood-plain of the Esaro with river-bank woodland; Pliocene platforms (150 ft. and 350 ft.)*



PLATE 132. *The T. delle Monache from Amantea: brushwood-covered slopes*



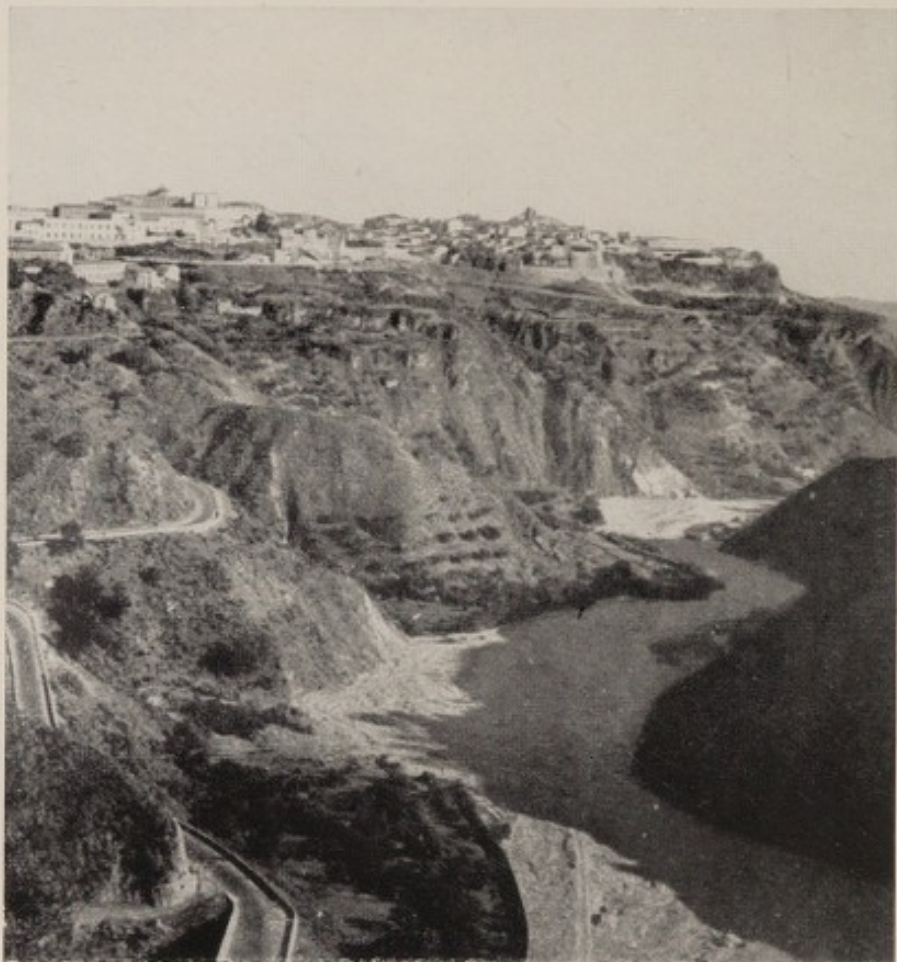


PLATE 133. *Catanzaro, on a terrace above the dry gorge of the Fiumarella*



PLATE 134. *The Arvo reservoir: view west to the Botte Donato ridge*



more cut up into individual mountains by the valleys of the eastward flowing F. Tacina and a number of shorter streams draining south-eastward, but a central east-to-west ridge rises immediately south of the F. Savuto and F. Tacina to 5,709 feet in M. Femminamorta. The south and south-east sides of the Sila Piccola are steep, and along the lower slopes runs the road (109) from Fossato to near Cotronei. On the west a saddle, followed by road 19, cuts off the triangular massif formed by M. Mancuso (4,361 ft.), M. Portella (3,409 ft.), and M. Reventino (4,646 ft.). This massif of M. Reventino has an average height of about 4,000 feet, and is dissected by the tributaries of the F. Savuto and F. Amato. M. Mancuso drops steeply to the sea in a magnificent series of well-marked though narrow terraces at heights, between Nocera Terinese and Falerna, of 500, 1,300, 2,100, and 3,000 feet.

The plant-cover of the Sila massif changes rapidly up its steep sides. The lower slopes, although mostly above the limit of the olive, are covered with Mediterranean evergreen trees and cereals, and with evergreen scrub on the steeper slopes. Chestnut groves on the middle slopes give way to beechwoods, and even to firs and pines near the summits. The extent of forest, although still considerable, is much reduced. Large areas in the beech and firwood zones are covered with open, grassy stretches carpeted with bracken. The climate at these heights (4,000 ft. and upward) is very different from the hill-land below. Rainfall is heavy and is not confined to winter; cloud is frequent; temperatures in winter and at night in summer are low; snow falls in abundance and lies on the ground for several months (Fig. 58).

The Sila, with its steep sides and gorges, is a formidable obstacle to traffic. The only easy route (road 19 and railway) crossing it is by the Piano del Lago (p. 347) and the high saddle (3,150 ft.) between the Sila Piccola and M. Reventino. Two main roads (107, 108) climb over the Sila Grande. Each has an easy passage once the high basins of the Neto and Arvo are reached, but both are closed by snow in winter, road 107 for six and road 108 for three months.

### *The Catanzaro Trough*

The isthmus of Catanzaro, 19 miles wide, clearly divides Calabria in two. This division is emphasized by a sudden break in the mountains between the crystalline massifs of M. Reventino (M. Portella, 3,409 ft.) and of the Serre (Serralta S. Vito, 3,324 ft.), only 16 miles apart. The intervening gap is occupied by a tableland of Pliocene sands



and clays, and, on the west, by a plain of recent alluvium. Although relatively low compared with the neighbouring highlands, the

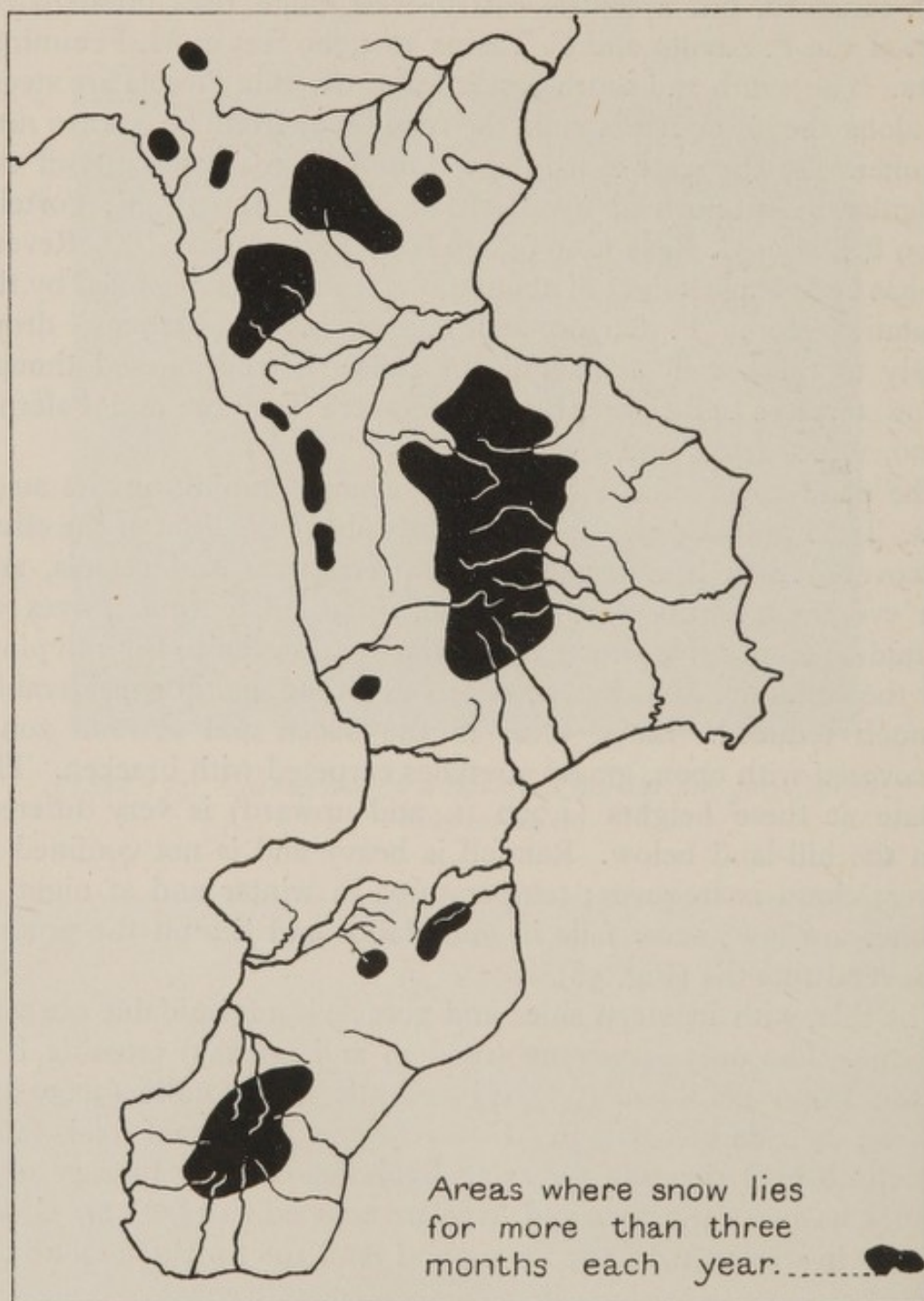


FIG. 58

Catanzaro depression, except on the west coast, is a land of steep hills, and culminates in a continuous north to south ridge about 1,000 to 1,150 feet high.

On the north the Catanzaro depression is bounded by the steep slope of the Sila, and merges north-eastward into the Tertiary hill



country of the Marchesato (p. 363). The Sila here falls steeply from levels of about 2,600–3,300 feet to a line marked, as so often in Calabria, by towns and large villages (Sambiase, Nicastro, Pianopoli, Marcellinara, Tiriolo, Catanzaro). Here the gradient lessens at the contact with the nearly horizontal sand and clay. The conical limestone mount of Tiriolo (2,785 ft.) is a landmark dominating the town and road 19. On the south the edge of the Serre trends north-east from near the mouth of the F. Angitola to Maida and then south-east to Point Staletti. On this side, too, the edge is well marked, steep, and followed by a line of villages from Curinga through Maida and Girifalco to Squillace. The depression is thus only  $6\frac{1}{2}$  miles across between Maida and Pianopoli, and widens on the west and east to 9 miles and more.

The uppermost surface of the Pliocene sands at 1,000 to 1,150 feet is more completely obliterated than in the other Tertiary regions of Calabria, but remains intact along a comparatively narrow ridge in the centre. On the west the extensive flat, alluvial plain of S. Eufemia (p. 106) extends in a broad sweep to a maximum of about 4 miles inland, where its limits are roughly indicated by the railway, except for an additional arm up the valley of the Amato. The plain is bordered by fairly gentle, tree-covered slopes which extend up the edges of the crystalline massif or of the abrupt tabular lands of the centre of the depression. These slopes rise to about 650 feet in the north, where they are mainly covered with vines, and to about 300 to 500 feet in the east and south.

The central part of the depression is formed of small, flat-topped areas at varying levels gashed by steep-sided gulleys (Plate 133), and crossed by the Amato gorge. On the western side several flat-topped spurs (Piana S. Maria, 330–600 ft.) extend between the valleys, and ascend in steps towards the east (Piano della Forca, 260–300 ft.; di Vena, 650–750 ft.). The largest and highest of these level regions, the Piani del Carra, di Cortale, and del Bello, between 1,000 and 1,150 feet, occupy much of the triangle between Borgia, Caraffa, and Cortale. Caraffa and Borgia stand on promontories at the brink of the steep scarp which limits this plateau on the east. From the foot of this scarp the country falls in steep, much dissected slopes to the narrow coastal plain and the fairly wide valley of the F. Corace (p. 115). East of this river Pliocene country rises steadily in ridges, between parallel south-east flowing streams, to a definite terrace at the foot of the Sila slopes (p. 352). On this terrace stands the town of Catanzaro (1,125 ft.; Plate 133).



In spite of the break in the mountains and the narrowness of the isthmus, the Catanzaro depression is too highly dissected to be favourable to communications. Railway and road (19 and 19-bis), however, avoid the scarp of the Piani del Carra by crossing the water-shed in the north, where it has been lowered by dissection to only 820 feet.

### *The Serre*

South of the Catanzaro depression rises the broad, rectangular mass of the Serre, formed mainly of schists in the small section north of a line from Capistrano to Chiaravalle, and of granite to the south. The massif has an extreme length of about 34 miles and an average width of 15 miles. On the north-west the low schist hills between Curinga and Vibo Valentia connect the Serre with the low granite plateau of M. Poro, and on the south a long, narrow ridge projects south-west from the Piano della Limina to the Aspromonte. On the west and east the Serre are bounded respectively by the Mesima trench and the east coast Tertiary margin.

The western slopes of the Serre rise in two steep walls divided by a broad and persistent terrace at roughly 2,000 to 2,300 feet. This terrace, which can be traced the whole way from Maida in the north to Laureana in the south, is about  $1\frac{1}{2}$  miles wide between Maida and Soriano, but widens to about 4 miles at Laureana (Piano la Rocca), where its range of altitude is also greater (1,770–2,600 ft.). The terrace, which is only relatively flat (gradient 1 : 23) and is incised by shallow ravines at frequent intervals, stands above the upper limit of fruit-trees and is mainly open country.

The central portion of the massif, which culminates in M. Pecoraro (4,659 ft.), consists of an imperfect plateau at roughly 2,600 feet in the north and 3,300 feet towards the south. From it rise two comparatively low, longitudinal ridges. One, at the western edge of the plateau, extends from M. Contessa (2,887 ft.) in the north, through Serralta S. Vito (3,324 ft.) and M. Crocco (3,340 ft.) to M. Seduto (3,770 ft.) in the south; this ridge consists of a series of rounded summits, and although much narrower in the centre than at either end is continuous and never drops below 2,600 feet. The other, in the east, passes from M. Trematerra (4,038 ft.) north-east of Serra S. Bruno, through M. Pecoraro to M. Gremi (4,068 ft.) in the south. This ridge is somewhat higher and broader than the western, but is more broken and shorter. North of M. Trematerra the ridge is traceable through the much lower M. la Rosa (2,320 ft.) and M. Palladina (2,241 ft.) to Staletti.



Between the two ridges there is a series of four shallow basins which become progressively higher in average elevation southwards. The two lowest and most northerly of these basins are bounded on the west by the high Serralta S. Vito and on the east by the lower ridge, which is broken through by the streams draining these basins. The T. Grande drains the basin of Vallefiorita (820 ft.) at the contact between the schists and the Pliocene. The double basin of Chiaravalle (1,300 ft. in the north, 1,650 ft. in the south) is drained by the F. Soverato and the F. Ancinale. The Serra S. Bruno basin (2,500–2,600 ft.) is drained northwards by the Ancinale, and the basin of Fabrizia (3,100–3,450 ft.) directly south-eastward by the Fiumara Allaro.

Between the Ionian coast and the eastern ridge there is an even ascent through the broken country of the Tertiary coastal strip, except to the west of Stilo where the sharp, narrow, limestone ridge of M. Stella (3,432 ft.) and M. Consolino (Busolino on maps, 2,297 ft.) introduces a scenery strange in this land of rounded slopes. This ridge runs south-west to north-east for about 4 miles and is crossed by road 110 at Pazzano.

The Serre are covered in patches with forest, especially with beech on the higher mountains in the south and east, and with large chestnut groves on the southern and north-eastern slopes. Cultivation and deforestation have, however, advanced up the central basins, and the western slopes are mainly bare pasture.

Communications almost entirely avoid the highland. One first-class road (110) crosses from east to west through the basin of Serra S. Bruno, and a third-class road traverses the length of the series of high basins from Squillace to Fabrizia and Gioiosa.

### *The Monte Poro Plateau*

West of the Serre the small plateau of M. Poro forms the headland which terminates in Cape Vaticano. This rectangular massif, 9 miles wide and 14 miles long, is lower and more isolated than the others. It is bounded on three sides by the sea and on the fourth is cut off from the Serre by the Mesima trench. To the north-east a narrow extension, nearly as long as the massif itself, connects it with the Serre at Curinga. The plateau is made up of granites, with schists in the north-east, but the bulk of the eastern half is covered by patches of younger deposits, imperfectly masking the underlying rock. As its surface is very much lower (M. Poro, 2,320 ft.) than that of the other crystalline massifs, its sides are less steep and the flatness of the central portions is well preserved.



The seaward flanks (p. 107) rise on all three sides in well-preserved terraces which break the slope into three or four or even more steps. Only in the north between Briatico and Marina di Vibo Valentia is there an appreciable coastal plain, and only in the south are the terraces absent for a short stretch where M. Poro rises sheer to 1,650 feet from the cliffs of Point Spinosa. The terraces are at many different heights, but, as an example, the road inland from Tropea crosses levels at about 160, 820-920, 1,050-1,150, and 1,400-1,575 feet before finally rising to the flat summit at about 2,000 feet.

The main portion of the plateau consists of a fairly smooth, flat surface. In the northward projection it is about 1,150 feet high just south of the transverse gorge of the Angitola, and rises slowly southward through the Piana della Scrisi to 1,280 feet. In the main massif the plateau continues to rise through the Piana di Monteleone (Vibo Valentia, 1,575 ft.), the Piana della Acqua Fredda and La Crista (1,900 ft.) to the gently rising summit of M. Poro with its general level at about 2,150 feet. The wide, central part of the plateau round Zungri is gently undulating but retains the general aspect of a plain. Only in an area just east of Zungri is the surface much dissected. These piani are covered with arable fields lined with occasional trees.

The eastern slopes of the M. Poro plateau are not formidable. In the north the difference in height (about 300 ft.) between the plateau and the Mesima trench is slight and the drop is gradual. Near Mileto the 650-foot difference is little steeper, but in the south near Nicotera the descent of 1,300 feet to the Gioia plain is in a series of terraces. Many of the slopes on all sides are covered with orchards.

#### *The Mesima-Gioia Trough*

This is an area of comparatively low land which is divisible into two parts, the Mesima trench (about 22 miles long and 6 wide) of dissected Pliocene sands and clays, and the Gioia plain (about 16 by 12 miles) of flat, Pleistocene sands and gravel. The Mesima trench in the north divides M. Poro from the Serre, and the Gioia plain in the south separates the northerly extension of the Aspromonte from the sea (p. 107). In the south-west, in contrast, a southerly extension of the plain is cut off from the sea by the low crystalline hills of Palmi (p. 360). In most places the edge of the younger rocks against the neighbouring crystalline massifs is clearly marked by a break of slope.



Immediately behind the low, flat coastal strip between Nicotera and Gioia the plain rises steadily south and south-eastwards in the form of a very large dejection-cone to a height of 1,300–1,500 feet at the foot of the encircling hills. In spite of its considerable gradient, only parts of the surface in the higher marginal strip and the southward extension round Seminara have been dissected. Otherwise it is a smooth though steeply sloping plain, covered, for the most part, with olive groves. Large villages throng the edge of the mountains.

The Mesima trench contains the valleys of the F. Mesima (Plate 136) and F. Marepotamo, and part of the middle Angitola. The Pliocene sediments in this trench have a general upper level of 800–1,150 feet, but they are incised by valleys as much as 650 feet deep. In the south, near the plain of Gioia, dissection is far advanced, but there are noticeable flat terraces at about 300 feet. Farther north there are numerous flat-topped hills and ridges, especially round Mileto (Piano Pongali, 920 ft.). In the basin of the F. Angitola and around Filadelfia the Pliocene rocks are highly dissected and most traces of the 1,000-foot level have disappeared.

The gentler slopes are frequently tree-covered, whilst the flat tops of the hills form open country. As usual a line of villages marks the junction of the old and recent rocks. Lines of communication avoid, as far as possible, the dissected centre of the trench and keep to the margins.

### *The Aspromonte*

The southern end of Calabria consists of the massive, round Aspromonte, the highest of the crystalline plateaux, which rises in Montalto to 6,418 feet. The Aspromonte shows most strongly the typical features of steep sides (average gradient from Scilla to Montalto 1 :  $8\frac{1}{2}$ ), and terraces and flattenings at many levels up to 3,300 feet and over. The mountain is bounded on the north by the plain of Gioia, and on the west and south by the sea. In the east a strip of Tertiary rocks is wide enough to be considered separately (p. 361), but in the north-east a long, narrow off-shoot extends to the Serre. The main mass of the Aspromonte is a rough square with sides 25 miles long, and from it the north-east extension projects for about another 15 miles. The lower slopes on the west, south, and east are covered by narrow Tertiary bands, but the main component of the massif is a hard gneiss. The upper slopes are cut into wide, flat platforms at heights of from 2,000 to 4,300 feet, above which the summit is of comparatively slight relief. These



platforms are most marked and extensive on the north side, but also exist on the west (p. 108).

The gradients and type of country encountered between the coast and Montalto differ greatly from one side to another. Between Palmi and Bagnara the flat-topped ridge of Palmi (1,700–2,000 ft.) backs the coast, but gives way inland to the southernmost extension of the Gioia plain. Between Bagnara and Villa S. Giovanni the gneisses rise sheer from the sea (Plate 26) to about 1,800–2,100 feet, where the flat surface of the Palmi ridge is continued south-westward in the lowest of a series of terraces (Piano Don Rocco 1,900 ft., Piano Chiusa 1,900 ft., Piani Melia 2,100 ft.) into which the abrupt ascent to the Aspromonte is broken. From the top of this platform at about 2,300 feet there is a steep slope, interrupted by a minor flattening at 2,450 to 2,800 feet to the Piani d'Aspromonte, the widest, largest, and most perfect of the Aspromonte platforms, which is 4 miles wide at its maximum, more than 5 miles in length, and rises from 3,300 to 3,900 feet. It is gashed by several deep, canyon-like ravines, which, however, do not mar the flatness of the surface. On the north side there is a steep fall without any break from this level to the Tertiary lands round Seminara (p. 359). To the south and east the Piani d'Aspromonte are connected with other almost equally perfect platforms at very similar heights. These extend along the whole of the west of the Aspromonte and over the whole summit of the north-easterly projection as far as the junction with the Serre. Above the Piani d'Aspromonte there is a further rise, relieved by the Piani di Carmelia (4,100–4,360 ft.), to the comparatively rounded slopes of the summit, which culminates near the centre in Montalto (6,418 ft.).

The west side to the south of S. Giovanni is similar to the north, except that the crystalline rocks do not rise directly from the sea. A narrow coastal plain rises to a series of Tertiary sandstone hills (Plate 27). In front of and between these hills steeply inclined dejection-cones have been built out by the fiumare and form a practically continuous belt, not unlike the plain of Gioia in form and material, but far smaller, narrower, and steeper. At S. Giovanni, at Reggio, and at Point Pellaro the older rocks and high hills come close to the shore, thus delimiting two embayments, the joint basin of the Fiumare Catona and Gallico to the north of Reggio and that of the Calopinace and S. Agata to the south, where these alluvial sands are widely spread. Behind the sandstone hills, about 2,500 feet high, steep slopes lead up to the broad Campi di Reggio, Campi



di S. Agata, and Campi di Sclanu. These together form a platform comparable in height and size with that of the Piani d'Aspromonte, but are separated by the deep canyons of the Fiumara Calopinace (1,000 ft. deep) and Fiumara S. Agata (1,500 ft. deep). Above these piani rises the rolling, upland surface of the plateau top.

The southern side of the Aspromonte differs greatly from the north and west. South of Point Pellaro the intensive garden cultivation of the north and west coasts gradually ceases. Great fiumare carry their sediments down to the coast (p. 112) and form marshy deltas. Bare hills rise directly from a narrow coastal strip. The lower hills of soft Tertiary rocks are steep and seamed with occasional calanchi (p. 489). On the higher slopes platforms are absent and a very dissected relief prevails everywhere south of the rolling summit. Forests desert all except the highest parts of this southern slope and are replaced by macchia. North of Cape Bruzzano begins the strip of Tertiary country which lines the whole eastern coast of Calabria.

The north-east projection of the Aspromonte is a simple steep-sided ridge of gneiss, rising wall-like from the smooth slopes of the plain of Gioia on the west to a flat and uniform summit 3,000-3,300 feet high. This high surface is roughly continuous with the series of platforms at about this height on the north side of the Aspromonte itself. The eastern ascent is rather less steep than the western. Three roads cross this ridge, but only the northernmost from Cinquefrondi to Gioiosa finds a notch in the crest-line. All these routes are liable to be closed by landslides.

The changes in vegetation between different altitudes are, if anything, almost more marked on the Aspromonte than elsewhere. There are sharp contrasts between the irrigated gardens and orange-groves of the north and west coasts, the bare or scrub-covered lower slopes, the open rye and potato fields and summer grazings of the high piani with their tree-filled canyons, and the forested summit plateau, where snow regularly lies till June.

### *The East Coast Tertiary Margin*

All along the east coast Tertiary rocks form a strip, varying in width and height, of fairly uniform country composed of horizontal or tilted strata now much dissected, but occasionally with noticeable platforms at levels up to about 1,000 feet. The northern and southern portions of this strip both merge into the Catanzaro depression, which may be taken as dividing it into two.

*East of the Aspromonte and the Serre* the Tertiary margin is



narrow, 8 miles behind Bovalino Marina, but mostly not more than 4 miles wide. The inland margin is not always clearly marked since the higher parts of the Tertiary rocks are often no less steep, only rather more dissected, than the edges of the crystalline massifs.

Along the coast (p. 113) there is, except at Point Staletti, a continuous, though narrow, cultivated plain of Pleistocene deposits about half a mile wide. Behind this plain the country is cut up into a series of comparatively narrow and uniform ridges between the valleys of the broad fiumare, which occur every 2 or 3 miles. Insignificant traces of narrow terraces up to 330 feet in height occur near the coast. The junction between the Tertiary and crystalline rocks is comparatively high (up to 1,650 ft.), and is marked less accurately than usual by a line of towns.

Between Bovalino and Gioiosa the coastal plain and Tertiary strip are both wider than elsewhere. In addition, about 4 or 5 miles inland, there can be traced, particularly between Cirella and Gerace, a rudimentary longitudinal vale, intervening between the crystalline slopes and a north-west facing escarpment of Tertiary sandstone (M. Varraro 1,916 ft.). Cultivation, too, is more intensive, tree plantations more widespread, and settlement denser and more scattered than elsewhere on the east coast. South of the Fiumara Buonamico and north of the Fiumara Turbido settlement is sparser and concentrated into hill towns between 650 and 1,600 feet up, and intensive cultivation confined to a few irrigated patches. North of Gioiosa the ridges of olive-covered hills continue, and the coastal plain at their foot is in places scarcely wide enough for road and rail. Indeed, the road has only recently been completed.

*East of the Sila* the Tertiary strip is of greater average width, but varies from 3 to about 18 miles (p. 115). In the south the Catanzaro depression occupies the whole width of the peninsula and merges gradually north-eastwards into a strip of Pliocene clays and sands at the foot of the Sila Piccola; in the north the same strip opens out to the Crati plain. The Tertiary lands here are narrow and, like those east of the Serre, have sloping ridges divided by fiumare at regular intervals. In the centre there is a broad and more complicated belt of Tertiary country, including the special features of the Marchesato and the Crotona peninsula.

Between the F. Corace and the F. Tacina a coastal plain about a mile wide and edged with dunes is backed by remnants of a 160-foot terrace. Above this, Pliocene ridges rise between the fiumare to about 900 feet, where a line of villages from Catanzaro



to Cropani marks the edge of the mountains. At Cropani this edge turns due north. East of the broad valley of the Tacina the region of the Marchesato is formed in similar clays and soft sandstones, but is divided into two different parts. The Crotone peninsula, which extends as far inland as the railway from S. Leonardo to Crotone, consists of a tableland of limestone-capped sands and clays at a height of 500 feet, which rises on the east and south from a coastal terrace at 70-160 feet. This tableland is almost perfectly flat and is covered, apart from some fields of corn, with very degraded macchia. Behind the Crotone peninsula the rest of the Marchesato extends in a broad sweep from coast to coast. It is a land of monotonous Pliocene hills, mainly of clays with some sandstones, and never rises above about 800 feet. This is one of the best-known areas of extensive cereal cultivation on large estates, and is uniformly covered with corn or bean fields, fallow and pasture. In the north the broad, forested and marshy valley of the F. Neto, terminating in a flat, wooded delta, interrupts this landscape which extends near the coast to Strongoli.

North and west of the Marchesato there is a large area of more confused and higher (1,000-2,000 ft.) hills formed in more varied rocks. Beds of harder limestone and conglomerate stand out as scarped ridges. This area also is crossed by the broad Neto valley (railway) between Timpa Grande and S. Severina. South of the Neto the high edge of the Sila is steep and well marked, but north of it the transition is more gradual. The coastal plain, which is  $1\frac{1}{2}$  miles broad south of the Neto delta, alternately narrows till it almost disappears and broadens for short distances. The coastal road was till recently not completed along this stretch, where there is little room to seaward of the soft clay hills, which rise directly inland from 600 to 1,600 feet. Only in the angle of Point Alice is there a low terrace above 150 feet. Between Cariati and Rossano the landscape, except for the Trionto delta, is similar to that between F. Corace and F. Tacina farther south. The coastal plain, about  $1\frac{1}{2}$  miles wide at Rossano, increases westwards in width and comes close to the lower Sila slopes near Corigliano, where it merges into the plain of the lower Crati. The bulk of these Tertiary hills are, like the Marchesato, devoted to cereals and grazing, with some olives on the slopes. In general the landscape and cultivation resemble the rest of the shores of the gulf of Taranto.

*Communications.* The topography of Calabria presents greater and more universal difficulties to roads and railways than most parts of



Italy. The relief is composed, as already indicated, of flat units separated by abnormally steep slopes. Gradients are consequently high, and even the relatively flat surfaces do not lend themselves to traffic since they are crossed by gorges and canyons. Thus the Pliocene areas, although relatively low, are unfavourable to movement. It is worth emphasizing that the Catanzaro trough is not a natural passageway from the west to the east coast. Communications tend to follow the lower crystalline slopes, either along the coast or near the crystalline-Pliocene junction. River valleys are avoided with the exception of the upper Crati. Routes along the coast are favoured by the almost continuous, though very narrow, coastal plain, which, however, is made difficult and dangerous by the innumerable fiumare and their violent floods. None of the crystalline massifs except the Aspromonte are insuperable barriers, but routes across them are few.

### THE APULIAN REGION

THIS region<sup>1</sup> comprises south-east Italy between the Adriatic coast and the Southern Apennines, and from the gulf of Taranto to the F. Fortore, including the Salentine peninsula and the promontory of M. Gargano. From Cape S. Maria di Leuca, at the south-eastern end, to the mouth of the Fortore is, as the crow flies, approximately 215 miles; the breadth averages about 40 miles.

The Apulian Region, which in itself is a geological and structural entity, became a part of the Peninsula only with the post-Pliocene uplift (p. 31). Its topography of broad plateaux and dissected plains is unlike the rest of the country and has a distinctive character. This is echoed in the history of Apulia, which for long maintained economic and cultural ties with the Balkans, particularly with Greece. Contrasting elements within Apulia are based not only on differences of height but also on differences of structure and of the porosity and solubility of the rocks.

There are four well-defined subdivisions: (1) the Taranto-Tavoliere corridor, bordered on the west by the Southern Apennines, and on the east by (2) the tableland of the Murge, which, together with the lower Salentine peninsula, is often called the 'heel' of Italy;

<sup>1</sup> Apulia (or Puglia), together with a part of what is now the compartment of Campania, was known as 'Apulia cum Calabria' from the time of Augustus until the Middle Ages, when the name Calabria was transferred to the 'toe' of Italy, previously called the peninsula of the Bruzzi (Bruttium). The compartment of Lucania was known as Basilicata before 1933.



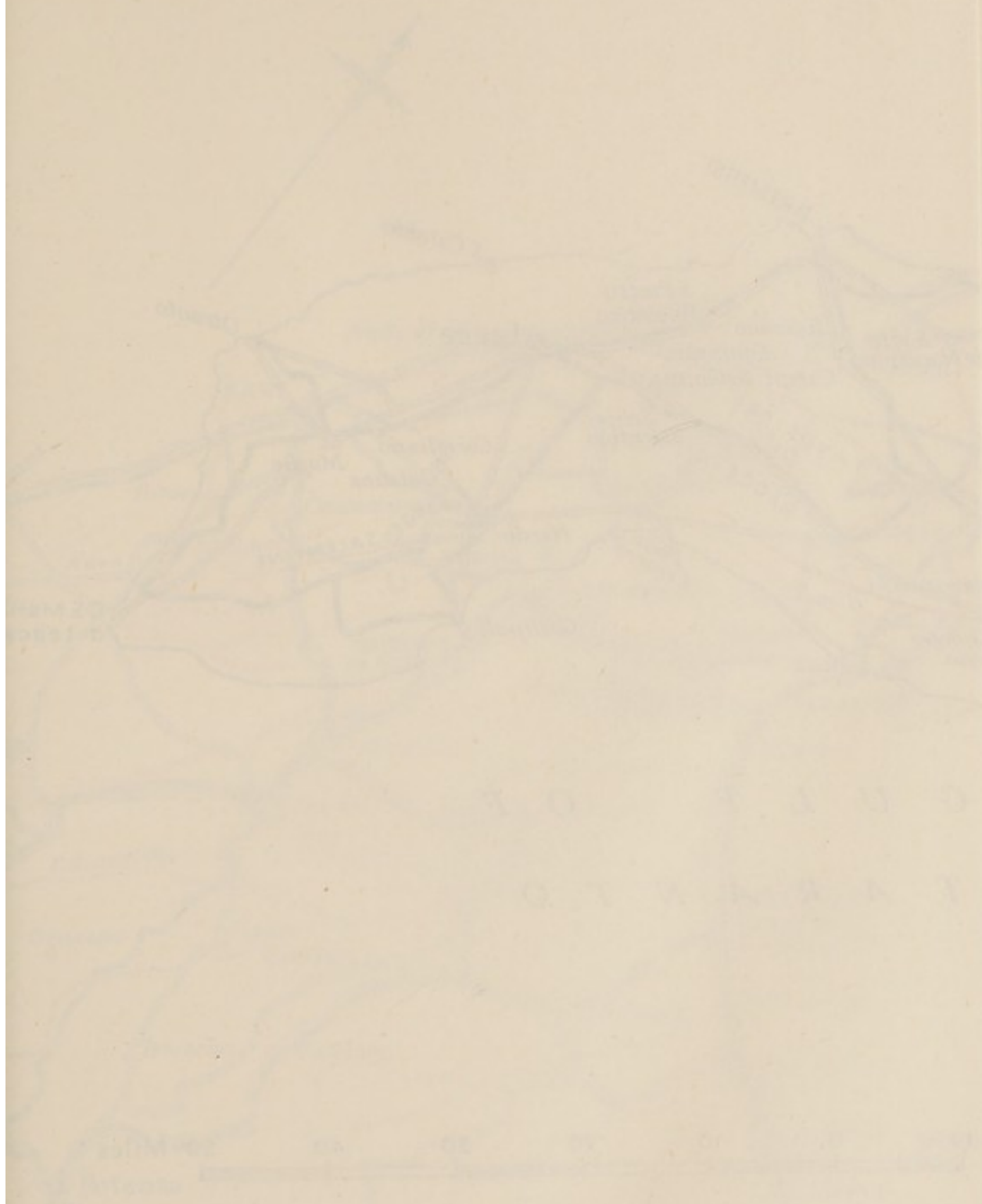






FIG. 59. The Apulian Region. (For Key see Fig. 40)



(3) the lowland plain of the Tavoliere di Puglia, extending to the north-west of the Murge plateau, and continuous with the Taranto-Tavoliere corridor; and (4) the isolated mountainous peninsula of M. Gargano, the 'spur' of Italy, which is bounded on the south-east by the gulf of Manfredonia and on the south and west by the Tavoliere.

*Physical Features.* Two main types of country are characteristic of Apulia and correspond in general with the two dominant types of rock, the massive Secondary limestones and the stratified sands and clays of the Pliocene and Pleistocene. The limestones coincide with the upstanding plateaux of the Murge and M. Gargano, and the Pliocene rocks with the more or less dissected lowlands intervening between these two blocks and the Southern Apennines. The Pliocene rocks, which were laid down in a sea covering the present lowland area, consist of yellow or blue clays covered by sands and other coarser debris. They are overlain in parts by comparatively coarse Pleistocene sediments, which are almost 100 feet thick in some areas of the Tavoliere. The rivers flowing through the lowlands have steadily cut down into the clays and left ridges capped by the relatively resistant sands and conglomerates, known in Lucania as *rocce-tetto*. On this firm foundation most of the settlements are sited. Where, however, the sands are incoherent or absent, dissection continues unhindered. In such areas and where the *rocce-tetto* rests on weak clays in the valley-sides, landslips frequently occur after winter rains. Hence many of the valleys are deserted and the population, always sparse, lives on the hill-tops. The main roads avoid the valleys and keep to the more stable ridges, although this adds to the difficulties of communication. In the Pliocene areas the streams, which drain to the sea in long parallel courses, mostly cease to flow in summer, but are very active in winter, when they carry tremendous quantities of silt and do much erosive damage. This is one of the driest areas in Italy (p. 423), and although water can be obtained from wells in summer, the supply is far from satisfactory.

The limestone of the Murge and M. Gargano, mainly of Cretaceous age, is extremely permeable, so that surface streams and river valleys are rare and landslips unknown. With one doubtful exception at Otranto, no perennial streams flow into the Adriatic between Taranto and the mouth of the Ofanto. There are, however, a number of dry valleys, especially in M. Gargano, and deep, canyon-like, dry gorges (*gravine*), strewn with loose boulders (Plate 135). Subterranean



drainage is dominant and parts of the surface are pitted with enclosed depressions, normally dry with a floor of terra rossa (p. 243). A variety of local names, such as *puli*, *caligiuni*, *murrituri*, *capoventi*, *gorghi*, *vore*, *avisi*, *grave*, are used to describe dolines (p. 38) and swallow-holes. Most of the usual limestone landforms appear in M. Gargano, and more rarely in the Murge. In the Salentine peninsula besides compact limestones there are considerable deposits of calcareous tufa and unconsolidated sands of Tertiary age, which, south of Lecce, occur in parallel bands. The older limestone forms ridges, known as *serre*, which, although clearly defined, do not attain any great height. The whole limestone area suffers from a serious shortage of water. Only in the coastal strip around Monopoli and between Bari and Barletta do springs break out in the calcareous tufa at the foot of the Murge. Even here, owing to the infiltration of salt water, there is a shortage of local drinking-water in the summer months.

*Water-supply.* Since tapping underground sources is impracticable in the limestone, and the rainfall is very low in the Pliocene areas, an ambitious scheme was inaugurated in 1905 to bring water by aqueduct from the copious headstreams of the F. Sele, on the north flank of M. Cervialto at Caposele (1,378 ft.) in the compartment of Campania (p. 334). Work was begun in 1906, but was interrupted from 1915 to 1919. By 1923 water was being supplied to Cerignola in the Tavoliere and by 1925 to Lecce. The whole project, which involved the construction of a principal conduit 150 miles long and of more than 1,500 miles of subsidiary channels, was completed on 10 September 1939. The main aqueduct crosses the Apennines by a tunnel, 9-10 miles long, and continues north-eastward to a point 13 miles beyond Spinazzola, where it turns south-east along the Murge, with extensions into the Salentine peninsula. Water is distributed to all the chief coastal settlements from Taranto to Vieste. The flow is mainly by gravity, assisted only by a few pumping stations. For much of the distance the main aqueduct is just below the surface of the ground.

*Vegetation.* The altitudes of Apulia do not rise appreciably above the zone of Mediterranean plants, except in M. Gargano. Soil differences are a most important element in determining vegetation (Fig. 62). There are three main types: treeless cereal land in the plains; trees (particularly olives), cereals, and vines intermingled in patches along the limestone slopes and round the towns; and poor sheep-pastures on the higher limestone plateaux. Forests are



reduced in extent to a few magnificent remnants in the eastern part of M. Gargano, some oakwoods in the south-eastern Murge, and pinewoods along the shores of the gulf of Taranto. There is some *macchia* on the hilly slopes of the sands and clays near the gulf coast, near the rivers of the Pliocene areas, and in patches on the surface of the Murge and M. Gargano. Small areas of fruit trees, vines, and gardens surround the towns in all parts of the region. Often these suburban districts are irrigated and hence clearly differentiated from the surrounding country.

*Settlement and Communications.* The concentration of the population, including the agricultural, into small towns, in between which the countryside is practically deserted, is a feature of southern Italy and Sicily, but most particularly of this region. There are some 130 towns with more than 5,000 inhabitants, and these account for the bulk of the total population of the region. The towns, which are some distance apart, have each a remarkable number of straight, radial roads and lanes leading out to the fields. On the Murge these roads are often lined with dry stone walls. Only near the tip of the Salentine peninsula are smaller and more scattered settlements at all common.

The Apulian Region presents no great obstacles to communications except for the south-west scarp of the Murge, M. Gargano, and the most highly dissected southern parts of the Taranto-Tavoliere corridor, all of which can be circumvented without difficulty. Roads and railways spread over most of the region. There is a particular concentration on the seaward slopes of the Murge, but the Taranto-Tavoliere corridor is practically deserted except for the roads and railway at the foot of the Murge scarp. Taranto and Foggia are the main route centres.

### *Subdivisions*

#### *The Taranto-Tavoliere Corridor*

This region stretches north-westwards for approximately 70 miles from the gulf of Taranto to the F. Ofanto, which flows along the southern edge of the Tavoliere lowland. On the south-west the corridor is bounded without any marked break by the fairly gradual rise of the Southern Apennines (p. 340), and on the north-east by the steep scarp of the Murge tableland. The breadth of the region varies from about 50 miles in the south to as little as 12 miles in the north.



The corridor consists of two distinct parts: a narrow, coastal strip, curving north-eastwards for nearly 50 miles along the shores of the gulf of Taranto from the mouth of the T. Canna to Taranto itself; and a broad, hilly, Pliocene zone rising north-westwards from the coastal strip, and composed mainly of long, narrow, flat-topped ridges, with steep-sided longitudinal valleys. The most important of these valleys are drained to the gulf of Taranto by the rivers Sinni, Agri, Cavone, Basento, and Bradano, which, on emerging from the Southern Apennines, bend south-east.

The *coastal strip*, of recent and Pleistocene age, increases in width north-eastwards to as much as about 15 miles near Metaponto, beyond which it narrows towards Taranto (p. 122). The surface of this strip, although mostly below 300 feet, rises from the low, coastal plain immediately behind the line of sand-dunes, towards the higher surface of the Pliocene rocks. The ascent is in four steps, which in some places are clearly marked terraces, but in others indistinguishable; their levels, furthermore, vary from place to place, but appear to fall slightly from west (65-100, 160-200, and 330 ft.) to east (50-65, 115, and 230 ft.). The edge of the lowest terrace is frequently an abrupt scarp, but those of the higher terraces are less steep. The flatness of the surfaces is emphasized by the steep sides of the valleys and occasional gullies. The coastal plain, with the exception of the dunes, and the mile-wide lower valleys are usually treeless cereal or grazing ground. The flat terraces are, in contrast, sometimes planted with olives.

Between the T. Canna and the F. Bradano the sand-dunes, which reach a maximum width of more than half a mile, are interrupted only by the swampy deltas of the Sinni and Agri. The loamy coastal plain widens from about one mile near the Canna to almost 4 miles near the Bradano. The lower edge of the first terrace (about 65 ft.) is well marked, and north of the Agri is followed for about 5 miles by the railway, here about 2 miles inland. On a projecting spur of this terrace overlooking the Bradano valley the remains of the Greek temple of Metapontum form a conspicuous landmark. Behind this first terrace the country rises, normally in three more steps. Along the Bradano these are at about 150, 260, and 325 feet, and are succeeded by a steep rise to the Pliocene surface at about 1,000 feet. The terraces are interrupted by the flat river valleys, still about a mile broad. Large gravel banks occupy much of the floors of the Sinni and Agri valleys, whilst the Cavone, Basento, and Bradano have narrower beds in flat, alluvial flood-plains (Plate 129). The



whole district is very lonely, with only a few, widely separated farms.

East of the Bradano the coastal strip narrows again. There are more trees and settlements and the sand-dune belt is covered with pinewoods. The individual terraces became less distinct; there are no more broad river valleys, and the landward edge is formed by the limestone ridges between Laterza and Mottola, instead of the less resistant Pliocene. Between the Bradano and the T. Lenna the surface of the seaward part of the strip is corrugated with series of parallel, straight, and narrow ridges, former coastal dunes, separated by shallow depressions. The ridges run parallel to the shore and have a relative height up to about 50 feet. East of the Lenna the surface of the ground is less irregular and the plain of Palagianò, about 6 miles wide, covered with a forest of old olive trees and a few vines, rises steadily inland to about 260 feet, at the foot of the Pliocene scarp which is furrowed by many small dry ravines. East of Massafra the plain narrows suddenly to about a mile and the country rises in a multiplicity of steps to the Pliocene rocks immediately below the limestone of the Murge. The railway from Palagianello to Taranto follows the inner edge of the Palagianò plain. Immediately west of Taranto a platform of Pleistocene sediments, cultivated with olives and arable crops, rises abruptly from the sea. Taranto itself stands on a similar platform, and the land-locked basin of the Mare Piccolo is surrounded by low cliffs, 30-60 feet high.

An abrupt scarp rises above the inner margin of the coastal strip to the upper, dissected surface of the *Pliocene zone* which slopes inland from 800-1,200 feet to a maximum of rather more than 2,000 feet at points near the Apennine border. The clays and sands have been deeply incised by the gulf rivers into straight, gorge-like upper valleys and broad, flat, alluvial lower valleys. The longest of these troughs, the Bradano-Basentello, although not a through line of communication, leads back to Spinazzola (1,427 ft.) on the watershed, 15½ miles short of the Ofanto. North of the watershed a number of streams, of which the F. Locone is the longest, drain through lower and less dissected country.

A highly confused relief of steep slopes and small flat hill-tops or valley bottoms dominates the zone, although the surface is more highly dissected near the coast and comparatively flat near the watershed (1,000-1,500 ft.) between Gravina, Spinazzola, and Genzano di Lucania, and in the area draining to the Ofanto. The disintegration of the surface, particularly in the south-east, has been



aggravated by thoughtless deforestation, with the result that the weak, clay valley-sides collapse easily. In the summer, as the volume of water in the rivers diminishes, extensive gravel flats are revealed amid the interlaced channels. The valley bottoms are malarial and avoided by settlements and roads which keep to the firmer and drier ground above.

The Basento valley is important since it is followed by the one railway from the coastal plain across the Lucanian Apennines. North of Pisticci its steep sides of soft, yellow clay are easily eroded into naked ridges and bizarre earth-pyramids. The middle valley has more stable slopes owing to a capping of *rocce-tetto* (p. 365). Along the northern edge, high above the river-bed (300–750 ft.), runs the Taranto–Potenza road (7) rising from 1,500 to 2,300 feet. Above Caleiano the narrower upper valley extends into the Southern Apennines (p. 341).

The Bradano valley forms a deep trough, broad below the confluence of the T. Gravina, narrower above it as far as Irsina, beyond which it crosses more open country. The upper section above Genzano station is steep and narrow in the Southern Apennines. There is the usual lack of settlements and roads in the valley.

The T. Basentello, the chief left-bank tributary of the Bradano, reaches almost to the north-western limits of the Pliocene zone. Its lower course below the crossing at road 96 is in a trench; its middle course is incised in the flat-topped Pliocene surface, but its upper course crosses a level plain. The valley is deserted except for widely scattered farm-houses. The basin of the Basentello is connected with that of the Ofanto by two low saddles on either side of Spinazzola, the Sella di Palazzo on the west (c. 1,280 ft.; Foggia–Spinazzola railway), and the Sella di Spinazzola on the east (c. 1,310 ft.; Barletta–Spinazzola railway).

The triangle between Spinazzola, Canosa, and Lavello is an area of undulating clay-land, dissected into low ridges by the F. Locone and other tributaries of the Ofanto. The southern margin, above the Fiumara di Venosa, is abrupt, but on the north there is a gentle descent to the flat Ofanto valley (p. 381).

In the angle between the Bradano–Basentello and the south-west edge of the Murge the complexity of the relief is increased by two outcrops of limestone, outliers of the Murge. The first of these upfolds extends as a ridge about 3 miles wide from Matera to Castellaneta, a distance of about 15 miles. This ridge is comparatively low (1,706 ft.) and normally rises about 300 feet above the surface





PLATE 135. *The 'gravina' at Castellaneta*



PLATE 136. *The Mesima valley: Pliocene plateaux*





PLATE 137. *Barren limestone outcrops with poor olives, near Otranto*



PLATE 138. *'Trulli' on the Murge near Alberobello*



of the surrounding Pliocene rocks. It is crossed between Ginosa and Laterza by a saddle followed by a main road, and at Matera by a remarkable canyon (5 miles long, 325 ft. deep) on the brink of which the town is situated. On the south the ridge rises almost directly from the plain of Palagiano (p. 369). On the north the flat Pliocene surface of weak sands and clays is fairly well preserved at about 1,300 feet. Its expanses of grain, beans, and rape contrast with the grey, dry sheep-pastures of the limestone ridge. The second limestone ridge rises some 230-260 feet above the Pliocene surface at Altamura (1,552 ft.). It reappears in the Murgia Catena (1,450 ft.), a little to the south-east, but its westward continuation is practically level with the Pliocene and is only betrayed by occasional vineyards, stony sheep-pastures, and by the limestone canyon of Gravina. The town clings to the brink of this canyon, in the sides of which dwellings and even a church have been hollowed out of the rock.

East of Castellaneta the Pliocene zone narrows considerably. From Massafra (360 ft.), at the inner limit of the coastal strip, northwards to the steep edge of the Murge (M. S. Elia, 1,473 ft.) is only 3 miles. Farther east still, however, between Crispiano and Grottaglie, the furrowed Pliocene surface broadens and continues east of Taranto.

### *The Salentine Peninsula*

From the edge of the Murge tableland, marked by the Taranto-Brindisi road (7), the Salentine peninsula, with an average breadth of about 25 miles, extends south-east for 65 miles to the rocky Cape S. Maria di Leuca, the ancient Iapygium. The peninsula is much lower than the Murge, of which it forms a continuation; the hills of the Murge Tarantine, to the south-east of Taranto, and the Murge Salentine, south of Lecce, rise only to 476 and 659 feet respectively, while the lowland areas south-west of Lecce and between Otranto and Brindisi do not exceed 165 feet.

In spite of the low relief, the surface geology is varied (Fig. 60). The rocks, which are mainly calcareous, consist of four chief types: compact Cretaceous limestone; a marly limestone known as *pietra leccese* (Miocene); calcareous tufa, mostly Pliocene; and unconsolidated sands. The compact limestone (Plate 137) outcrops in the hilly areas but forms the substratum of the whole peninsula. South of Lecce the asymmetrical ridges (*serre*) of this limestone trend towards the south-east and are separated from each other by longitudinal depressions, which were originally caused by fracturing associated with folding of the limestone, but have since been deepened by



erosion. The pietra leccese, a greyish-yellow stone, is present in the east in scattered lowland areas, of which the largest is immediately south-east of Lecce, where the formation attains a thickness

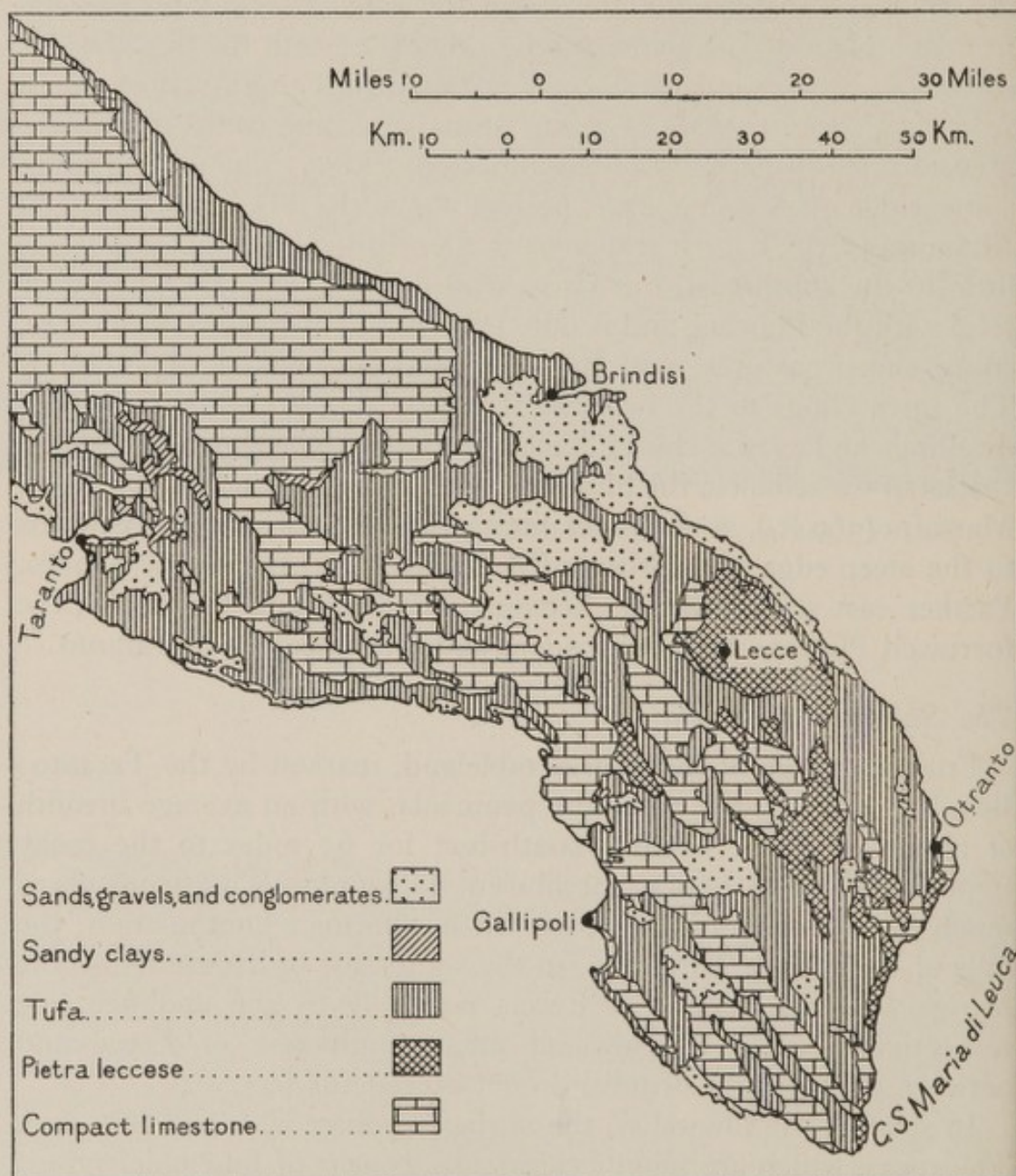


FIG. 60. *The Geology of the Salentine peninsula*

of more than 200 feet. The pietra leccese is easily worked and has been much used in the baroque architecture of the town. The calcareous tufa, which is widely distributed, fills many of the depressions between the serre and covers much of the lowland north-west of Lecce. The unconsolidated, yellowish sands occur mainly in beds resting on the tufa to the west of Lecce and towards the south of the peninsula.



In addition to these four main rock types, deposits of terra rossa (p. 243), in places as much as 16 feet thick, cover parts of the troughs between the serre. The terra rossa, tufa, and pietra leccese are all important since they constitute bands of fertility in a land which, like the Murge (p. 374), lacks surface water. Temporary streams (*canali* or *fossi*) flow in winter, but few reach the sea. The only perennial stream is said to be the F. Idro, which enters the sea at Otranto. Although most of the drainage is underground, there is a greater variety of scenery and vegetation than might be expected. Formerly there was much natural woodland, but this has given place to cultivation and grazing.

Taranto and the Mare Piccolo are encircled by plains of Pleistocene clays and sands continuous with the coastal lowlands of the gulf of Taranto on the west and east. North of the Mare Piccolo the plain, here 6 miles wide, rises to the Pliocene surface between Crispiano and Montemesola, and eastwards gives access through the Grottaglie gap (road 7 and railway) to the Brindisi lowlands.

South-east of the Mare Piccolo the gradually narrowing Pleistocene coastal lowland extends to Porto Cesareo (p. 123). This is, on the whole, a sparsely peopled region, owing in part to the ravages of malaria, but near Taranto some small depressions, formerly containing salt-pans, have been reclaimed. Inland the lowland rises sharply to the bare, flat ridge of the Murge Tarantine. This ridge, which rarely exceeds 350 feet and diminishes in height to the south-east, extends more or less parallel with the coast for 30 miles from S. Giorgio Ionico. Its dry surface affords grazing-land for sheep. Flattish hill country, mostly dry and stony pasture-land, less than 160 feet high, continues south-east of the Murge Tarantine almost to Nardo and reaches the sea in low limestone cliffs beyond Porto Cesareo.

North and east of the Murge Tarantine a broad lowland of remarkably uniform altitude (100–250 ft.), the Tavoliere di Lecce, extends for more than 30 miles from the Taranto–Brindisi road (7) to a line from Nardo to Lecce. The rainfall here is low (20–25 in.) and water is scarce especially where porous sands cover the surface. There is, however, a comparatively well-cultivated and densely populated triangle to the west and north-west of Lecce, where there are several large settlements, such as Campi Salentina, Squinzano, and S. Pietro Vernotico, around which olives, figs, vines, and tobacco are produced with the aid of water stored in cisterns. Elsewhere in the Tavoliere di Lecce the land is generally suitable only for grazing



sheep. Farmsteads are widely scattered and villages few. North of the limestone Oria scarp, which sweeps south-east from the vine-clad slopes at Oria (545 ft.) towards Lecce (167 ft.), predominantly arable country, relieved by a zone of trees with a few vineyards around each town, drops gently towards Brindisi (Plate 29).

Along the Adriatic coast the gently inclined surface of the coastal plain does not rise above 165 feet between Otranto, Lecce, and Brindisi. The low, deserted, sandy lagoon shore, where reclamation has been active to the north of S. Cataldo, is backed by thinly populated country (p. 127). East and south-east of Lecce the population is, however, denser where the *pietra leccese* has a covering of reddish marl, which is irrigated by well-water.

South-east of the Gallipoli-Lecce road (101) the hilly limestone country of the north-west to south-east *serre* and their intervening troughs stretches for nearly 30 miles to the extremity of the peninsula and as far east as the coastal plain north of Otranto. Owing, however, to the partial levelling of the surface by erosion and to the filling of the valley-like troughs with sediments, the *serre* do not as a rule appear as conspicuous topographical features. The more or less impervious sediments form bands of fertility, which are cultivated, especially where the *terra rossa* is present, with olives, vines, almonds, and other trees. Many small settlements flourish in these troughs. The *serre* can be grouped into two, the western or the Murge Salentine, including the Serra di Eleuterio (640 ft.) and the Serra del Cianci (659 ft.), the greatest heights of the Salentine peninsula, and the eastern, which are generally the better watered, including the Serra di Corigliano (394 ft.). All the *serre* lose height as they approach the east coast. Both ridges and troughs alike are truncated by the coastline, which leaves the troughs suspended high above sea-level, so that the line of cliffs is almost unbroken between Cape S. Maria di Leuca and Cape Otranto.

### *The Murge*

The great tableland of the Murge<sup>1</sup> extends for some 90 miles north-west from the Taranto-Brindisi road (7) to the lower Ofanto valley, and for about 30 miles between the Adriatic coast and the sinuous line from Grottaglie to Minervino, which marks its steep edge above the Taranto-Tavoliere corridor. The tableland consists of a homogeneous block of gently folded, greyish-white, stratified limestone of Cretaceous age, and rises on the east from a narrow

<sup>1</sup> Singular *murgia*—a dry, rocky, and stony limestone surface.



coastal plain to a crest close to its south-western edge. The maximum heights of more than 2,000 feet are attained in the north-west by the flat-topped Torre Disperata (2,251 ft.), M. Caccia (2,231 ft.), and M. Scorzone (2,198 ft.).

The ascent from the Adriatic coast to the higher plateaux is in several broad terraces, sometimes edged with conspicuous scarps, the more marked of which are shown on Fig. 61. There is no general agreement whether these terraces are of purely marine origin or are mainly the product of faulting. It is clear, however, that not only do they vary greatly in height throughout their length, but also lack continuity. There is, furthermore, a marked absence of terraces in the triangle between Bari, Casamassima, and Grumo Appula. The Murge lack surface-water. The impervious rocks are at such a depth that there are no springs, and only where superficial Pliocene deposits hold a little ground-water are reliable supplies naturally available. Typical limestone landforms are, however, comparatively rare; there are few rugged and rocky hills, dolines, or caverns, an almost complete absence of valleys, apart from a number of dry ravines (*gravine*) near Bari and in the edges of the plateau, and no poljes (p. 38). The lack of surface-water, however, does not here imply infertility. The red-brown soil, which covers most of the surface, although full of stones, holds some moisture and is highly productive. The bare rock is visible only in the ravines or in the highest areas where erosion has stripped the soil. The stones in the soil are collected together and built into walls between the fields or gathered into heaps. In the south-east, especially, there are large areas strewn with boulders, which, because they split naturally into slabs, are used in the construction of peculiar beehive-shaped buildings (*trulli*). These are built mostly in scattered groups of twos and threes to the south of Monopoli (Plate 138).

The narrow coastal plain (p. 129) and the lower, terraced slopes of the tableland, which together form a band roughly 12 miles wide, constitute the most fertile and densely peopled part of the Murge. The 40-mile stretch of coast between Brindisi and Monopoli is, for the most part, deserted, but from Monopoli to Barletta there are at intervals of about 6 miles moderately large settlements, dominated by Bari. A second line of towns, 4 to 8 miles from the coast, extends from S. Vito de' Normanni, west of Brindisi, to Canosa di Puglia, above the Ofanto valley. West of Bari these towns are linked together by a main road (98) which runs parallel with the coastal road (16) along a broad terrace. The most important of the



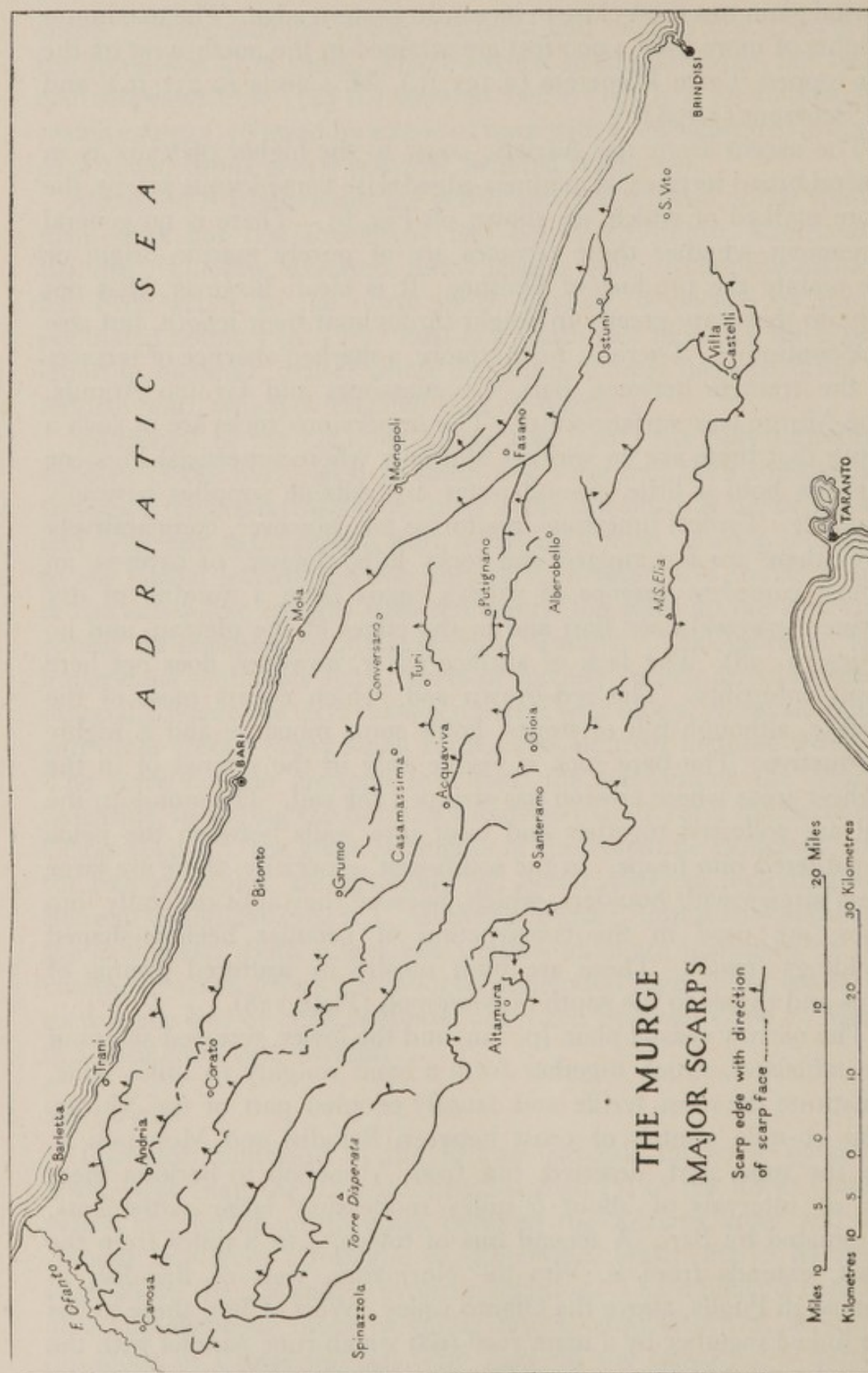


FIG. 61.



cultivated crops are olives, vines, almonds, and various cereals (Fig. 62). Olive groves are particularly profuse along the wide coastal plain below the Fasano scarp between Brindisi and Monopoli, and also in the coastal area between Bari and Barletta. Almost all olive groves are within 15 miles of the coast and below 1,000 feet. Most of the vineyards are in a belt between 5 and 12 miles of the coast and 300 and 1,000 feet above sea-level. There are occasional vineyards at lower levels, especially in the north, and in favoured districts above 1,300 feet, as at Alberobello, Santeramo, and Altamura. The almond tree, which thrives best on loose, calcareous soil, is most widespread 6 to 12 miles inland and between 650 and 1,300 feet. At higher altitudes and farther from the coast, the chief crops are wheat, oats, and beans. Finally, above the sown lands are the lonely grazing expanses of the high Murge, which are covered with scanty grass and drought-resisting plants, barely suitable even for grazing sheep. Some patches of *macchia* and woodland, especially deciduous oak, still remain, particularly in the south-east.

Settlements are rare in the high sheep pastures and the farm-houses (*masserie*) are widely separated, except where the limestone is overlain with fertile sands or with deposits of *terra rossa*<sup>1</sup> (p. 243), or where wells have been sunk in the few patches of Pliocene clays and tufa, which constitute 'oases', such as Acquaviva delle Fonti, in an otherwise waterless country. An almost completely uninhabited area of 500 square miles lies west of the Grumo-Altamura road (96).

Between Brindisi and Monopoli the coastal plain, which is covered with a fertile tufa, is made up of some minor terraces, furrowed by small, dry valleys. The plain reaches its greatest breadth of  $3\frac{1}{2}$  miles below the steep scarp at Fasano. This 50-mile long scarp, which is etched with small ravines and artificially terraced for olives, increases gradually in height north-westward from near Brindisi. At Ostuni the top of the scarp is 750 feet above sea-level, and above Fasano it rises nearly 1,000 feet above the coastal plain to M. Signora Pulita (1,319 ft.). Beyond this point the scarp decreases in height and finally dies out west of Mola di Bari. Between Monopoli and Bari the road (16) and railway are forced nearer the coast by the outer spurs of the Murge. North-west of Bari the slopes of the Murge tableland come down to the Adriatic shore in low cliffs, but from Trani to Barletta the coastal plain reappears and attains a width of 2-3 miles. Its surface is covered with fertile Tertiary deposits planted with vines.

<sup>1</sup> Known locally as *bolo*.



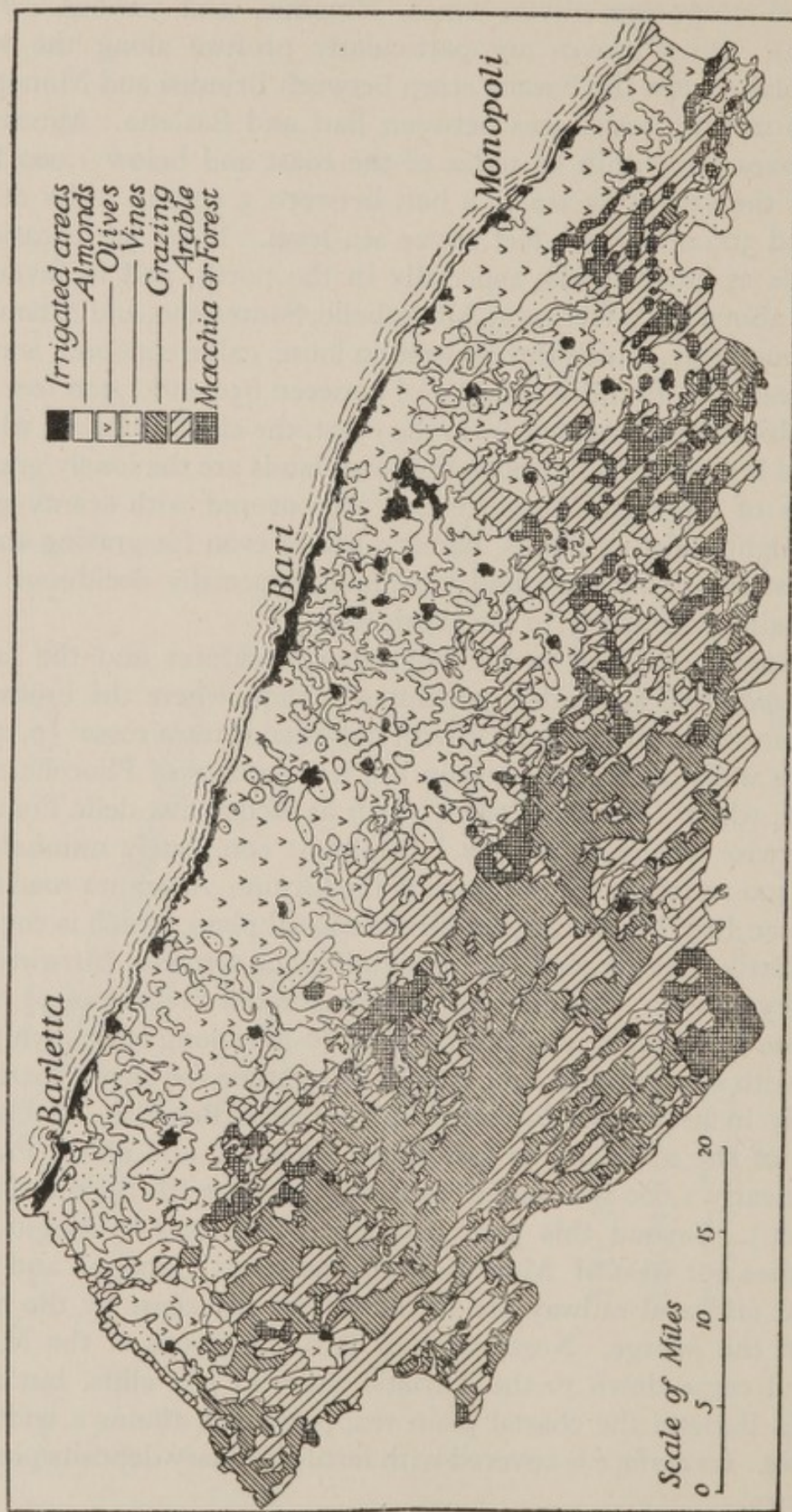


FIG. 62. The Murge: Land Utilization



Behind the coastal plain the plateau of the Murge proper rises in its series of broad steps with north-east facing scarps of varying height and steepness. Fig. 61 shows only the most striking of these and makes no attempt to distinguish their magnitude. It will be seen that the scarps are much more numerous and regular in the west, although the highest and steepest of all is that near Ostuni and Fasano. The eastern and western parts of the plateau are separated in the neighbourhood of Gioia del Colle by a gap, through which passes road 100 from Bari to Gioia. In this gap and in the triangle between Bari, Casamassima, and Grumo Appula the scarps are few and low, and the steady rise of the plain is interrupted only by a number of deep, dry ravines converging on Bari.

Regular terraces are scarcely discernible in the east of the plateau, and above the main Ostuni-Fasano scarp the land rises irregularly to an undulating region between 1,300-1,500 and even 1,600 feet high. A peculiar feature to the south of Fasano, Putignano, and Turi is a string of narrow, flat depressions, about two-thirds of a mile wide, sunk about 150 feet below the surface of the plateau, and bounded on either side by low scarps. Tree crops are less important in them than cereals, and scattered buildings (*trulli*) more common than on the plateau surfaces. Alberobello, at the end of one of these basins, is the only town in which *trulli* are found in any number. Farther south on the higher plateau some deciduous oakwood and *macchia* still remain; elsewhere the surface is covered with stony sheep-pasture.

Scarps and terraces succeed each other with some regularity and parallelism in the west, where the plateau is broader and rises, with rather more scarps than in the east, to over 2,000 feet in a large area between Altamura and Minervino. The summit of the Murge is an undulating zone about 5 miles broad, mostly treeless, stony sheep-pasture. Woods and *macchia* are much less common than in the east. Patches of water-bearing clays and sands are the usual sites of the towns, in which the population is almost entirely gathered.

The abrupt southern edge of the Murge falls about 400-600 feet, usually in one step, to the Pliocene surface of the Taranto-Tavoliere corridor. In the south-east the edge begins at Villa Castelli and rapidly increases in height westward to M. S. Elia (1,473 ft.) and M. Orsetti (1,513 ft.), both overlooking the Pliocene surface at about 800 feet north of Massafra. South of Gioia del Colle the scarp is in several steps and a wide scallop of Pliocene territory, followed by road 100, penetrates into the Murge. West of this embayment the



edge is again high and abrupt and projects south of Santeramo in Colle, where M. della Parata (1,598 ft.) rises 400 feet above the flat Pliocene surface. Round Altamura another Pliocene scallop, also followed by a road (96), bites into the edge and separates the Murge from the limestone of the Murgia Catena and Altamura-Gravina upfold (p. 371). The scarp here falls in terraces, the edges of which are notched with dry ravines (gravine). West of Altamura the scarp is again steep and straight as far as Minervino and the Ofanto valley. Above the scarp edge north of Gravina is a remarkable doline, the Pulicchio di Gravina, 580 yards by 400 yards and 270 feet deep. Both limestone and Pliocene rise towards the west and the average height of the scarp is about 600 feet. Above the Ofanto the plateau rises gently and the slope is covered with Pliocene sands up to a height of 1,000 feet.

### *The Tavoliere di Puglia*

The lowland of the Tavoliere is the only true plain in the south-east of Italy. It stretches north-westwards for 60 miles from the F. Ofanto to the F. Fortore and westwards for 30 miles from the Adriatic coast and M. Gargano to the Neapolitan Apennines, the eastern edge of which is marked by the sharp fold or fault-line extending from Lavello to Bovino and then north-north-west to the F. Fortore. On the east and on the north the plain reaches the sea, and on the south and north-west is continuous with the Pliocene country of the Taranto-Tavoliere corridor and of the Adriatic flank of the Apennines.

The surface of the Tavoliere is composed of nearly horizontal beds of comparatively soft Pliocene sands and Pleistocene clays. These beds are covered, except along the outermost rim, with a calcareous crust immediately below the dark surface soil. Along the Adriatic is a sandy and marshy coast, backed in the centre by a low-lying Pleistocene plain, which slopes very gently inland up to Cerignola, Foggia, and S. Severo. Still farther inland, a line of low but gradually rising platforms of Pliocene sands, capped with a thin layer of Pleistocene, extends in a semicircle round the plain from the south-east near Cerignola to Torremaggiore in the north-west. In the north a Pliocene ridge connects M. Gargano with the Apennines.

With the exception of the F. Fortore, which flows to the north, the main rivers, the Ofanto, Carapelle, Cervaro, Vulgano, and Candelaro, drain with gentle gradient towards the gulf of Manfre-



donia. All, except the Ofanto, tend to be dry during the summer drought, which is prolonged and severe.<sup>1</sup> This is, indeed, one of the driest parts of the country, but, like many of the alluvial plains of southern Italy, suffers from alternate scarcity of water in summer, and excess in winter, when the surface is often waterlogged.

Until the second half of the nineteenth century the Tavoliere was divided into large grazing farms (*masserie*), the homes of enormous flocks of sheep. Very little of the soil was cultivated and agriculture was hampered by restrictions designed to maintain the interests of the sheep-farmer. The flocks were pastured here only, during the cool season and in summer moved along the broad drove-tracks (*tratturi*) northwards to the grassy upper slopes of the Central Apennines. The *tratturi*, including broad areas of grazing for the moving flocks, occupied a considerable portion of the surface. During the last sixty or seventy years the numbers of sheep have been reduced, and the practice of seasonal migration has decreased. At the same time the Tavoliere, except for the less favourable areas near the coast, has been steadily converted to 'extensive' cereal land. Some of the large farms have been broken up and many of the *tratturi* have been made into roads or ploughed up for wheat. This change has done little, however, to change the appearance of the Tavoliere. There are still scarcely any trees in the central parts, and after the harvest in June the plain is a barren steppe, practically bare of vegetation, brown or yellow in the heat. Ground-water is not available to make up for the deficiency of rainfall, and the Tavoliere does not offer the same scope as many of the alluvial plains of the country for reclamation by a combination of drainage and irrigation.

The broad Ofanto valley, between the Murge and the Cerignola plateau, is a straight and comparatively steep-sided trough, but in the west the south side rises gradually to the Taranto-Tavoliere corridor (p. 370). The valley floor is covered with scrub and nearly every winter is inundated by turbulent flood-waters, owing to lack of embankments. The mud discharged by the river tends to silt the harbour of Barletta to the south.

From the mouth of the Ofanto almost to Manfredonia, under the slopes of M. Gargano, the low dune-fringed coast is backed by lagoons and marshes. Inland a flat and featureless alluvial plain (50 miles long, 15 miles wide), crossed by the lower Carapelle, Cervaro, and Candelaro, slopes gradually up towards Foggia (243 ft.).

<sup>1</sup> Foggia receives only 3 inches of rainfall during June, July, and August.



Immediately north-west of the mouth of the Ofanto the marshes and one-time Lake Salpi have been converted into the salt-pans of Margherita di Savoia, the largest in Italy. Reclamation is in progress farther along this coast, and has been completed in the extreme north near Manfredonia (p. 131).

Beyond the recent alluvium the plain extends on to the loamy Pleistocene soils and in the north and south to higher platforms. The small, 150-foot high tableland around Petrulla, which is cut off from a similar terrace at the foot of M. Gargano (p. 384) by the marshy lower valley of the Candelaro, has almost isolated the low plain of the upper Candelaro between Foggia and Apricena. The western edge of M. Gargano rises sheer from this inner plain to over 2,000 feet.

The slightly higher Pliocene platforms of the outer rim are covered with a layer of Pleistocene gravels and a calcareous crust. These platforms are lightly furrowed by small watercourses and divided into separate blocks by the broader valleys of the Apennine rivers. There is, indeed, little to distinguish them from the lower plain out of which they emerge, except that, especially in their higher parts and on the edges of the valleys, they are dotted with some olive groves, and, particularly in the south, with some large vineyards.

The Pliocene platform around Cerignola (407 ft.) is isolated on the south from the Murge and the Taranto-Tavoliere corridor by the trough of the Ofanto valley, and on the west from the Apennines by a low sill (800 ft.) near Candela, which connects the elbow of the Ofanto with the Carapelle valley. This sill is followed by the railway from Foggia to Rocchetta S. Antonio-Lacedonia junction. The plateau of Cerignola (30 miles long and 15 miles at its broadest) has a gently undulating surface, rising from about 150 feet in the north to 650-1,000 feet above the Ofanto valley in the south, and, through several terraces, to 1,650 feet in the west immediately above the Candela sill (M. Carpinelli, 1,660 ft.). The sandy southern and western edges are steep. In recent years the districts immediately to the north of Cerignola and north-westwards as far as Orta Nova have been brought under cultivation. Vines, olives, and almonds have been planted, and crops of wheat grown on former grazing land.

On the western margin of the Tavoliere the platforms, about 12 or 13 miles wide, rise from about 500 feet to 1,500 feet at the sharp edge of the Mi. della Daunia (p. 328). This edge can be traced from the elbow of the Ofanto to Bovino, and thence north-north-west to



the Fortore valley. It is marked by a line of large villages. Numerous streams, tributaries of the T. Cervaro and T. Candelaro, flow through valleys incised in the platforms, the sandy sides of which are subject to landslips. Like the Cerignola plateau, these platforms are comparatively fertile and are planted with some fruit-trees and vines. On a detached remnant rising abruptly out of the plain stands the market town of Lucera (824 ft.).

Between the F. Fortore and M. Gargano a narrow ridge, about 460 feet high, rises gradually on the north from the flat shores of Lake Lesina, more steeply on the south from the low-lying plain near Apricena, and abruptly on the west above the Fortore valley. It is crossed by the main east coast railway near Poggio Imperiale, but road 16 climbs the scarp near the Fortore farther south. South of the T. Candelaro the road and rail junction of S. Severo is on a protruding spur of Pliocene deposits, surrounded by vine-planted slopes.

### *The Gargano Promontory*

The Gargano Promontory, about 35 miles long and 20 broad, is bounded on the east and north by the Adriatic (p. 133) and on the south and west by the Tavoliere lowland. Its steep faulted sides rise abruptly to a broad plateau (2,600–3,000 ft.) dominated by an east to west line of rounded heights rather more than 3,000 feet high. The ascent along the southern flank is in several terraces with steep edges. Elsewhere, in contrast, the rise to the summit is along a series of steep ridges separated by shallow troughs. These are parallel (NW.–SE.) to each other in the north-west and north, but in the north-east converge on the summit ridge.

The promontory is composed of Secondary limestones, some hard and rocky, especially near the centre where dolomite outcrops, and some rather softer and covered with more soil, particularly towards the east. On the north-western and southern flanks there are several small areas of Pliocene deposits. In spite of the relatively high rainfall (Fig. 74) there is a lack of surface water except on the margins of the plateau and particularly in the north-east, where springs break out intermittently. The relief of the limestone is rougher than that of the Murge and typical limestone landforms are more common.

The height of M. Gargano is sufficient to increase the rainfall considerably and modify the vegetation. At the base there is a belt of Mediterranean vegetation and crops, with a few irrigated orange-groves near Rodi and on the south coast, and here and there woods of Aleppo pine, now much reduced in extent. Higher up there are



woods of oak, especially Turkey and hairy oak. Still higher are beech woods, of which the Bosco d'Umbra on the road between Monte S. Angelo and Vico is the best known. Other trees mixed with the beech and oak are maple, hornbeam, holly, and lime. Forests are, however, the exception; the bulk of the surface of the plateau and of the terraces is open sheep and goat pasture. The natural vegetation contains a number of Dalmatian species not found elsewhere in Italy.

The ascent from the Tavoliere to the abrupt southern face of the plateau is normally by two distinct terraces. The gently inclined triangular surface of the lower terrace is about 250-500 feet high, 6 miles across at its broadest, and furrowed by occasional ravines. In the south-east there is a narrow, lower step below about 150 feet. The steep south-western edge, about 250 feet above the valley of the T. Candelaro, extends for about  $12\frac{1}{2}$  miles from M. Aquilone (423 ft.) to Madonna di Cristo (522 ft.), below Rignano Garganico. A deeply incised, high escarpment, which is particularly precipitous in the east, leads to the upper terrace (1,650-2,000 ft.). Above the scarp edge, which stretches from Coppa d'Apolito (1,529 ft.) westwards for 25 miles to M. della Donna (1,552 ft.), the ground rises rapidly in the north-east to a discontinuous ridge (M. degli Angeli, 2,907 ft.), crowned by the important hill-top settlement of Monte S. Angelo (2,766 ft.), the chief centre for pilgrimage in southern Italy. The ridge is separated from the plateau to the north by a narrow, straight, east-to-west depression containing three separate, steep-sided basins, and is followed throughout by a secondary road from Monte S. Angelo to S. Severo. In the east the Valle Carbonara is occupied by a stream draining eastwards, with the small Mattinata plain at its mouth. This valley, which has a maximum depth of 1,650 feet, is well known for its vineyards. To the west of the Valle Carbonara is the basin containing the town of S. Giovanni Rotondo (1,827 ft.) and the former Lake S. Egidio or S. Giovanni (1,476 ft.), drained in 1932 and now cultivated. Still farther west, at the head of the steep-sided Valle di Stignano, is S. Marco in Lamis (1,805 ft.). The partly wooded northern slopes of these depressions climb steeply to M. Spigno (3,314 ft.), M. Calvo (3,465 ft.), and Monte Nero (3,317 ft.), the highest summits of M. Gargano, which rise gently and slightly above the general level of 2,600-3,000 feet.

Between Coppa d'Apolito, at the eastern end of the upper terrace, and the port of Vieste, the limestone ridges come down to the coast in low cliffs. In the district immediately round Vieste and to the







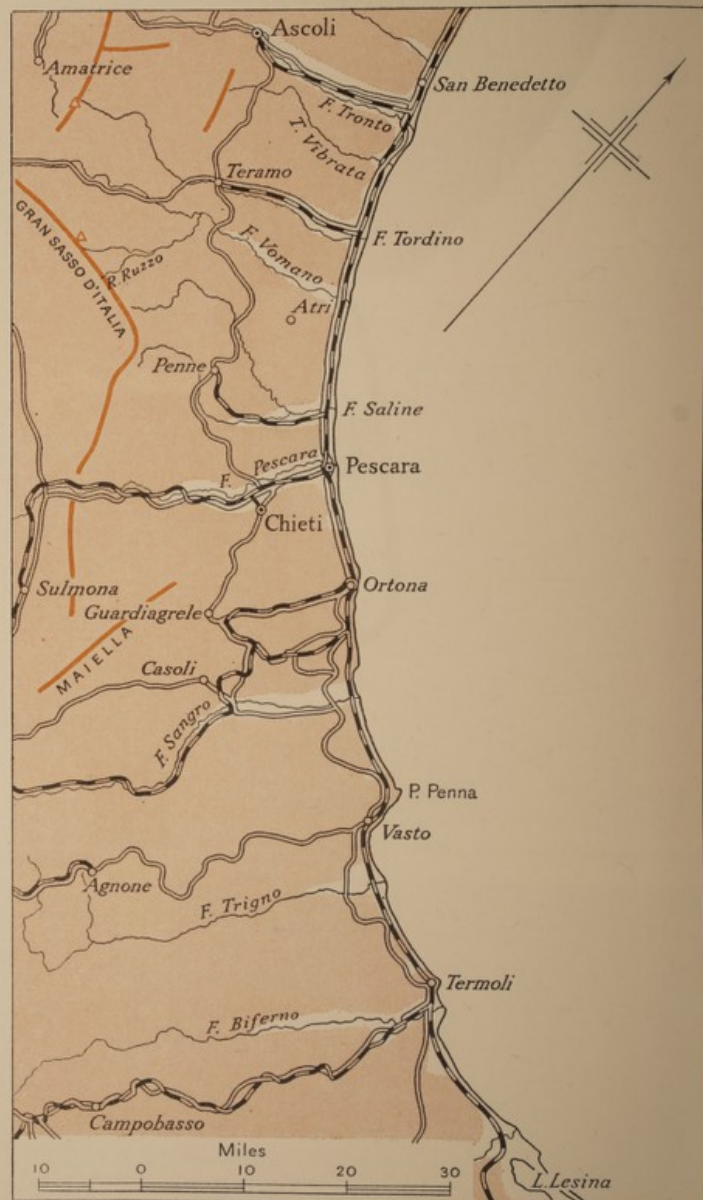
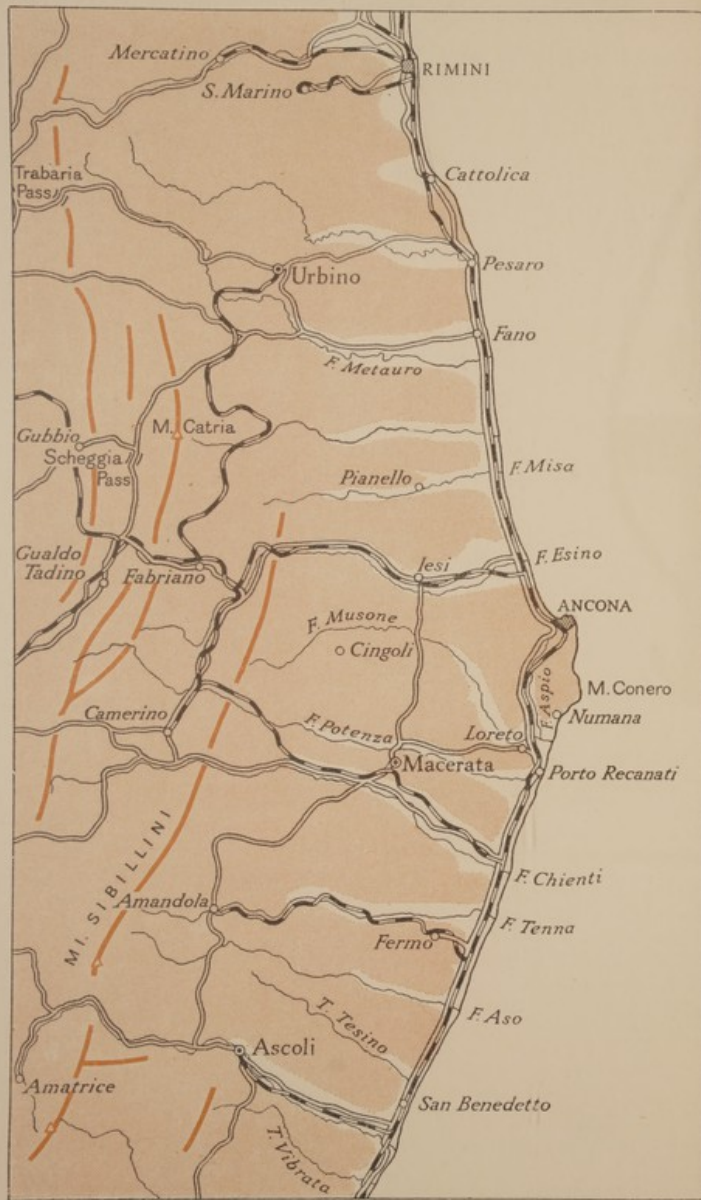


FIG. 63. The Adriatic Coastland. (For Key see Fig. 40)



north-west the country is lower and more fertile. Vines and small olives, in particular, grow well and there are pinewoods on scattered deposits of Pleistocene sands. Inland on the rising ground are woods of deciduous oak and yew, and still higher of beech. Near the picturesque north coast between Peschici and Rodi (Plate 31) there are deposits of terra rossa and much tree cultivation. In this area a larger population than in most parts of the promontory manages to support itself by the skilful use of spring-water.

The wooded M. d'Elio (827 ft.) separates Lake Varano from the narrow and shallow Lake Lesina, the marshy areas to the south-east and west of which have been, or are in process of being, reclaimed. The ridges which run south-eastwards from the neighbourhood of these lagoons rise steeply to between 1,600 and 2,000 feet, and are partly cultivated with olive and vine, as near Cagnano Varano and Sannicandro, and partly covered with woodland. Towards the interior, as the height increases, the limestone appears as bare rock or with but a thin veneer of plant cover. The western half of the plateau, with its poor stony pastures, fit only for sheep and goats, is in striking contrast with the forests of the eastern half. The valley-like depressions between the ridges seldom contain water, and dolines bear witness to underground drainage. The western edge of M. Gargano rises steeply for some 1,650 feet from the low plain of the upper Candelaro to the nearly flat surface of the plateau, or, in the south, of the upper terrace already mentioned.

Communications avoid the plateau as much as possible, though there are three or four roads which cross it. The coastal route is comparatively easy only in the north and south. The east coast, especially south of Vieste, is very difficult and is avoided, except at Vieste itself, by the new circular road (89). The proposed railway around Gargano is complete only to Manfredonia in the south and to Peschici in the north.

## THE ADRIATIC COASTLAND

THIS region is a remarkably uniform strip, only about 20 miles broad, extending north-westwards for about 215 miles along the Adriatic shore from the F. Fortore, which divides it from the Pliocene rim of the Tavoliere di Puglia (p. 380), to Rimini on the borders of the Northern Plain (p. 265). At either end the region passes into country similar to itself, but on the west is bordered by the bolder slopes of the Central and part of the Northern Apennines (pp. 314 and 306). In



general terms it consists of the lower parts of the parallel transverse ridges into which the Adriatic slope of the Apennines is dissected.

*Physical Features.* Geologically the region is composed almost entirely of blue-grey Pliocene clays or clayey marls, often with a capping of yellowish sand. Some older clays and marls outcrop along the western border, and alluvial deposits (Pleistocene and recent) line the coast and extend up the lower valleys of the main streams. In M. Conero, near Ancona, and at San Marino there are small but noteworthy outcrops of limestone.

Throughout the whole length of the region there is normally a narrow coastal plain, backed by the dissected remnants of Pliocene plateaux rising gently inland from about 300 feet to about 1,100 feet. There is a further rise to 1,300–2,000 feet before the distinct and very much sharper ascent of the wall-like barrier of the Apennines begins. The Pliocene plateaux are dissected, as already stated, into ridges by parallel rivers which flow at right angles to the coast. The ridges, however, are not simple and symmetrical, but are further dissected into minor ridges, parallel to the coast. It is supposed that the Pliocene deposits were uplifted and gently folded along west-south-west to east-north-east axes at right angles to the earlier folding of the main Apennine range. The Apennine streams flowed in the downfolds across the newly uplifted land-surface. Possibly owing to the nature of the original folding and to a relatively greater uplift in the north-west, some of the rivers have been thrown against the steeper southern sides of the downfolds, with the result that their present valleys are noticeably asymmetrical,<sup>1</sup> e.g. those of the Pescara, Tordino, Tronto, Potenza, Musone, and Esino. These valleys, accordingly, have a northern slope composed of long, narrow ridges at right angles to the course of the river. In contrast their southern side consists of a continuous ridge parallel to the river. Calanchi and landslips occur in the weak rocks forming the sides of these ridges, particularly on the northern slopes of the valleys.

The bluff headland of M. Conero divides the narrow coastal plain into two unequal parts. The longer, southern part, low, sandy, and remarkably straight except for Point Penna, is alined from south-south-east to north-north-west. Apart from some points at Vasto and Ortona, where the hills come close to the sea, the narrow coastal fringe of alluvium, sand, and shingle extends without interruption northward to Numana, near M. Conero. Between the T. Tesino

<sup>1</sup> Many features of the landscape are clearly shown in the excellent series of panoramas in *Mediterranean Pilot*, vol. iii, 6th edition, 1929, pp. 449–471.





PLATE 139. *M. Titano (San Marino)*



PLATE 140. *Claylands near Urbino*



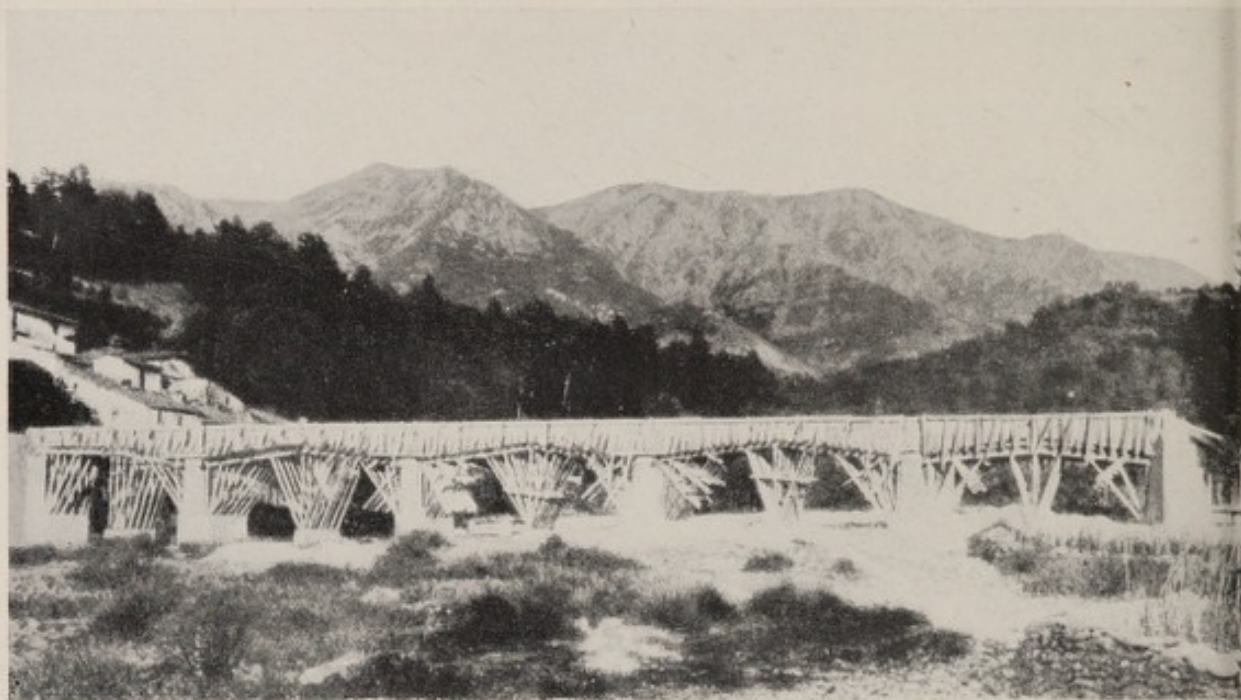


PLATE 141. *The Tronto valley: dry river-bed*



PLATE 142. *The Conca d'Oro*



and the F. Aso, where the plain is particularly narrow, landslips have occurred along the coastal margin of the Pliocene hills behind. The coastal plain is broader near the river mouths, but in spite of the large supply of sediment the deltas protrude little beyond the general line of the shore. The flat-topped limestone block of M. Conero rises to 1,877 feet, and is divided from the Apennine foothills by the alluvial valley of the F. Aspio, which is followed by the main coastal road (16) and railway. The block is composed of whitish and reddish limestone, and its seaward slopes from Numana to Ancona, about 15 miles, are steep and covered with *macchia*. North of Ancona the coast has a south-east to north-west trend, with hills here and there approaching the shore in low, broken cliffs, particularly between Pesaro and Cattolica. The deltas are scarcely perceptible, but the lower valleys of the rivers are broader than farther south. Near Rimini the coastal plain begins to widen and merges into the plain of Emilia (p. 136).

Behind the coastal plain the ground rises sharply to low, tabular Pliocene hills with rounded flanks. From the sea they appear to form a continuous level surface, generally of uniform height. The level of this surface is usually at about 300-400 feet immediately behind the coast, but in places, as between the F. Saline and F. Tronto, rises to over 600 feet. In the north, in an area extending from the mouth of the F. Potenza and behind M. Conero as far as Fano, the level is generally somewhat lower than usual. This footstool to the Apennines rises gradually to about 1,300-2,000 feet along a line 15 to 25 miles inland, above which the Apennines rise fairly abruptly. At San Marino the limestone M. Titano (2,421 ft.) stands conspicuously above the surrounding clays (Plates 139, 140).

The chief rivers emerge mostly through deep, steep-sided valleys from the limestones or sandstones of the Apennines, into the younger and lower Pliocene rocks which have been dissected into the asymmetrical ridges already described. There are more than twenty of these rivers, which occupy broad, flat, and sandy troughs with a general west-south-west to east-north-east direction to the south of Ancona, and south-west to north-east to the north. The shorter streams flow through narrow valleys, in which there is sometimes barely room for a road. Frequently the more resistant, sandy beds of the upper Pliocene present steep, scarped slopes like *balze* (p. 493), which may surround the heads of ravines. The valley of the Tronto, followed by both road (4) and railway, may be regarded as typical. From its mile-wide delta as far as Ascoli Piceno, 17 miles inland,



the river keeps to the south side of a broad and remarkably straight trough below the steep slopes of a continuous east-north-east to west-south-west ridge, 350-1,000 feet high. The river in this section has practically no tributaries from the south. The northern side of the valley, which is followed by both road and railway, has gentle slopes incised by numerous tributary streams into short, parallel ridges. Most of these trend south-south-east to north-north-west and are subject to landslips (Plate 141).

*Agriculture.* Most of the region is cultivated, mainly with grain crops, although some of the higher ground is uncultivated, as in the province of Teramo, where the projected Ruzzo aqueduct has been designed to make use of water from streams rising in the Gran Sasso (p. 325). Though practically all the region is below the limit of the olive (1,800-2,000 ft.), there is a scarcity of trees due to the compactness of the soil, the cracking of the surface, and the consequent exposure of the roots. A number of the broad lower valleys, particularly those of the rivers Tordino, Vibrata, Tronto, Tenna, Chienti, Musone, Esino, and Metauro, are well cultivated and often contain more vines and mulberries than the heights above. Some of the other valleys are lined with strips of *macchia*. On the slopes and hills there are large fields of wheat, the main cereal crop, maize, and sugar-beet. Along the sandy coastal fringe vegetables are an important crop, and there are more trees, with olives on the rising ground inland. Intensive cultivation is, however, limited to the neighbourhood of the towns.

*Population.* Almost all the settlements are set on hill-tops above the fertile fields and at a distance from the scattered farm-houses. Sites for villages and towns were, as a rule, chosen for defence and for freedom from landslips. The larger settlements are concentrated along three lines. Except for Ancona, settlements on the coast itself did not arise until piratical incursions ceased to be a danger a little more than a century ago. Many small fishing-ports, such as San Benedetto del Tronto, have to-day entered upon a new lease of life by providing facilities for sea-bathing. Numerous holiday resorts are strung along the practically continuous beach, some seventeen between Termoli and Ancona, and eleven, mostly larger ones, between Ancona and Rimini. The parent towns of these coastal settlements, which form a line within 6 miles of the sea, include Chieti (1,083 ft.), Atri (1,450 ft.), Fermo (1,047 ft.), and Loreto (417 ft.). The third line of towns, about 15-20 miles from the coast and near the foot of the Apennines, includes Guardiagrele (1,893 ft.),



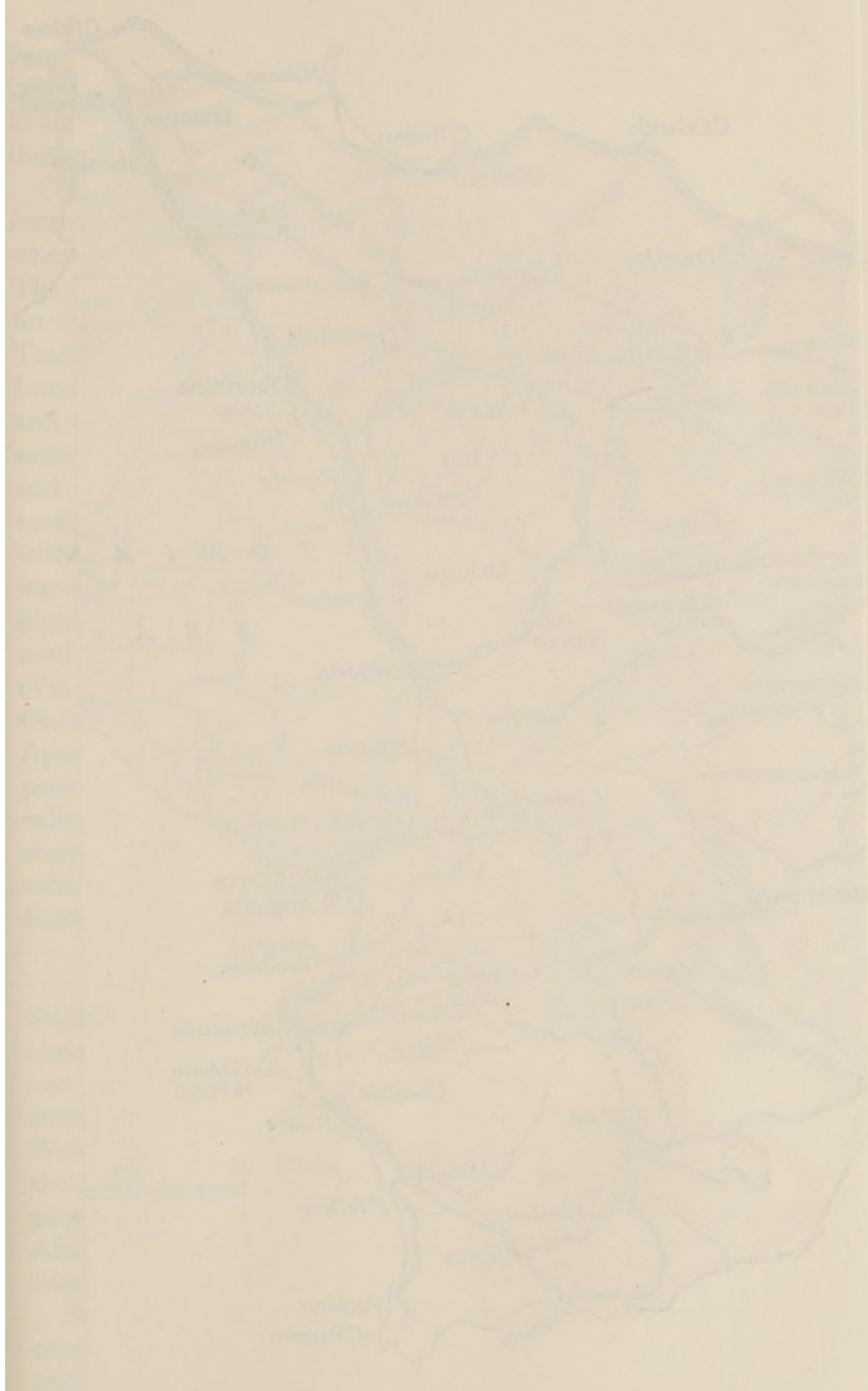






FIG. 64. Sicily. (For Key see Fig. 40)



Penne (1,437 ft.), Teramo (869 ft.), Ascoli Piceno (502 ft.), Cingoli (2,070 ft.), and Urbino (1,480 ft.). Macerata (1,020 ft.; 12 miles inland) is the only large town which is not included in either of these lines.

*Communications.* The main east coast railway keeps strictly to the narrow coastal plain, except between Porto Recanati and Ancona, where it cuts behind M. Conero, and between Pesaro and Cattolica. The road (16) follows a similar course, except south of Ortona where, for the most part, it keeps away from the coast among the foothills. Transverse communications from the coast inland are of two classes. Local roads keep almost exclusively to the ridges, to serve the towns and villages and to avoid landslips. Some of the main roads do the same, especially in the south, as road 86 from Vasto and road 87 and its companion railway from Termoli. Most of the through roads, however, and the short railways connecting the principal towns with the coast keep to the main valleys. Of these roads the most important are: road 5, along the Pescara valley and through the highest chain of the Apennines into the Sulmona basin (p. 325), road 4 along the Tronto to the Amatrice basin (p. 321), and Road 3 (Via Flaminia) through the Metauro valley to the Scheggia pass. Only five of the railways penetrate beyond the edge of the Apennines. Movement parallel to, but not following the coast, presents the greatest difficulty, owing to the number of transverse valleys. There is a main road (including 81 and 78), abounding in steep gradients and sharp turns, from near Casoli in the Sangro valley, via Chieti, Teramo, Ascoli, and Macerata to Iesi, in the Esino valley.

## SICILY

SICILY is roughly triangular in shape. Its northern side measures about 175 miles from Cape Boeo (Marsala) to Cape Peloro, its eastern 120 from Cape Peloro to Cape Passero, and its south-western 170 from Cape Boeo to Cape Passero. In area it is somewhat larger than Wales. The island is separated by only 2 miles from southern Italy at the Straits of Messina, and by 90 miles from north Africa. Sicily is geographically transitional between the two; the resemblance to Africa is largely climatic, while physiographically and geologically the island is a continuation of the Peninsula.

*Physical Features.* Sicily has a mountain backbone along the north coast flanked by a belt of hilly upland covering most of the centre and south. In broad terms, the island consists of a plateau with a



higher northern edge (about 3,000 ft. or more), which drops abruptly to the sea, and a gentle slope to the south and south-west to heights usually averaging over 1,000 feet near the south coast. Little of the surface is low ground; only 15 per cent. lies below 330 feet. The only true plain is that of Catania. On the other hand, although almost all the area is hilly or mountainous, little of it is really high (only 6% over 3,300 ft.).

The volcano of Etna is the most conspicuous feature of the island and forms a distinct region. It is composed, like Vesuvius, of layers of lava and ash. To the north of Etna the northern highland, a continuation of the Apennines, stretches along the north coast. The Mi. Peloritani in the east are crystalline, the Mi. Nebrodi in the centre clay and sandstone, and the Madonie in the west limestone. The isolated limestone hills of western Sicily rise out of a setting of more rounded clay and sandstone hills and terraces, and form a continuation of the Madonie as far west as the Egadi islands. In the south-eastern corner the tableland of the Mi. Iblei is capped in part with basaltic lava and in part with a calcareous stratum. Between these hills and Etna is the alluvial plain of Catania; otherwise the rest of the island as far west as Sciacca is occupied by a highly dissected plateau of Tertiary clays and sandstones, in particular saline and gypsiferous clays and some Pliocene sandstones.

*Vegetation.* In few parts of Italy has the vegetation been as profoundly transformed by the action of man as Sicily. The most striking contrasts are in summer between the luxuriant, irrigated areas and the desiccated cornfields. Near the shores rock or sand plants predominate. Close inland marsh types occur in places, but most of the marshes dry up in summer, whilst near Trapani and Marsala such areas have been converted into salt-pans. A special feature of the low-lying banks of the rivers Anapo and Ciane, near Syracuse, is the papyrus, a tall reed-like plant more familiar in the Nile valley. The tallest of European reed-grasses (*Arundo donax*) is widely grown for vine-stakes.

Apart from the scanty remains of forest, the hill pastures, and coastal areas, almost the whole of Sicily is covered with non-natural vegetation, including many plants only recently introduced into the country. Of the total area 90 per cent. is in cultivation, which takes two strikingly different forms. There is (1) the mainly coastal fringe, often irrigated, of mixed cultivation of fruit and other trees, beneath and among which are sown successive crops of vegetables or cereals. This extends in a narrow, often terraced strip on the mountain-sides



all along the north coast and from Messina to Catania, around the base of Etna, and south of the plain of Catania on the sides of the *Mi. Iblei*. Similar luxuriant vegetation is found immediately surrounding most of the towns in the rest of the island and in particular near Sciacca and Agrigento on the south coast. At the lower levels (below about 1,000–1,600 ft.) lemons and oranges predominate and are usually irrigated. In the drier parts of this zone and also above it olives (up to about 2,600 ft.) and vines (up to 3,600 ft.), mastic trees, carobs (especially near Syracuse), sumach (especially near Palermo), almonds, mulberries, and many other trees take the place of citrus fruits and are not usually irrigated. The gardens of citrus fruits and other enclosures are often surrounded with hedges of prickly pear, instead of the high stone walls which in former times were used to protect the orchards from thieves. On rocky, dry, and soilless slopes between the gardens there is some *macchia*. In the west, behind and around Marsala, Mazara del Vallo, and Castelvetro, this mixed cultivation is replaced by the vine, grown in great vineyards occupying the greater part of the region.

(2) Over the rest of Sicily there prevails an 'extensive' type of cereal cultivation, principally of wheat, with some beans and lucerne. This gives the interior and the south coast a practically treeless landscape of arable land, which extends monotonously over the hills and is only lacking in the driest areas such as the limestone hills of the west. The contrast between the coastal and interior areas is thus tremendous. In the one there is verdure and fruit practically all the year round, and a covering of trees over most of the landscape: the other is without trees or hedges, green in winter and spring with young corn, but from the beginning of June assumes a desert-like appearance, which is complete by the end of the month when the harvest is gathered and the vast arable expanses are left quite bare. The cultivated and fallow fields are bright in spring with the gaily coloured flowers of many annual and perennial herbs. In the dry pastures and on the hill slopes low, bushy plants are common, among them the dwarf palm, which is widespread in the south-east and in the south-west (e.g. near Segesta). These merge imperceptibly into rock pastures (Plate 143).

The areas above the effective limit of cultivation are small, and the extension of cultivation and grazing has reduced the forests to very small remnants (about  $3\frac{1}{2}\%$  of the island). The lower limits of the deciduous forest trees are high (oak 2,000 ft., chestnut 1,600 ft., beech only common above 4,000 ft.). Practically the only considerable



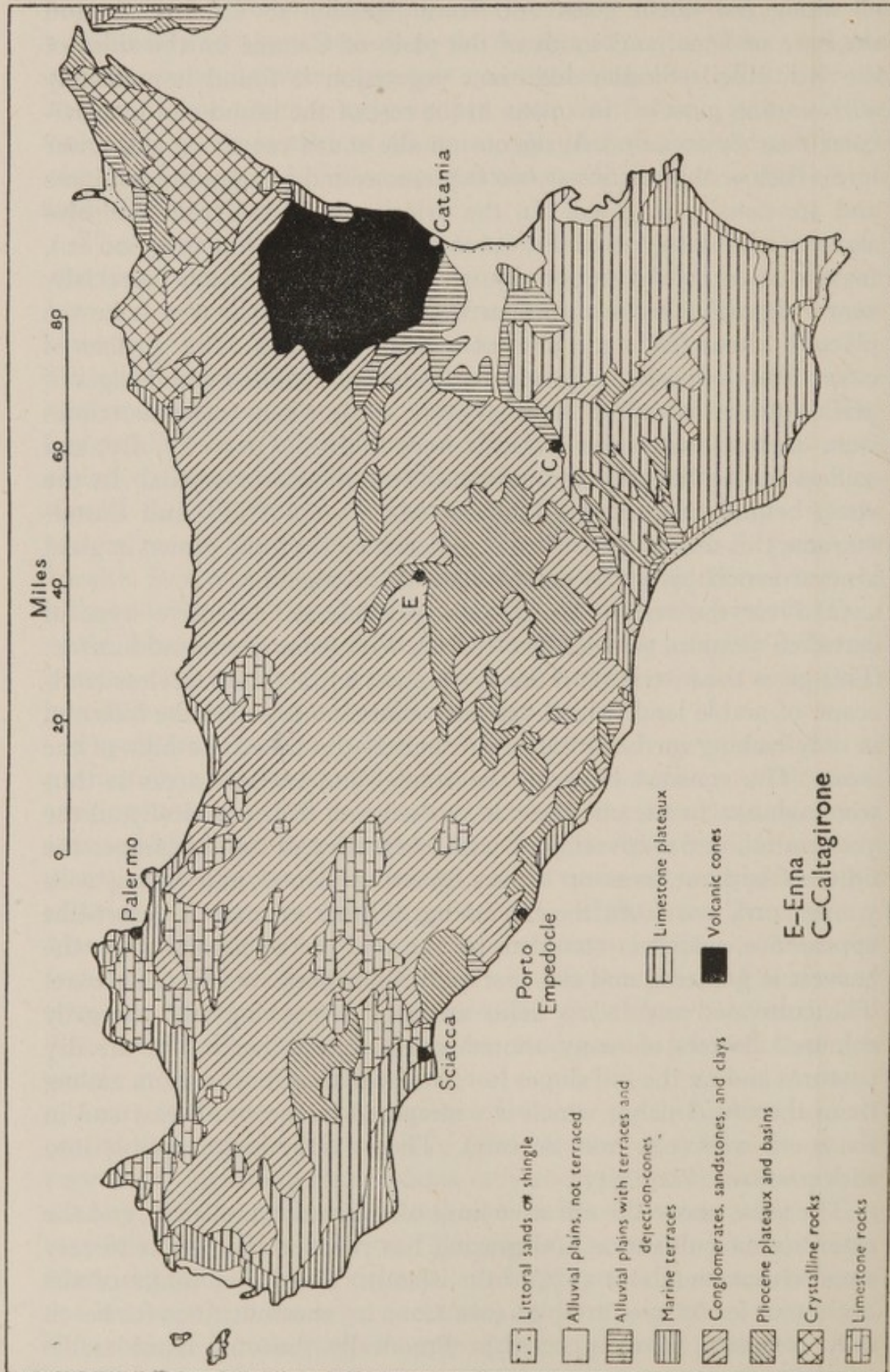


FIG. 65. Landform types: Sicily



areas of woodland remaining are on the northern slopes of the northern highland, particularly of the Nebrodi (Bosco di Caronia; macchia, oak, and beech) and the Madonie (evergreen and deciduous oaks, holly, and beech), on the northern slopes of the Rocca Busambra (Bosco della Ficuzza; oak), round the upper part of Etna, and in the basin of the F. Acate in the south-east. The upper limit of the forest is not very high and the higher summits of the Nebrodi emerge above it.

*Communications.* The principal centre of routes is Messina, whence connexion is made with Villa S. Giovanni and Reggio on the mainland. From Messina routes are confined to two lines along the north and east coasts. The coastal road and railway continue the whole way round the island, and leave the coast only at a few points, notably near Cape S. Vito, and in the extreme south. On the east coast the circum-Etna valley allows road and rail to branch off near Riposto. Apart from the northern highland and the Mi. Erei, there are no large barriers in the interior, and few obvious natural route-ways except the circum-Etna valley. Minor obstacles, such as small limestone masses, unstable slopes subject to landslides in the clay areas, and the multiplicity of small hills and valleys, abound throughout the interior, and are reflected in the tortuous courses of many of the roads and railways. The hill-top position of many towns seriously aggravates the difficulty of communications.

*Population.* The distribution of population is closely governed by differences in agriculture. In the coastal belt of the north and east and on the lower slopes of Etna there is a dense population, the greater part being gathered into large villages and towns; many, however, live dispersed over the countryside among the orchards and vineyards. It is only near this part of the coast that there is any considerable number of villages with less than 5,000 inhabitants. Throughout the interior and the rest of the coast the population is almost exclusively gathered into compact towns of over 5,000 and mostly over 10,000 inhabitants. Many of these towns have a chequer-board ground-plan and occupy natural acropolis-sites on flat hill-tops, e.g. Erice, Mistretta. Over the bulk of the centre and south of the island the density of population outside the towns and villages is less than 12 per square mile.

### *Subdivisions*

The island may be divided, mainly in accordance with geological differences, into (1) western Sicily, west of the F. Torto-Cammarata-



Sciacca line; (2) the northern highland, which backs the rest of the north coast and extends inland roughly as far as road 120; south of this (3) south central Sicily, extending to the south coast between the Torto-Sciacca line which delimits western Sicily on the one hand, and the western slopes of Etna, the plain of Catania, and the Mi. Iblei on the other; (4) south-eastern Sicily, composed of these last three units.

### *Western Sicily*

Western Sicily is a region of considerable diversity. It consists rather of a number of intermingled types of relief than of self-contained subdivisions. The three main types are (1) the rounded hills of the clay country which forms the matrix, as it were, of the whole area; (2) the more or less isolated, harder limestone eminences which rise above these clay hills, and (3) the coastal plains and terraces which stretch round practically all of the coast (pp. 157, 168). Since the clay hills continue into south central Sicily, and the limestone hills into the Madonie mountains of the northern highland, it is not easy to give precise limits to this region. Its eastern boundary is, however, marked approximately by the railway from the mouth of the F. Torto to Cammarata, and thence by a line direct to Sciacca.

The limestone mountains are most conspicuous and numerous in the north, where they form the westernmost extremity of the Apennine system. This has here degenerated into a number of disconnected mountains, which project into the sea in the coastal headlands east of Trapani. Farther west still the range sinks beneath the sea, and only its higher parts emerge as the rugged, limestone Egadi islands. In between the mountains at the heads of the bays are small coastal plains or terraces, usually covered with a shelly deposit known as *tuffo*, which has weathered to a rich red soil a foot or more deep. These coastal plains and terraces are the only noteworthy areas of lowland in the island apart from the plain of Catania. From west to east along the coast north-east of Trapani there are first two small terraces (each 3-4 miles long and 1 wide) on either side of the headland of M. Cofano (2,162 ft.). Another, larger terrace (about 12 miles long and 3 wide), at the head of the gulf of Castellammare, has a narrow extension round the headlands of Cape Rama and Point Raisi as far as Isola delle Femine. By far the most famous of these coastal plains, the Conca d'Oro, extends from the sea at Mondello (just south of Cape Gallo) behind Palermo and the steep-sided, limestone lump of M. Pellegrino, to continue as a narrower strip



almost to Bagheria and the site of the ancient Solunto. The Conca d'Oro varies from about 1 to 4 miles in width, and most of its surface is thickly covered by fruit trees with ground crops beneath, all irrigated by springs rising at the base of the steep, surrounding amphitheatre of mountains, and by an elaborate series of irrigation canals and norias (Plates 37, 142).

The plain along the west coast from Trapani southwards to Marsala and thence eastwards to Sciacca is continuous and much broader, and is limited inland, not by encircling limestone scarps, but by a low plateau formed by a horizontal, limy bed (cf. the Mi. Iblei). The coastal plain is up to about 5 miles wide and slopes inland uniformly or in scarcely perceptible terraces, and is but slightly incised by a few streams. Farther inland the low plateau, similar to the coastal plain but slightly more rolling and more deeply incised by the main streams, rises to as much as 1,000 to 1,300 feet north of Castelvetro. The plain and plateau together are predominantly covered with vineyards from which Marsala wine is produced. The usual intensive garden cultivation surrounds the towns. The coast is low and in places marshy, and between Trapani and Marsala is largely lined with salt-pans.

Behind the north coast rises the disjointed chain of limestone mountains which wall in the coastal plains. East of Trapani is the isolated M. S. Giuliano, crowned by the town of Erice (formerly S. Giuliano). Farther east beyond the valley of the T. Forgia (F. Lentina) a V-shaped mountain mass opening to the north-west, and culminating in M. Sparagio (3,642 ft.), falls precipitously to the coast and to the clays in the south. M. Inice (3,490 ft.), behind Castellammare, and M. Bonifato (2,710 ft.), south of Alcamo, continue this mass to the south-east. Between Alcamo and Partinico there is a gap in the limestone, and this is filled by much lower and more rounded hills behind the coastal plain of Castellammare. East of Partinico again is a large, irregular group of limestone highlands, mostly with precipitous sides and comparatively gentle, undulating upper levels. This mass occupies most of the headland between the gulfs of Castellammare and Termini and extends south as far as a line through S. Giuseppe Iato and Marineo. To the west of Monreale and Piana dei Greci these mountains mostly rise to about 3,300 feet or more (M. Gibilmesì 3,946 ft., la Pizzuta 4,373 ft.), but east of Monreale the smaller groups, although equally precipitous, are mostly less than 2,600 feet high (Plates 37, 38).

The disjointed nature of the mountains is brought out by the



number of small, flat basins occurring among them, and by the passage of roads from Palermo to the west and south. The basins, except for that of Carini, are not so densely populated or cultivated as the Conca d'Oro: the Piano della Stoppa is almost deserted; the Piana dei Greci has been converted into a reservoir by damming the F. Belice, where it cuts through a limestone ridge to the south. Isolated by the Conca d'Oro and its extensions, M. Pellegrino (1,988 ft.) rises abruptly from the plain and from the sea, as a dominating landmark to the north of Palermo. East of the F. Ficarazzi (Eleutero) the limestones are more discontinuous and appear as rugged hills standing out from the groundwork of clays in such eminences as Cape Zaffarano (M. d'Aspra, 1,234 ft.; Plate 38) and M. S. Calogero (4,346 ft.) which dominates the valley of the F. Torto. East of this valley the limestone Madonie form part of the continuous northern highland.

The interior of western Sicily is formed principally of much lower hills of clays and some sandy rocks, rising to between 1,000 and 2,000 feet and much dissected by rivers into small rounded hills. These claylands fall naturally into three fairly clear, major drainage basins, one in the west (F. Birgi), one in the centre drained north by the F. Freddo through a gap near Alcamo (railway), and one in the east drained to the south by the F. Belice through a narrow valley near Partanna. Out of these lower clay hills rise isolated limestone mountains (Plates 143, 144, 146). West of road 119 they are few and disconnected, the Montagna Grande, west of Calatafimi, being the highest (2,398 ft.). In the east they are more numerous and form many east to west ridges. The most outstanding of these is the Rocca Busambra, a narrow, limestone platform about 6 miles long, walled with precipices and rising 2,300 feet above its surroundings to 5,292 feet, the highest summit of western Sicily. The Bosco della Ficuzza on the northern flanks of this ridge was a game preserve of the Bourbon kings. Farther south the Mi. Sicani (M. Rose, 3,749 ft.) are formed by a succession of ridges stretching from M. Genuardo (3,867 ft.) eastward to the Platani valley and Cammarata. South of the Mi. Sicani again, but separated from them by the upper basin of the F. Carbo, is a broad, undulating, limestone upland about  $4\frac{1}{2}$  miles from north to south. This stretches as far east as the Verdura valley, and is cut across by the gorge of the F. Carbo. Its surface is at from 1,300 to 2,600 feet and its southern edge, which drops sharply to the clayland at Caltabellotta, is dominated by the Rocca Ficuzza (2,956 ft.). South and east of this plateau and of the Mi. Sicani the claylands extend uninterruptedly into the south central region.



*The Northern Highland*

This region of continuous highland stretches from the broad valley of the F. Torto to Cape Peloro, and from the north coast inland for between 15 and 20 miles to a line marked roughly by road 120, where the highland merges into the upper part of the hilly plateau of central Sicily. In the east the highland reaches the east coast between Cape Peloro and Taormina. It thus forms a barrier, 100 miles long from east to west, which is crossed only eight times by road and once by rail. The highland is divided into three parts, each distinguished by a different rock type, and each having a certain resemblance to a corresponding part of the Apennines on the mainland. The Madonie in the west are of limestone surrounded by a ring of clays and sands, and resemble the limestone mountain-blocks of the Southern Apennines. The Mi. Nebrodi in the centre are mainly of clays with some sandstones, and resemble the Northern Apennines. The Mi. Peloritani in the east, like the Calabrian massifs, are of old crystalline rocks. The F. di Pollina approximately divides the Madonie from the Nebrodi, and the road (116) from Cape Orlando to Randazzo separates the Nebrodi from the Peloritani, although on the south side of the mountains sandstones extend well east of this line.

The highland falls steeply to the sea, except where there are occasional, narrow, coastal plains. Most of these are closely cultivated with mixed fruit trees and ground crops. The principal plains are: (1) east of the F. Torto (about 11 miles long); (2) at the mouth of the F. di Caronia (about 3 miles); (3) between the mouth of the T. Furiano and Cape Orlando (12 miles); (4) from Oliveri eastwards for 24 miles, and up to 3 miles in width, behind the small, rocky peninsula of Milazzo; (5) at Cape Peloro. There are no plains along the east coast (p. 170).

The *Madonie* are similar in structure to the hills of western Sicily, with rugged relief, precipitous slopes, and an absence of surface water. They include the highest summits in the island apart from Etna (Pizzo Antenna or della Principessa, 6,480 ft.). Typical limestone country with woods of oak and beech is confined to the highest, central parts, which are surrounded by lower slopes of clays and sands. At the junction of the two kinds of rock copious springs rise. These are used for irrigation and for Palermo's water-supply, but also cause the rapid and continuous erosion of the clays; the resulting landslips and calanchi (p. 489) make upkeep of the Termini-Agrigento railway difficult. Limestone pebbles fill the dry beds of the streams,



which resemble the *fiumare* of the *Mi. Peloritani* and Calabria. In the clays surrounding the *Madonie* the *F. Torto* (railway) and *F. Grande di Imera* (road 120) have cut back their valleys well beyond the line of the main summits and form natural passages across the highland (Plate 145).

The *Mi. Nebrodi* (*Le Caronie*), although lower and formed of softer rocks than the *Madonie*, are more continuous. The soft clays, shales, and sands are capped here and there by a harder sandstone, which forms some of the higher peaks and acropolis-sites for towns, such as *Mistretta* (3,117 ft.). The ridge falls more steeply to the sea in the north than in the south, where it merges into the central Sicilian plateau. The valleys of the northern streams do not penetrate sufficiently far back from the coast to destroy the remarkable uniformity of the watershed, which from *M. Timpa*, west of *Mistretta*, to the *Peloritani* never drops below 3,600 feet, and for the most part keeps above 4,300 feet. There are several summits over 5,000 feet, and *M. Soro* rises to 6,060 feet. The slopes are fairly smooth and rounded, except where cappings of the harder sandstone remain, and the valleys, which have dry stream-beds, are subject to landslips. For this reason the few roads and mule-tracks frequently follow the ridges, especially in the higher parts. There are only three road crossings of the chain: the *Contrasto* pass (road 117) rising to 3,740 feet; the *Meraglia* pass, on the ridge road from *S. Fratello* to *Cesaro*, to 5,016 feet; and the *Floresta* pass (road 116) to over 4,000 feet. There is a great contrast between the highly cultivated coastal strip and small coastal plains, and the deserted higher and southerly slopes with cereal fields, pasture, and even, on the upper parts, forests of oak and beech.

The *Mi. Peloritani* fill the north-eastern extremity of Sicily and extend south to the valley of the *F. Alcantara*, which divides them from *Etna*. Although not so high as the *Nebrodi*, they form a still more continuous ridge which maintains a height of 3,600 to over 4,000 feet from *Floresta* to *Pizzo Poverello* (4,195 ft.), and then drops steadily towards *Cape Peloro*. The harder crystalline rocks have a more abrupt topography, steeper slopes, and narrower valleys than the clays of the *Nebrodi*. The granites and schists are similar to those of the *Aspromonte* on the other side of the Straits of *Messina*, but the *Mi. Peloritani*, being narrower, have been more cut up by steep valleys into sharp ridges and relatively pointed summits. The high platforms characteristic of the *Aspromonte* (p. 359) have been destroyed in the *Peloritani*. The streams are the short, steep *fiumare*





PLATE 143. *The Greek temple of Segesta at the foot of the limestone M. Barbaro; poor, dry pastures*

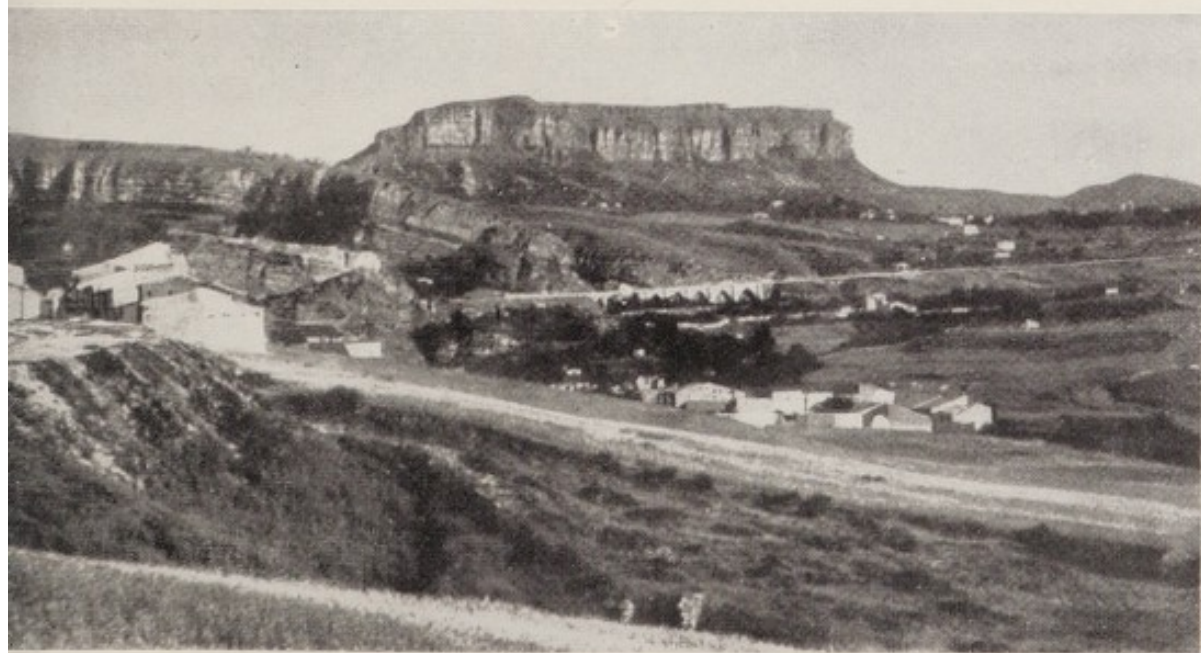


PLATE 144. *The limestone Rocca dei Maschi from the outskirts of Corleone*





PLATE 145. *The Madonie: the Piano degli Zucchi at the foot of Pizzo Antenna Piccola; bare pastures and open deciduous forest of high limestone mountains*



PLATE 146. *Rolling claylands south-west of Calatafimi: M. Polizzo (background) and road to Garibaldi monument*



characteristic of Calabria, and have broad, steep-sided, pebble-filled beds (Plate 148). The valleys end in culs-de-sac and do not break the continuity of the ridge, which is sufficiently uniform to have allowed the construction of a ridge-road south-west for about 15 miles from Cape Peloro. There are a few isolated masses of rugged limestone, such as those at Cape Tindari (932 ft.), which forces the road away from the coast, and at Rocca Novara (4,395 ft.) dominating the Pertusa pass, and the group around Taormina (M. Veneretta 2,900 ft.).

Apart from routes round the north-eastern end of the range there are only three main crossings by road. The railway from Messina tunnels right through the ridge. Road 113 climbs steeply from Messina to 1,525 ft., but the other two roads are comparatively high, and rise to about 3,770 feet at the Pertusa pass (main road from Francavilla to the north coast) and to over 4,100 at Floresta.

Cultivation climbs up the mountain-sides to about 1,600 feet, and above this height there are few trees. Villages and houses are practically confined to a very narrow coastal strip.

### *South Central Sicily*

South central Sicily extends east of the limestone ridges of western Sicily and south of road 120 as far east as the slopes of Etna and the plain of Catania, and as far south-east as a line from the west end of the plain of Catania to the mouth of the F. Acate (Dirillo). The bulk of this region is formed in clay and sandy rocks with many small beds of gypsum.

In the western part of this subdivision, as far east as a line through Enna and Caltagirone, is the region known as the *Altipiano Zolfifero* (*Sulphur plateau*). There are here two chief beds of rock: (1) a salt-impregnated, sandy clay, with small beds of salt, gypsum, and limestone, and in places bituminous schists; and (2) above this, clays and sands characterized by numerous lenses of gypsum and sulphur (p. 26). The second bed covers a smaller area, mainly between Sciacca and Agrigento, but occurs in many patches elsewhere. The sulphur is the basis of the main industry of the island. The gypsum causes most of the abrupt features in the relief (Plate 147), for despite its solubility it often influences the scenery in much the same way as limestone and appears at the surface in bare and rocky eminences. Occasionally, however, the solution of small masses of gypsum in the ground causes subsidence and leaves hollows at the surface, such as the one near Enna, filled by Lake Pergusa, which has no surface outlet.



The Altipiano Zolfifero is not a perfect plateau. There is a general southerly slope from the foot of the northern highland, where heights average between 3,300 feet and 4,000 feet, to the coast, where the plateau terminates at heights up to 1,000 feet. The plateau has been cut up by numerous south-flowing streams into a region of vastly confused relief, of small hills and valleys without pattern or leading features. Apart from the gypsum all the rocks are easily eroded and slopes are generally rounded. Landslips in the valley-sides are frequent. Most of the streams are brackish and in summer for all practical purposes are dry (p. 51). The main rivers, the F. Platani and F. Salso or Imera Meridionale, have excessively tortuous courses and steep-sided, flat-floored valleys, which have occasional constrictions in their lower courses. Thus there is a marked gorge on the Platani near Cattolica Eraclea, about 9 miles from its mouth, and the Salso enters the Licata plain through a ravine some 4 miles above its mouth. Except for a period in spring when the wheat and beans are young and green, these hills and valleys present a completely desolate and arid appearance, with bare, brown earth and no trees or dwellings. There are a few large towns into which the population retires each evening, and these, like the roads serving them, keep to the heights and for the most part avoid the valleys.

Along the coast the plateau for the greater part of its length falls steeply in terraces (p. 161) to a narrow beach. Behind Licata is a coastal plain about 3 or more miles wide and nearly 10 miles long, divided from the sea for about  $3\frac{1}{2}$  miles west of Licata by a narrow ridge (561 ft.) on the end of which the town stands. Divided from the Licata plain by low hills (M. Agrabona, 1,266 ft.) which come close to the sea, is a small plain, about 4 miles long by  $2\frac{1}{2}$  wide, around the mouths of the T. Comunelli and the Vallone Pizzuto. This lowland is again separated by a low hill from the larger plain of Gela, formed by a coastal plain 3 miles wide and the broad alluvial valleys of the F. Maroglio and F. Gela. West of Gela the plain is separated from the sea by low, narrow ridges, but on the east it continues along the coast to the F. Acate.

Agrigento, near the south coast, stands on a small limestone tableland, highest on its steep, northern side, where it averages about 1,000 feet. Southward it is incised by the F. S. Anna valley, but continues to the coast at Porto Empedocle, where there are high cliffs. The town is surrounded by luxuriant, irrigated vegetation.

In the east of the Altipiano Zolfifero the clays are capped by a resistant bed of sandstone, which has been preserved along the chain



of the *Mi. Erei*. This irregular series of flat-topped hills with precipitous sides forms the watershed between the Ionian Sea and Sicilian Straits, and stretches north-north-west from Caltagirone through Piazza Armerina and Enna to Gangi (3,304 ft.; road 120). Gangi, which was one of the main strongholds of the *Mafia*, stands on the watershed between streams draining to all three coasts of the island. The *Mi. Erei*, although much fretted by erosion, form a continuous and level barrier, the height of which rises from 1,600–2,000 feet near Caltagirone to 3,000 feet at Enna and farther north to over 3,300 feet in the more rounded mountains of the spur extending to M. Zimmara (4,370 ft.), west of Nicosia. The tabular character is particularly noticeable at a level of 2,600–2,800 feet between Piazza Armerina and Valguarnera. There are crossings at either end of the *Mi. Erei*, namely at Caltagirone (1,995 ft.), which stands on the ridge connecting the chain with the similar tabular hills of south-east Sicily (*below*), and near Gangi at the Tre Fontane pass (3,287 ft.) on road 120. In between these two the main crossing and the only gap in the range is the deep valley immediately north of the hill-top town of Enna (3,254 ft.). Through this gap (1,981 ft.) pass road 121 and the only inland east-to-west railway. Ridge roads from north and south also cross here, so that Enna is one of the most important route-centres of the island. Road and railway between Piazza Armerina and Valguarnera also climb over the ridge (c. 2,600 ft.).

East of the *Mi. Erei* clay and sandstone hills, similar to the Altipiano Zolfifero, slope down to the Pleistocene gravel terraces (p. 31) bordering the plain of Catania. This country is traversed by the steep-sided, flat-floored valleys of the eastward-flowing Salso, Dittaino, Gornalunga, and Caltagirone rivers. The *Mi. Erei* sandstone extends eastward along the watershed between the Salso and the Dittaino, and is followed by road 121 through Leonforte and Regalbuto. The valleys are comparatively deserted. The Catania–Enna railway, using the flat-floored Dittaino valley, does not pass near any villages above Catenanuova.

### *South-eastern Sicily*

The south-eastern subdivision is dominated by the tablelands of the *Mi. Iblei* and the volcanic cone of Etna, between which lies the plain of Catania, the only large alluvial plain in the island.

The *Mi. Iblei*, with their surrounding terraces and small river plains, occupy the south-east corner of Sicily east of the rivers Acate and Caltagirone and south of the plain of Catania. The hills consist



of flat tablelands of white or yellowish limestones or calcareous tufa, capped in the north round M. Lauro and also to the west of Pachino by harder, basaltic lava-flows. All these rocks are nearly horizontal and give rise to a tabular relief with very steep-sided, narrow valleys, known as *cave*, which radiate from the central, highest point, M. Lauro (3,232 ft.). Apart from these valleys the level surfaces are interrupted only by a few volcanic eminences. While the limestone surfaces are bare pasture, the calcareous tufa, the basalt, and especially the sides of the plateaux and the valleys, are covered by intensive, mixed cultivation with fruit trees, vines, almonds, carobs, and citrus fruits (pp. 165, 180). The coastal areas are varied. Between the small plain at the mouth of the Acate, which is an extension of the Gela plain, and Pozzallo, there are only tiny, river-mouth plains separated by cliffs. The south-eastern extremity of Sicily is the Pachino peninsula to the south-east of road 115 where it passes through Ispica, Rosolini, and Noto. Here the plateau rises only to 300 feet in the centre, and the greater part is less than 150 feet except for a small patch of lava (alt. 233 ft.) west of Pachino. This south-eastern extremity is a fertile, vine-clad plain, and is connected by a narrow coastal strip with the Anapo plain west of Syracuse. This strip widens out in the valley of the T. Tellaro, near Noto, and in Point Cane. The small, alluvial Anapo plain, encircled by gravel terraces, extends inland for 9 miles to Solarino, and is limited on the north by the flat ridge on to which ancient Syracuse extended. The three peninsulas, Cape Murro di Porco, Magnisi, and Cape S. Croce, which largely account for the irregularity of this coast, are isolated limestone blocks with cliffed sides. The shore of the gulf of Augusta is fringed by a narrow coastal plain behind which the ground rises gradually inland in a low platform (2 to 4 miles wide) to a steep scarp at the edge of the plateau of the Mi. Climiti (1,350 ft.). The plateaux again approach the coast between Augusta and Agnone, and border the plain of Catania.

The northern edge of the tablelands of Mi. Iblei falls in terraces to the Lentini basin, a subsidiary plain divided by a ridge from the much larger *Plain of Catania*, and to the flat floor of the Caltagirone valley. Near the watershed between this stream and the F. Gela the tablelands of Mi. Iblei are connected with the similar flat-topped Mi. Erei by a narrow ridge, followed by road 124 and railway through Caltagirone.

The lake or marsh of Lentini, or Biviere, occupies part of a small depression about 8 miles long from north-east to south-west and



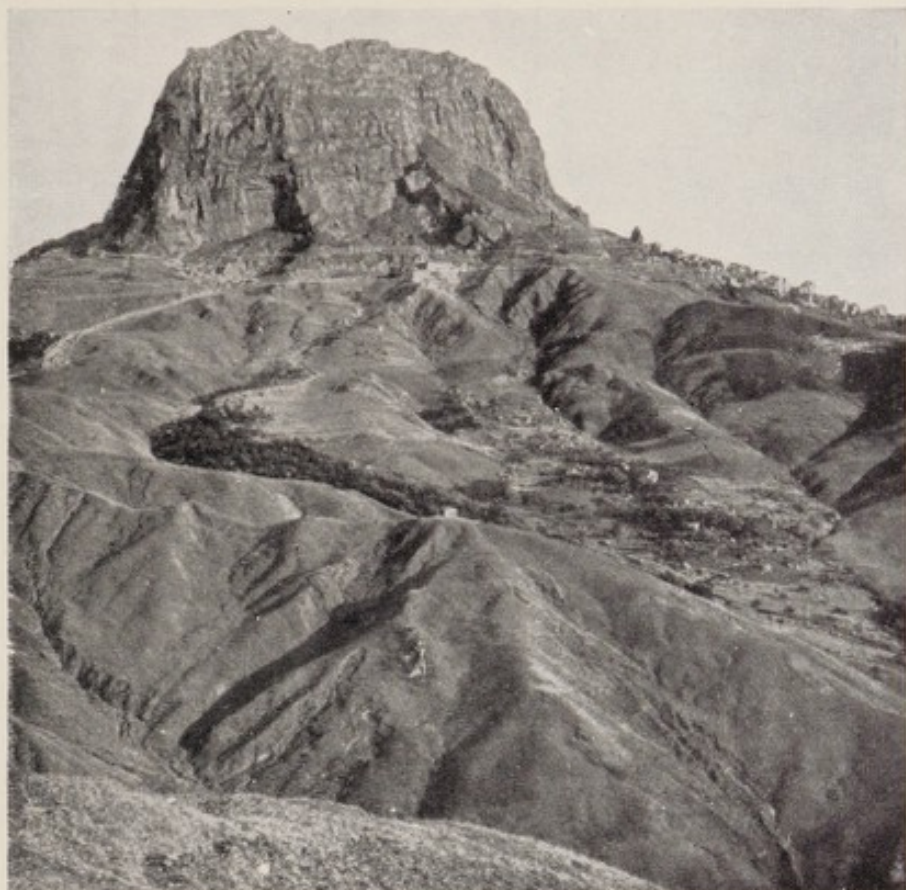


PLATE 147. *M. S. Paolino and Sutera at its foot: a gypsum outcrop rising above clay hills*

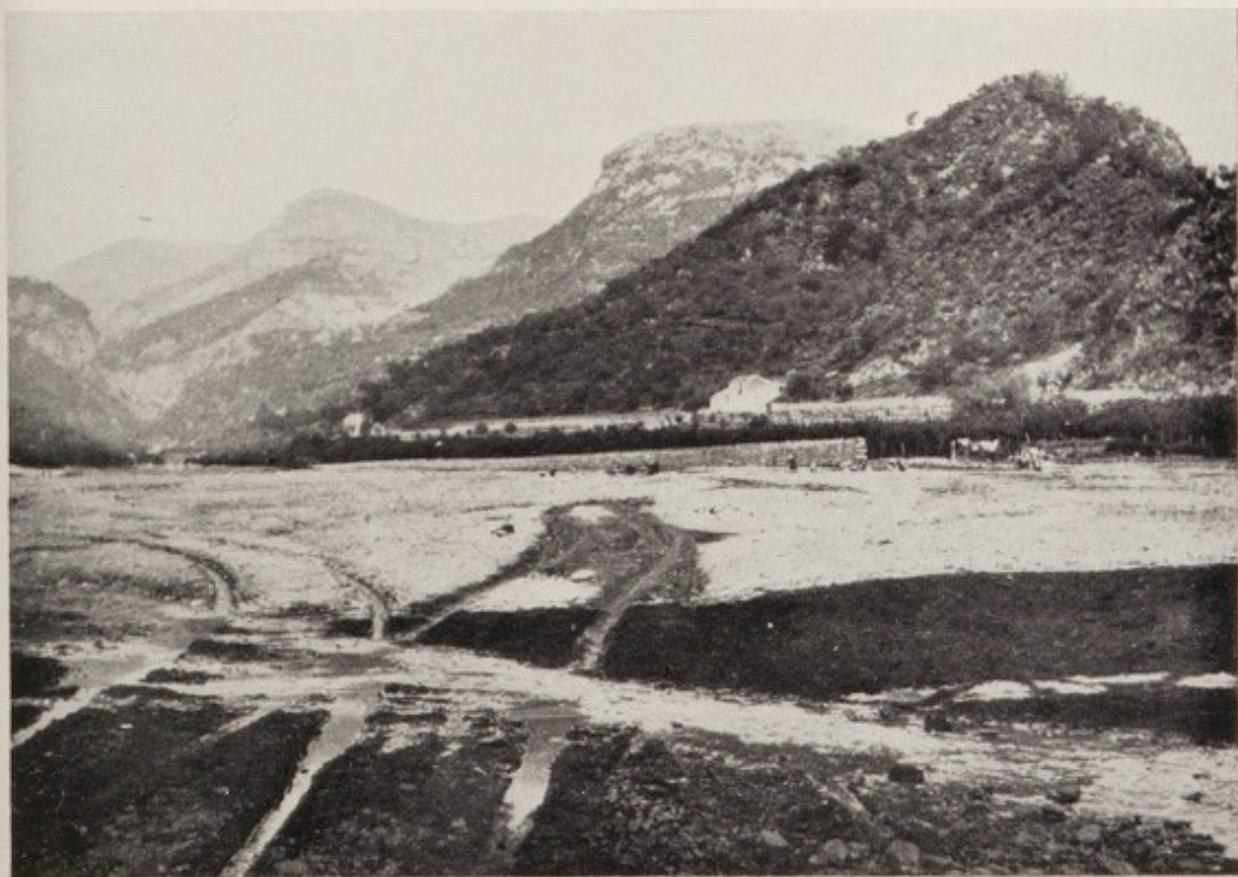


PLATE 148. *A fumara near Messina used as a roadway*





PLATE 149. *The Mi. Rossi: vineyards enclosed by dry stone walls (right); wild brushwood of Etna greenweed (left foreground)*

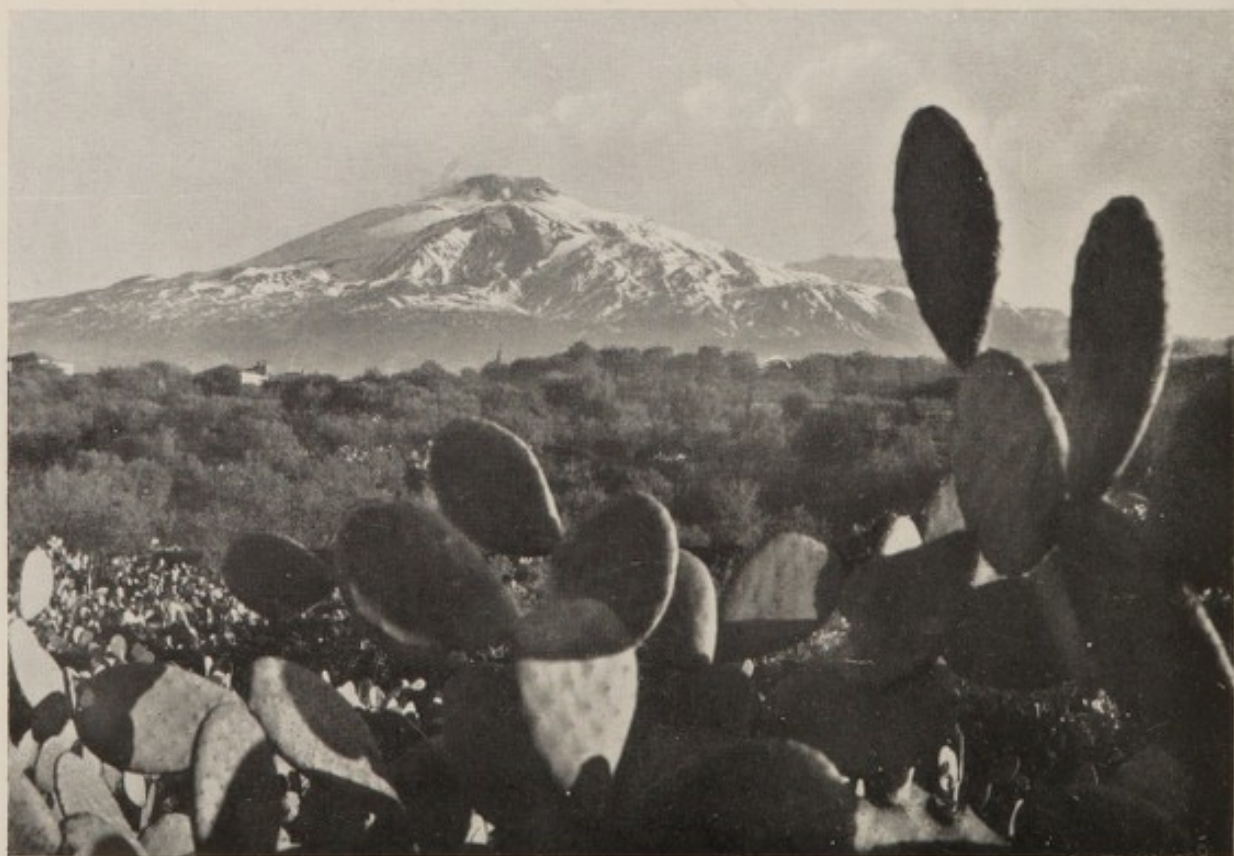


PLATE 150. *Etna from Taormina*



about 5 miles wide. This depression is separated from the plain of Catania by a low ridge of gravel hills (over 300 ft.) which extend north-east nearly to the mouth of the Simeto. On the east the Lentini marsh, which is in course of reclamation, is shut in by another flat-topped ridge about 150 feet high. This ridge is pierced by the small gorge of the F. Lentini (or S. Leonardo), which opens on to the Pantano di Lentini (5 miles long and 3 wide), a small, reclaimed, alluvial plain between these ridges and the sea.

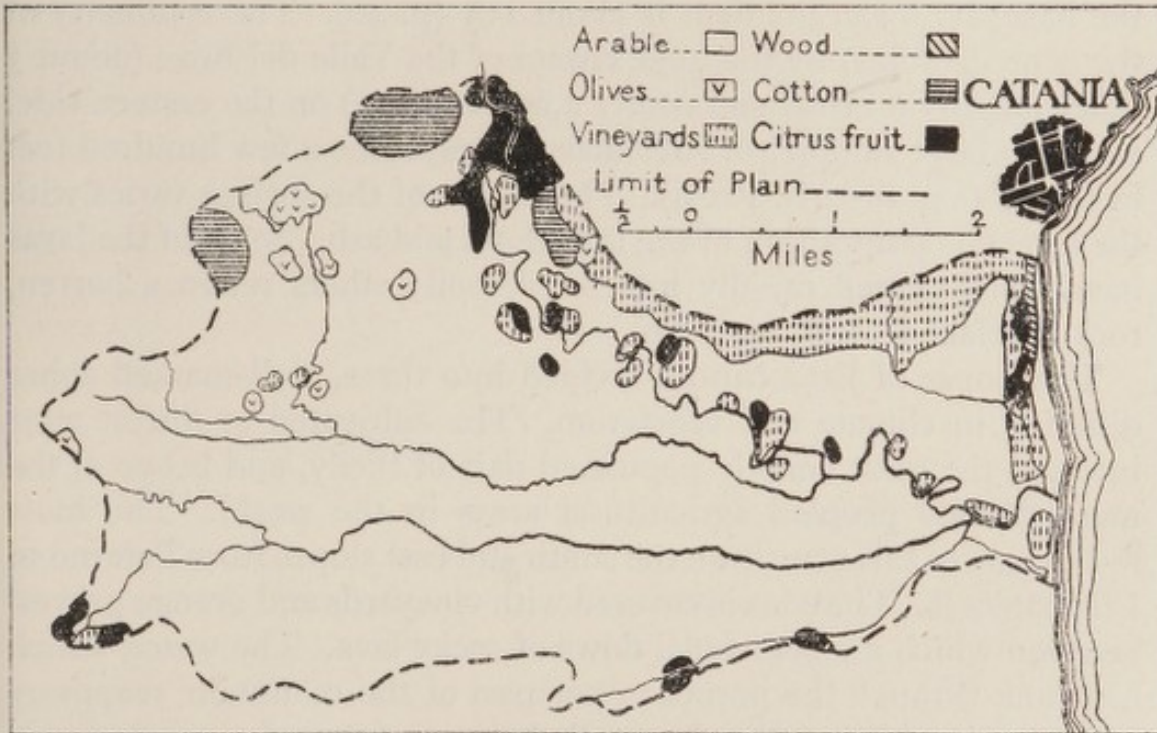


FIG. 66. *The plain of Catania: vegetation*

The plain of Catania (Fig. 66), the largest plain in Sicily (20 miles long, 8 wide), is the combined flood plain of three rivers, the Simeto, Dittaino, and Gornalunga. It is separated from the sea by a belt of wooded and vine-clad sandhills, behind which it rises slowly and steadily to 250 feet in the south and to 330 feet in the north. Arms of the plain follow the main river valleys, and around the margins are gravel terraces about 150 feet high. The plain, which is intersected by the rivers and by drainage ditches, is mostly pasture and has practically no trees, but there are vineyards and orange groves along the northern border, where there is a wide zone of gravel and clay hills and dissected terraces along the southern flank of Etna. Communications except along the main road (114) are poor and there are few bridges over the large streams (p. 179).



*M. Etna* rises to about 10,740 feet as an isolated mountain separated from the clay and sandstone hills of central Sicily and of the northern highland by the valleys of the upper Simeto and the Alcantara. The former opens southwards on to the plain of Catania, and the latter on to a small coastal plain between Cape Schiso and Riposto. The heads of these valleys are linked by a col about 2,855 feet high, so that a natural line of communication, followed by the circum-Etna railway and main road, encircles the volcano. Etna, a volcano of the Vesuvian type (p. 471), consists of a cone with a diameter of about 20 miles at the base; its mean gradient is about 1:5 (p. 40). The symmetry of the cone is broken by the huge chasm of the Valle del Bove (about 3 miles long by 2 broad and nearly 4,000 ft. deep) on the eastern side, and by a large number of subsidiary cones, some a few hundred feet in height (e.g. the Mi. Rossi). The nature of the surface varies with the age and composition of the lava-flows and ash. Some of the lavas have disintegrated rapidly into fertile soil; others retain a barren, rocky surface (Plates 149, 150).

The slopes of Etna can be divided into three, well-marked zones differing in climate and vegetation. The cultivated or lowest zone includes the most densely populated part of Sicily, and is one of the most densely peopled agricultural areas in the world. The most fertile part of this zone is on the south and east slopes from Paterno to Linguaglossa. The zone is covered with vineyards and orange groves, between which are occasional flows of rocky lava. The water, which has sunk through the porous upper part of the mountain, reappears in powerful springs at levels usually between 600 and 1,000 feet, and scarcely ever above 1,650 feet. The chief cultivated plant is the vine, but citrus fruits are abundant up to about 1,500 feet and extend even higher. The north and west slopes are drier and mainly devoted to olives and cereals.

From 4,000 feet to 6,600 feet is a forest zone, in which, however, little forest remains, except on the less accessible north-west slopes. The forest originally consisted of oak, chestnut, and birch, and at higher altitudes black pine, which still forms the forest of Linguaglossa. The oaks are now mostly low; pure beechwoods are rare and composed of small trees. Where the forest has been destroyed its place has been taken by bracken and an undergrowth of low bushes. The tree-line is approximately at 6,000 feet. In this zone there is little habitation or water-supply.

Above this limit is a zone of mountain brushwood, consisting of hard, thorny shrubs, which can grow to a height of 2 to 3 feet, but are



often pressed close to the ground or form 'cushions'. Above 9,000 to 9,600 feet flowering plants give way to loose ash and blocks of lava. Although the snowfields melt in summer, some snow is preserved by being covered either naturally or artificially with sand. This and moisture dripping from the walls of caves are the only sources of water. The observatory (9,670 ft.) is the only building. The summit, a cone of loose ash and lava about 1,200 feet high, has a gradient of about  $33^{\circ}$ . The theoretical visibility is 150 miles, and Malta has been seen from the summit.



## CHAPTER V

### CLIMATE

(All temperatures in degrees F., precipitation in inches, and altitudes in feet. The tables mentioned in the text will be found in Appendix VII. Places mentioned in the text and tables are marked on Fig. 67.)

#### GENERAL

LIKE most countries of western Europe, Italy cannot be said to have a single type of climate. Large regional variations are caused by the great extent of latitude ( $10^{\circ}$ ), the very varied relief and high altitudes, and, finally, the contrast between the nearness of the sea to peninsular Italy and the almost complete insulation from maritime contacts of the Northern Plain. There are, however, certain general characteristics of the climate of the country as a whole which justify its description as 'Mediterranean'.

The element of uniformity is due to two geographical features—the Alpine barrier and the Mediterranean Sea. The chain of the Alps, highest and most continuous in the west, from which direction most of the weather of this part of the world advances, sharply divides the climates of Italy from those of central and western Europe. This division is due in part to the obstacle presented by the Alps to the movement of air, and in part also to the abnormal warmth of the south-facing slopes, open to the sun and southerly winds.

The Mediterranean Sea, owing to the submerged barrier of the sill at Gibraltar, maintains, throughout the year, a roughly constant temperature of  $55^{\circ}$  at a depth of about 150 fathoms. Annual variations in the temperature of the water are limited to this upper layer, and, except locally and in shallow water, as for example in the extreme north of the Adriatic, these fluctuations are limited in a downward direction to this minimum of roughly  $55^{\circ}$ . The nearness of this warm sea powerfully moderates the winter temperature of all lands within its influence. This is true of the whole of Italy with its relatively long coastline, but especially the coast and the valleys open to winds from the sea.

The climate of Italy may thus be said to be, on the whole, of the 'Mediterranean' type with mild winters, hot summers, a severe drought in June and July, and the bulk of the rain in autumn, winter, and spring. Compared with England, the whole country is characterized by long hours of bright sunshine, good visibility, and low relative humidity.



The wide local variation within this type depends, apart from latitude, on maritime influence and altitude.

*Maritime Influence.* This is manifested in comparatively high rainfall and equability of temperature. Protection from maritime influence is accompanied by a decrease in rainfall and an increase in the range of temperature, both diurnal and annual, features which it is convenient to summarize in the term 'continental'. Protection from or exposure to this influence depends closely upon the relief (*see below*) and the geographical setting of the country. The latter is partly responsible for two tendencies exhibited by the Italian climate. (1) It becomes increasingly maritime towards the south, as the country itself changes from its continental root in the north, through its gradually narrowing and articulating Peninsula, to the highly maritime islands. (2) The east is more continental than the west, owing to the mass of the Balkan peninsula and to the shallow and enclosed character of the Adriatic Sea.

*Influence of Relief.* This influence is partly direct, i.e. that of altitude *per se*, shown, as everywhere, in an irregular increase in precipitation at all seasons, a lowering of temperature, and a consequent increase in cloud and humidity, and partly indirect, i.e. due to the shelter given by relief. The principal example of the influence of relief is afforded by the Alps, but scarcely less important is the part played by other mountains. The Alps and the Carso of Istria cut Italy off from the continental mass of Europe. At their foot lies the Northern Plain, severed from the moderating influence of the Tyrrhenian Sea and the westerly winds by the narrow but effective barrier of the Maritime Alps and Northern Apennines, and only wide open in the east to the north Adriatic. This sea, however, is the least maritime and most continental of all the segments of the Mediterranean proper owing to its shallow depth, enclosed shape, and the freshness of its water (salinity 35‰, compared with 38‰ in the western Mediterranean). The Peninsula, which includes the Italian Riviera, extends south of the Plain and is traversed from end to end by the range of the Apennines, in such a manner that in the northern half the hills lie nearer to the east coast and in the southern half to the west. On either side lie scattered coastal and interior plains. The Peninsula can as a result be climatically divided into west, centre, and east. In Sicily and in Sardinia the relief has no sundering effect on the climate.

The relief accordingly presents three main climatic barriers: (1) the Alps, which cut Italy off from the continent; (2) the Maritime Alps



and the Northern Apennines isolating the Northern Plain from the Tyrrhenian Sea and the south; and (3) the Central and Southern Apennines which separate the east from the west of the Peninsula.

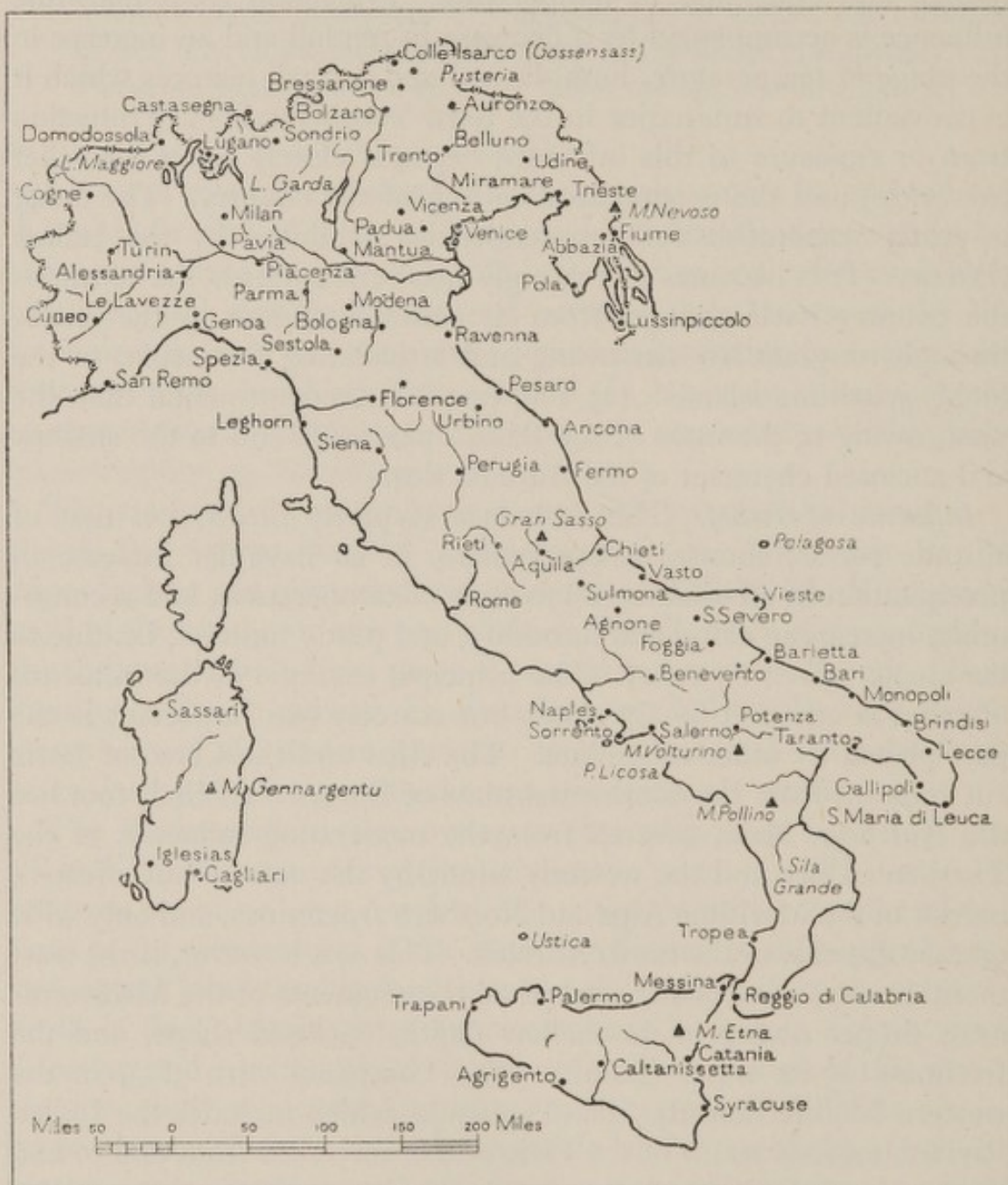


FIG. 67. *Meteorological stations mentioned in the text*

Relief may thus be said (a) to reinforce the two tendencies already mentioned for the continentality of the climate to increase towards the north and towards the east, and (b) to cause a fairly sudden change between maritime and continental types along these three narrow, mountainous, transitional zones.



Superimposed upon these broad climatic tendencies are minor ones due to smaller relief features and to actual distance from the nearest sea. The Adriatic Sea and even the larger lakes of north Italy have a moderating effect on their immediate surroundings. All these tendencies help to determine the regional distribution of the various climatic elements, and are of value in supplementing the statistical information available from a restricted number of stations.

*Pressure (Fig. 68)*

During the winter the Azores high pressure is in its most southerly position and stretches as a narrow belt from Egypt to North America. There is also a narrow extension of the Asiatic high pressure through central Europe as far as Spain. In between, the Mediterranean has relatively low pressure. A secondary ridge of high pressure extends from central Europe along peninsular Italy and is surrounded by areas of low pressure over the Adriatic, Tyrrhenian, and Ionian seas. The westerly winds of the temperate zone are found as far south as the latitude of Gibraltar and throughout the length of the Mediterranean. These winds consist, in fact, of alternating south-westerlies and north-westerlies accompanying, with some winds from other quarters as well, the passage of depressions from west to east. The detailed average pressure distribution is the outcome of the tendency of these depressions to follow certain fairly defined tracks, keeping to the sea and low ground, and avoiding highland and continental masses. One track passes along the south coast of Sicily towards Crete. Most depressions, however, approach from the gulf of Lions, whence they take one of three main courses: (a) south through the Tyrrhenian Sea and then east via the south coast of Sicily, or via the Straits of Messina; (b) across the Northern Plain and south-east along the Adriatic; (c) across the Plain to the northern Adriatic but thence crossing the Julian Alps to Hungary.

In summer the Azores high pressure is restricted to the Atlantic. Centres of low pressure exist over Persia and the interior of north Africa. The western Mediterranean is occupied by a region of gentle pressure gradient between these two extremes. A tongue of relatively low pressure extending from the south-east covers most of the country, but the west coast is affected by the higher pressure of the Tyrrhenian Sea. This relatively high pressure in the western Mediterranean, and the northerly position of the Azores high pressure, confine the prevailing westerlies to the north of Spain, and depressions travelling through the Mediterranean basin are very much rarer than in winter.



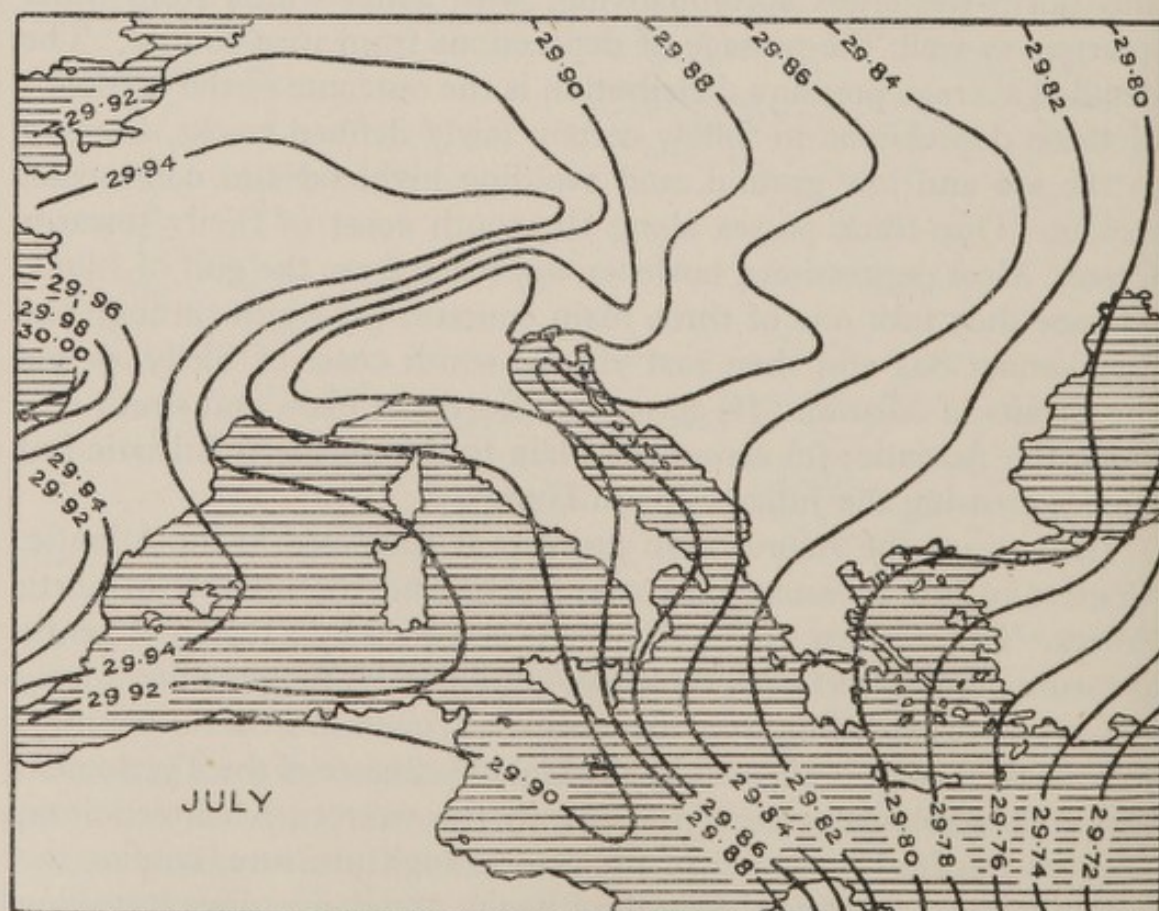
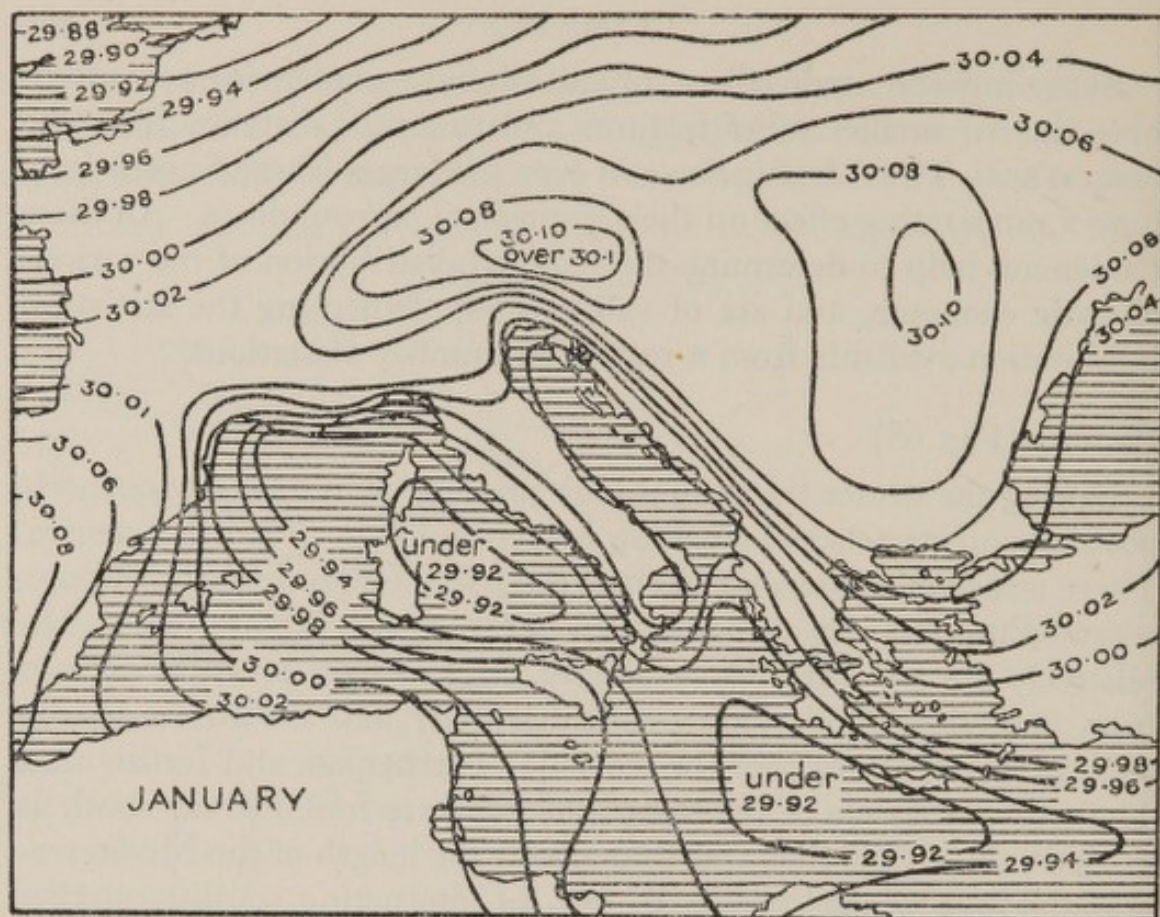


FIG. 68. Mean pressure over southern Europe



*Surface Winds* (Figs. 69 and 70; Table 1)

Generalization about the winds of Italy is difficult because the country lies in the transition zone between prevailing westerlies and prevailing north-east trades, and because they are very much affected by general and local pressure changes (Fig. 68). It is clear that the relative strength of the 'Mediterranean' and 'continental' influences in different parts of the country will depend, *ceteris paribus*, on the direction and force of the wind. The data given in the table and maps do not give as much help as might be hoped, since great variability exists in wind direction and this is, at all land stations, more or less controlled by the local relief. The direction recorded at a station may thus have a fairly loose relation to the real direction of the general flow of air.

The most outstanding general feature is the difference in direction between summer and winter. There is a tendency for outblowing winds in winter and inblowing winds in summer; i.e. northerly in winter and westerly in summer along the Tyrrhenian coast; N. and NW. in winter and N. or SE. in summer on the Adriatic. Inland the prevailing wind will depend on the direction of the valleys opening to one side or the other of the Peninsula. The plain of the river Po is a region of calms and light winds with an inward, easterly tendency in summer, outward and westerly in winter.

Throughout the Mediterranean region the nature of the wind and the origin of the air it brings largely determine temperature and humidity in both winter and summer. Sharp contrasts of both are often experienced with changes of wind. It is not surprising that the region is particularly rich in special winds associated with very definite meteorological characteristics, and with local names. Some of these are of great climatic importance. Among them may be noticed the *land and sea breezes* which are very well developed around practically the whole coast during summer, when the prevailing winds are weak and indecisive, particularly in clear weather. In the south they are important all the year round. As a rule the land breeze is light and shallow (a few hundred feet), and does not affect much more than the immediate coast and up to 10 miles out to sea. It blows during the greater part of the night and some of the following morning. The sea breeze, which is normally stronger and may reach 20 miles inland, is also fairly shallow, not extending above 3,000 feet. It springs up in the middle of the morning or later, lasts until sunset, and dies



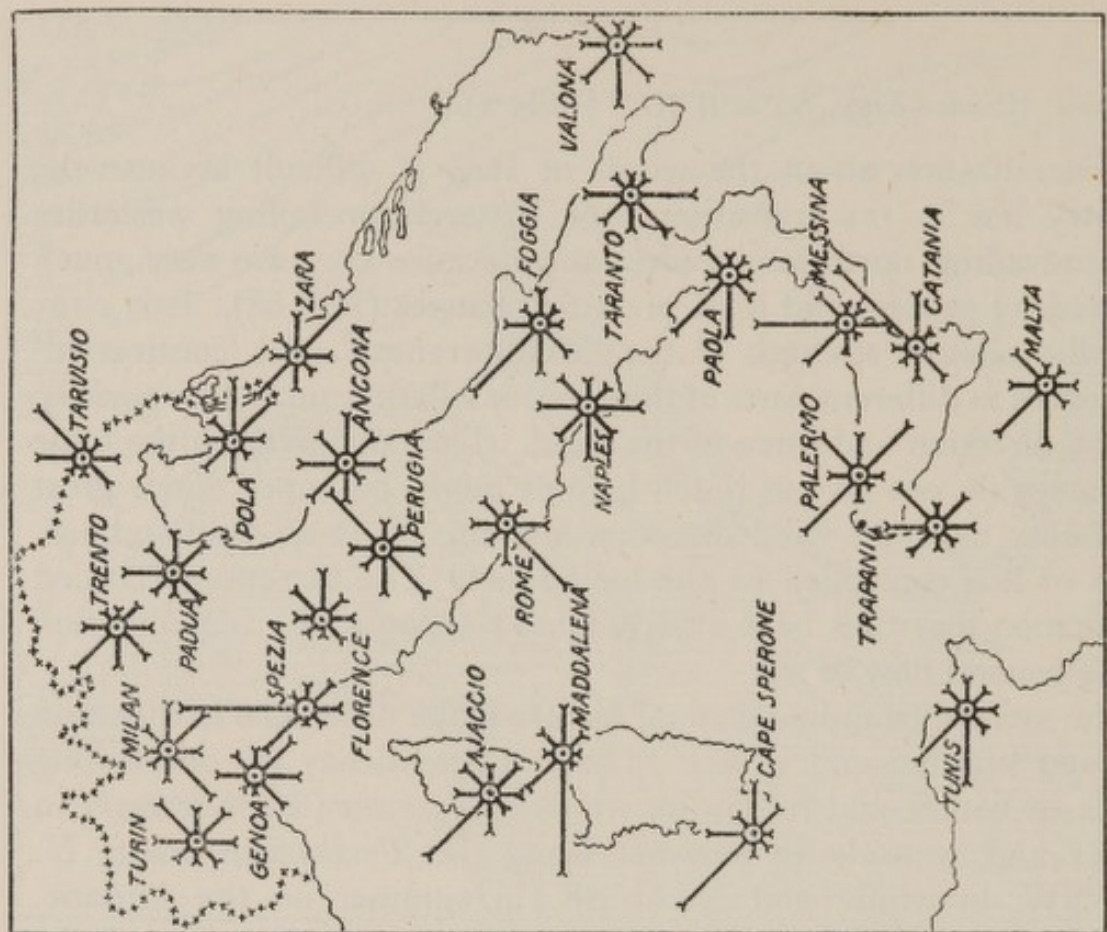
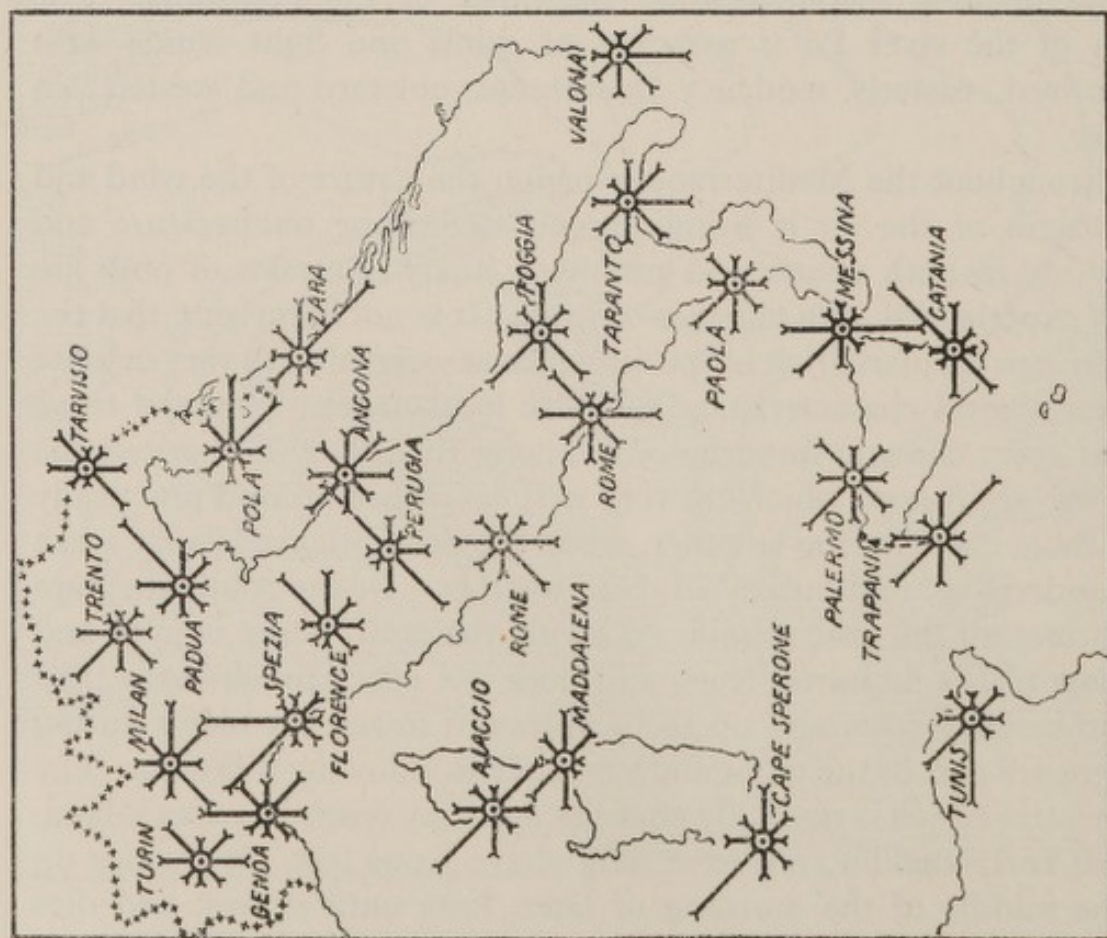
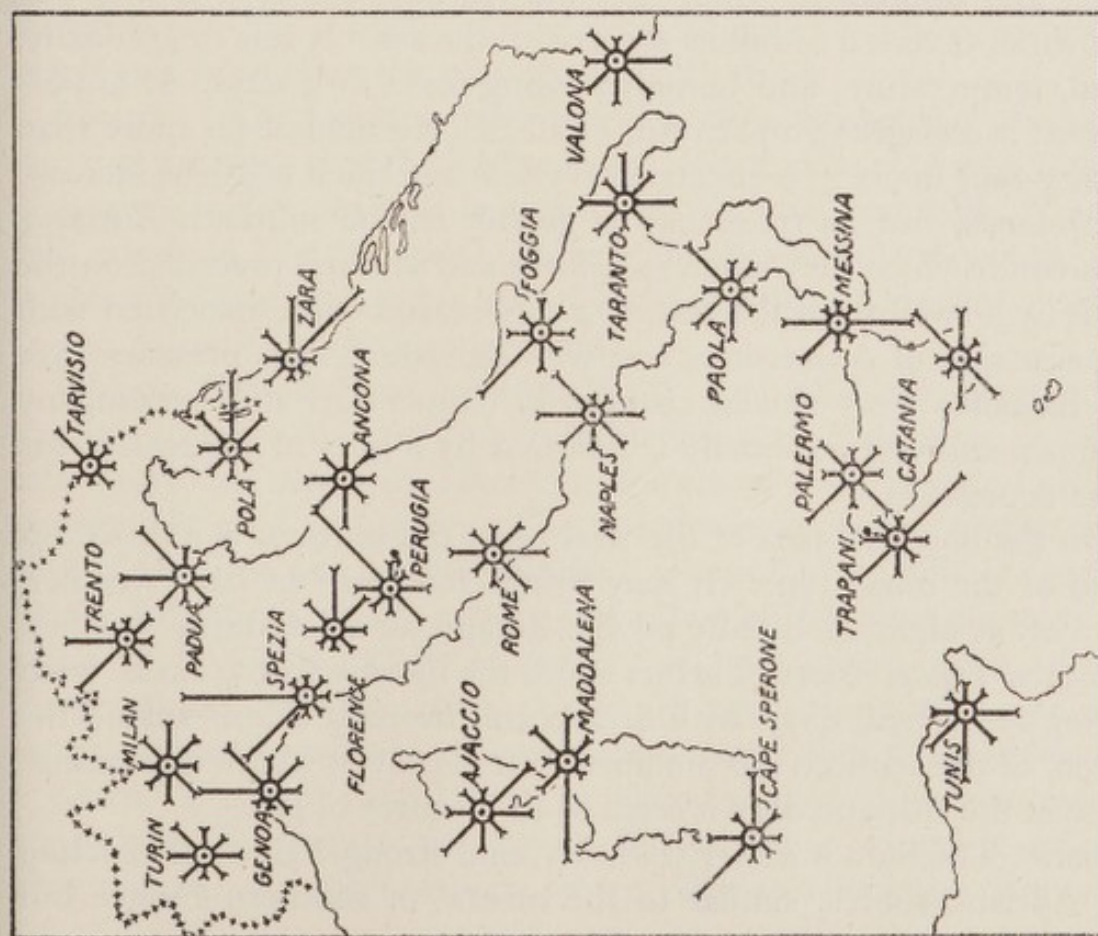
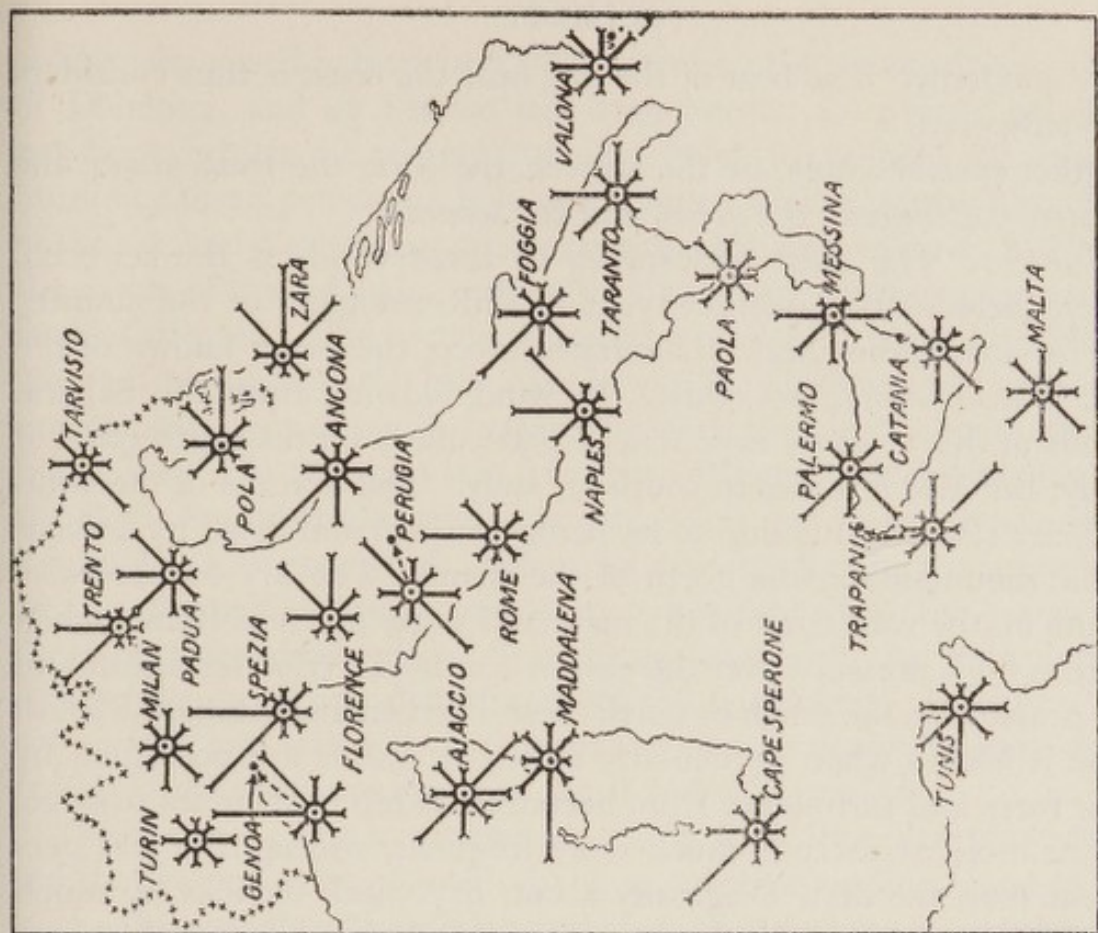


FIG. 69. Surface winds





Autumn



Winter

FIG. 70. Surface winds



away suddenly. The heat of the day near the coast is thus considerably tempered.

Other special winds are the *scirocco*, the *bora*, the *tramontana*, the *maestro*, the *libeccio*, the *greco*, and the *levante*.

*Scirocco*. The most widespread of these winds is the scirocco, which includes two distinct types in different parts of the country and its surrounding seas. The dry scirocco, the better known of the two, is a very hot, dry, dusty, S. wind blowing from the Sahara. Winds of this type are experienced particularly on the north coast of Sicily, but also at times in southern Italy. The dryness of the wind in Sicily (Palermo) is due to its being warmed and dried by descent of the mountains in the north of the island. The dry scirocco also occurs on the west coast of the mainland as far north as Rome, when there is high pressure over the east or south-east Mediterranean and low pressure in the north or north-west Tyrrhenian. Along the south coast it occurs when particularly strong S. winds are prevented by their force and turbulence from becoming damp in their sea passage.

The moist scirocco is much more frequent, widespread, and persistent than the dry. Originally a hot, dry wind, it picks up much moisture in passing over the sea and strikes Italy as a warm but very moist and oppressive wind. On the Adriatic coasts it is a strong SE. wind, diverted to follow the axis of the sea. It sets in gradually, wind, temperature, and humidity rising for 2 or 3 days. It is persistent; at Pelagosa 70 per cent. of all SE. storms last for more than twenty-four hours. Its effects, heavy seas and thick weather, increase northwards, but its frequency is greater in the southern Adriatic. The wind, which may reach gale force and is often preceded on the coast by a swell from the east, is a cool-season wind associated with the east side of depressions and with persistent high pressure over the Balkans. Very violent changes in temperature may accompany its onset and end, especially if followed by a bora in the rear of the same depression.

On the northern part of the west coast the scirocco is a S. to SE. wind of the moist type. It may bring cloudless but hazy weather, overcast at night, as usually on the Riviera, or thick, rainy weather, as on the Tuscan coast. Farther south the moist scirocco is a S. wind lasting for several days, with drizzle and overcast skies. Inland the effects of the scirocco are modified, but it is everywhere unpleasant. Only in the Adriatic does it seem to be a source of gales.

*Bora*. The bora is a very cold, dry, and strong NE. wind affecting the Adriatic shores, similar to the mistral of southern France but



colder. Its speed is increased by descending the mountainous slopes of Dalmatia, and at Trieste has been known to average 70 miles per hour, whilst the temperature has fallen to  $14^{\circ}$  and the relative humidity to 15 per cent. It is much more violent on the east shore of the sea, and many boras do not even reach the west shore. Although the whole of the Adriatic coast is liable to it, the north-east extremity is most affected. The bora is strongest and most frequent at Trieste, where it blows from the NE. Fiume and the Quarnero are peculiarly exempt, but it is especially dangerous among the neighbouring islands. From Venice to Gargano it is frequent, although not so violent as in the east. South of Gargano it is a N. wind and rarer. Everywhere the bora is a winter wind. When, as usually, the bora is associated with a depression, its coldness may be intensified by a scirocco preceding the depression. Sometimes, however, the bora arrives independently of any disturbance of the barometer. In either case the wind is comparatively persistent and may continue for some days. It is said once to have endured for as much as 30 days.

*Tramontana.* The tramontana is a cold wind from the Alps affecting the western part of north Italy, and corresponding there to the bora. It is usually a N. or NE. wind blowing in the rear of a depression passing from the gulf of Lions across north Italy. It has neither the violence nor the severity of the bora, though it may occasionally reach gale force after the passage of a cold front.

*Maestro.* The maestro (or *maestrale*), although bearing the same name as the mistral of the Rhône valley, is not to be confused with it. The name is given to NW. winds in the Adriatic, and NW., N., and NE. winds in Liguria and Tuscany. In the west the maestrale is a winter wind (Genoa), but is less cold and dry than the mistral proper. In the Adriatic it is a summer wind.

*Libeccio.* Winds from between WSW. and SSW., sometimes including also due W., are known at many places as libeccio, a name referring to the direction rather than the character of the wind, which is normally mild and moist. The libeccio is important on the west side of Sardinia and of the mainland, except for the gulf of Genoa. In the Adriatic it chiefly affects Istria, but on the west shore many bring very violent squalls in the lee of high coasts, as at Monte Gargano and Ancona. Such winds are everywhere strongest and most frequent in winter, as they are associated with depressions.

*Greco.* The NE. wind known as greco (or *gregale*) is encountered around the Tyrrhenian Sea and in Sicily, and in winter it may be very violent. In the northern part of this area and the Straits of



Messina this wind is dry and cold, blowing off the land, but, having crossed the sea, brings rain in Sicily and Sardinia.

*Levante.* The name levante is applied to E. winds in Sardinia. There appears to be little to distinguish them from the moist type of scirocco. They are, consequently, very different from the llevente of the east coast of Spain.

Of all these specially named winds only the bora and the scirocco have highly distinctive characters irrespective of their location and direction, or are meteorological peculiarities demanding special explanation. The other winds are the normal variants to be expected with the passage of a depression and owe their characters to the source from which they come. The bora and the scirocco, however, bring with them very abnormal weather, and by their persistence and frequency appreciably modify the climates of regions peculiarly liable to them.

*The force of the wind* (Table 1) diminishes greatly inland (cf. Milan and Venice). Over most of the country the average velocity is greater in winter than in summer, except in the Northern Plain, where the cold, clear winters are accompanied by a weakening of the wind, the average velocity of which is greater in summer (cf. Venice or Milan with Trieste or Palermo).

### *Upper Winds*

The winds of the upper air are even less susceptible of general description than those at the surface. Near the surface (up to 1,650 ft.) they roughly coincide with the surface winds. At moderate heights sea breezes tend to be reversed, and above 3,300 feet other winds also begin to deviate from the direction at the surface. At greater heights the winds over the islands and peninsula, and surrounding seas, appear to be predominantly W. and NW. (Figs., pp. 519-524). This is true at all seasons, though the predominance is greater in spring and summer than in autumn or especially winter. In the north and interior of Italy any prevailing trend is difficult to detect. Northerly winds are most frequent at high levels (3,300 and 6,600 ft.) in winter, and in summer W., SW., and NW. directions are more frequent. There is much local variation in the Alps, e.g. at Trento due N. and S. winds dominate all levels above the surface, but S. winds are important only in summer and spring.<sup>1</sup>

<sup>1</sup> For detailed information reference must be made to *Weather in the Mediterranean*, vol. i, General Information (M.O. 391 a), and more particularly to vol. ii (M.O. 391 b), Parts 2, 4-7, and 9, where data are given both in diagrammatic form and in tables



*Rough Sea and Swell* (Table 2)

It is impossible to generalize on this subject. Rough sea along the coast is most frequent with strong onshore winds, provided they have a long fetch over uninterrupted sea, e.g. SW. winds at Taranto. Strong winds blowing slightly off shore will, if continuous, raise a sea, e.g. in the northern Adriatic the bora is sufficiently important for rough seas to occur most frequently with NE. and E. winds, except at Fiume. Local influences are of great weight in determining the frequency and occasions of rough sea, which in most localities may be brought by almost any wind.

Swell is most likely to approach a coast from the direction in which the wind has the greatest fetch, and for this reason is always slight in the Mediterranean compared with Atlantic coasts. Its frequency will depend on that of strong winds in the required direction, not at the coast itself, but some distance away. Swell may appear on the coast earlier than the wind that causes it; such premonitory swell is said to arrive from the east on the Adriatic coast before a scirocco. Swell also often persists for twenty-four hours after the wind giving rise to it has dropped.<sup>1</sup>

A local peculiarity commonest on the south-west coast of Sicily, but affecting also the west, south and east coasts, is the *marobbio*, *marrubbio* or *carrobbio*. This consists of isolated waves, or series of waves, with a period of 10 to 25 minutes, which, during undisturbed weather, may raise the sea level by two or three feet. Their origin is uncertain.

*Temperature* (Figs. 71 and 72; Tables 3 and 4)

The distribution and regimes of temperature throughout the country well reflect the main influences mentioned at the beginning of this chapter. The general rules are that (1) temperatures decrease as altitude increases, (2) temperatures decrease from south to north, (3) the annual range of temperature decreases from north to south and from east to west, and (4) the annual range increases from the coast inland. These general tendencies and the detailed distribution of temperatures can be seen from the maps of the mean temperatures for January and July.

for the following stations: Frequency only: Genoa. Frequency and force: San Antioco (Sardinia), Capo Mele (Riviera), Leghorn, Vigna di Valle (Rome), Ischia (Naples), Messina, Maddalena, Palermo, Trapani, Malta, Taranto, Valona, Viesti, Venice, and Udine. Also Ancona (diagram only).

<sup>1</sup> See *Weather in the Mediterranean*, vol. ii.



In winter the lowest temperatures are, naturally, experienced on the higher parts of the Alps, but at lower altitudes the coldest part of the country is the western portion of the Northern Plain. Here



FIG. 71. *Mean temperature: January*

Alessandria (322 ft.) and Piacenza (236 ft.), although low-lying, each have a mean January temperature<sup>1</sup> just below freezing, and the mean

<sup>1</sup> Explanation of terms used to describe temperature variations:

*Monthly mean* = the average temperature throughout the whole month (day and night together).

*Mean monthly minimum* = the average of all the lowest temperatures recorded during the month in question in all the years of observation; i.e. the lowest



annual minimum at Turin is as low as  $17^{\circ}$ . These low temperatures are partly due to stagnation of cold air in the low-lying parts, and the temperature actually increases with height above sea-level (Turin,

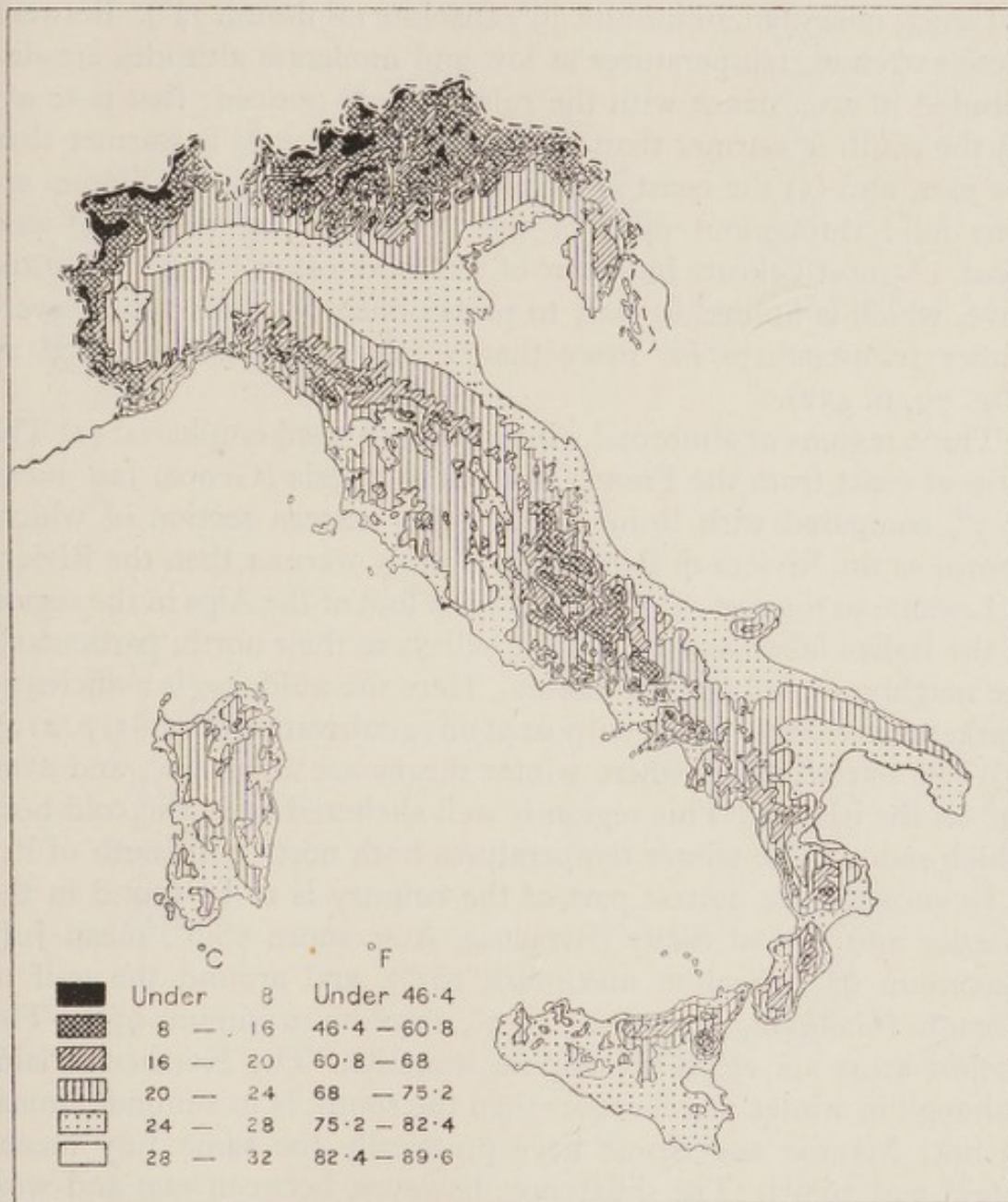


FIG. 72. Mean temperature: July

point to which one may expect the temperature to drop to during that month. This must be distinguished from the *mean daily minimum* during any month, which is the average of all the daily minima during that month averaged over all the years of observation, i.e. the point to which one may expect the temperature to drop at some time (usually early morning) in each day of the month.

*Absolute minimum* = the lowest temperature ever observed.

Example: Venice (Jan.) Monthly mean  $34.9^{\circ}$ . Mean daily min.  $32^{\circ}$ . Mean monthly min.  $24^{\circ}$ . Absolute min.  $14^{\circ}$ .



906 ft., Jan. mean  $32.5^{\circ}$ ; Cuneo, 1,821 ft.,  $34.5^{\circ}$ ). Similar conditions, on a smaller and less intense scale, may occur in the enclosed basins of the Apennines, such as those of Aquila, and even Florence. The warmest area in winter is the south-west coast of Sicily (Jan. mean  $54^{\circ}$ ; Syracuse, mean Jan. minimum  $39^{\circ}$ , absolute minimum  $32^{\circ}$ ). Between these extremes, temperatures at low and moderate altitudes are distributed in accordance with the rules already noticed; that is to say (1) the south is warmer than the north, (2) the west is warmer than the east, and (3) the coast is warmer than the interior. Winters are thus mild throughout most of the Peninsula, especially the west coast. A most delicate indicator of the mildness of the winter is the olive, which is limited in Italy to parts unlikely to experience severe winter temperatures for more than a very short period, if at all (Fig. 79, p. 452).

Three regions of abnormal winter warmth need emphasis: (1) The strip of coast from the French frontier to Spezia (Genoa, Jan. mean  $45.5^{\circ}$ , compared with Rome,  $44.1^{\circ}$ ), the western section of which, known as the Riviera di Ponente, is slightly warmer than the Riviera di Levante to the east. (2) The southern foot of the Alps in the region of the Italian lakes, and the Alpine valleys to their north, particularly the neighbourhood of Lake Garda. Here the mildness is sufficiently marked and reliable for an outpost of olive cultivation (Fig. 81, p. 212). (3) The Istrian coast, where winter means are about  $40^{\circ}$ , and even  $45^{\circ}$  on the islands. This region is well sheltered from the cold bora which reduces the winter temperatures both north and south of it.

In summer the hottest part of the country is to be found in the interior and east of Sicily (Syracuse, Aug. mean  $78.6^{\circ}$ , mean July maximum  $97^{\circ}$ , absolute maximum  $105^{\circ}$ ), and around the gulf of Taranto (Gallipoli, Aug. mean  $77.5^{\circ}$ , absolute maximum  $97^{\circ}$ ). The coolest areas are again the Alpine summits. The Northern Plain, although in winter much colder than the south, is in summer almost as hot; Mantua and Rome have practically the same July means ( $76.5^{\circ}$  and  $76.6^{\circ}$ ). The difference, however, between east and west is maintained, Ancona being about  $2^{\circ}$  warmer than Leghorn. The main contrast, where not masked by altitude, is between the interior and the coast. The mean summer temperatures on the coast are lower and the daily range is smaller, since the heat of the day is almost everywhere tempered by sea breezes. Inland, although the heat of the day is greater, the cooler nights give a degree of relief which is not felt near the coast. The daily range is also greater on the east than on the west (Table 3). In the islands, particularly in



Sicily, nights tend to be hot in summer (night minima about  $70^{\circ}$  on the coast).

Throughout the country, altitude normally reduces temperature.

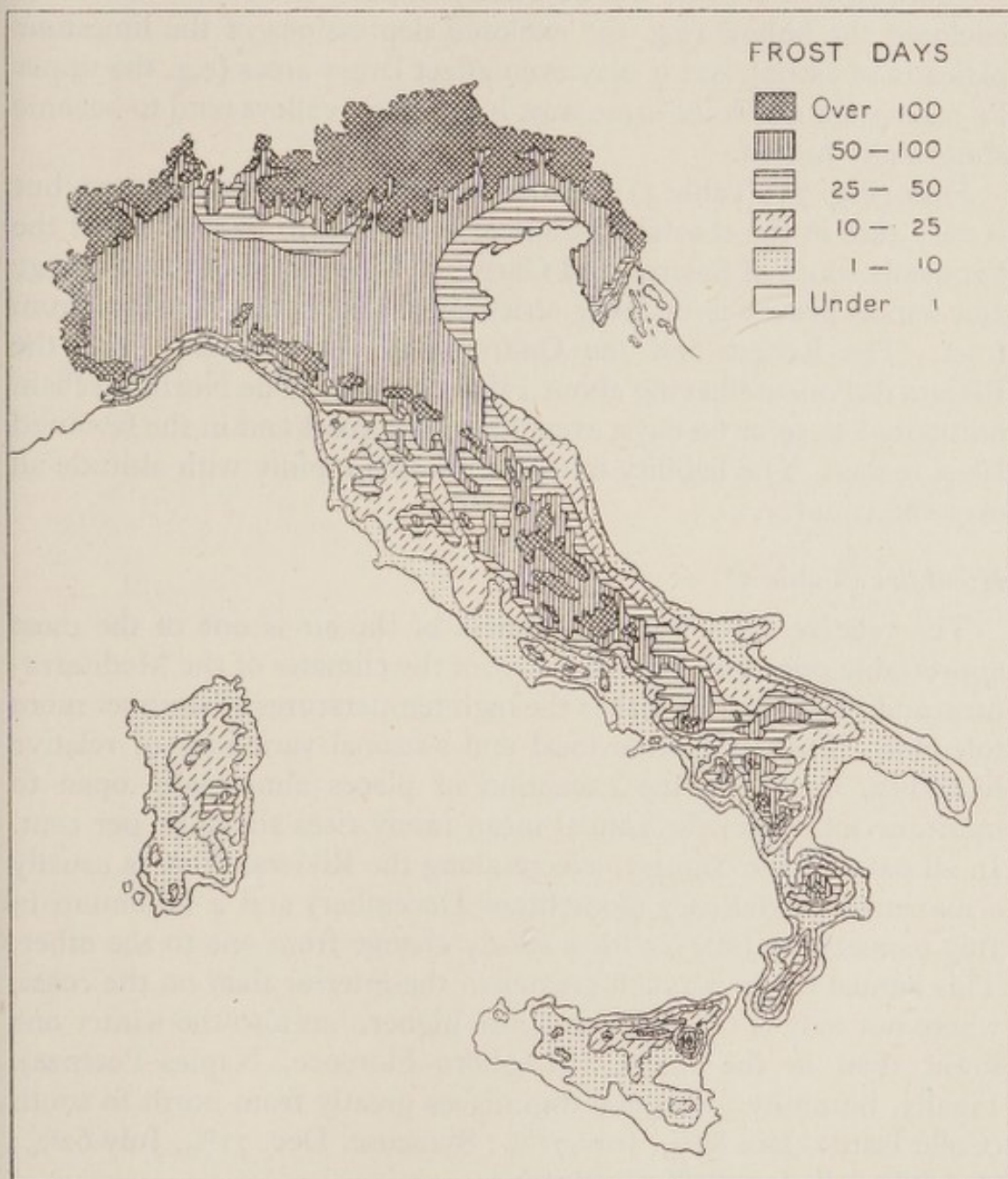


FIG. 73. *Days with frost*

The rate of this reduction is difficult to determine and varies to a certain extent. On the slopes of Etna it seems to be about  $1\frac{1}{4}^{\circ}$  for every 300 feet. Farther north it becomes slightly less, in the eastern Alps just under  $1\frac{1}{2}^{\circ}$  for every 500 feet. These figures only represent a mean condition; the rate varies from season to season and from place to place with local conditions, being usually greatest in late



spring and least in winter. An exception to the operation of this rule is found in valleys or other hollows in winter, when cold air draining down the slopes may cause temperature to increase with height. This accumulation of cold air will be more prevalent and marked the more enclosed the hollow (e.g. the enclosed depressions of the limestone plateaux of Istria), but it may even affect larger areas (e.g. the upper Po basin). In much the same way, in summer, valleys tend to become abnormally heated.

*Frost* (Fig. 73; Table 4) may occur in any part of the country, but is very rare in the coastal districts of Sicily, south Sardinia, and the Peninsula south of Salerno and Gargano. The distribution of orange and lemon groves is in fairly strict accord with this freedom from frost. The Riviera and the Quarnero are exceptionally free, the Riviera di Ponente having about 1 day per year. The Northern Plain normally has 50 or 60 days, except near the coast and in the favoured lakes region. The liability to frost increases rapidly with altitude all over the country.

#### *Humidity* (Table 5)

The relative dryness and crispness of the air is one of the most appreciable points of contrast between the climates of the Mediterranean and England, and makes the high temperatures of summer more tolerable. There are wide local and seasonal variations of relative humidity, but, with the exception of places abnormally open to maritime influence, the annual mean rarely rises above 70 per cent. In all parts of the country, except along the Riviera, there is usually a maximum in January (sometimes December) and a minimum in July (sometimes June), with a steady change from one to the other. This annual range is much greater in the interior than on the coast, where not only is the summer figure higher, but also the winter one lower than in the interior (Leghorn-Florence, Naples-Potenza). Finally, humidity in general diminishes greatly from north to south (Colle Isarco, Jan. 82%, July 71%; Syracuse, Dec. 71%, July 62%; cf. Liverpool, Jan. 86%, July 79%).

It is generally true to say that low humidities accompany high temperatures in both place and time, and that on the whole humidity varies inversely with temperature. On the Riviera, however, humidity is highest in summer, and on the Northern Plain comparatively high summer humidities are found (55-60%). In the south and in the interior of the Peninsula remarkably low mean humidities are experienced (Aquila 45%, Caltanissetta 46%, in July).



Table 1

Year

1950

1951

1952

1953

1954

1955

1956

1957

1958

1959

1960

1961

1962

1963

1964

1965

1966

1967

1968

1969

1970

1971

1972

1973

1974

1975

1976

1977

1978

1979

1980

1981

1982

1983

1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	

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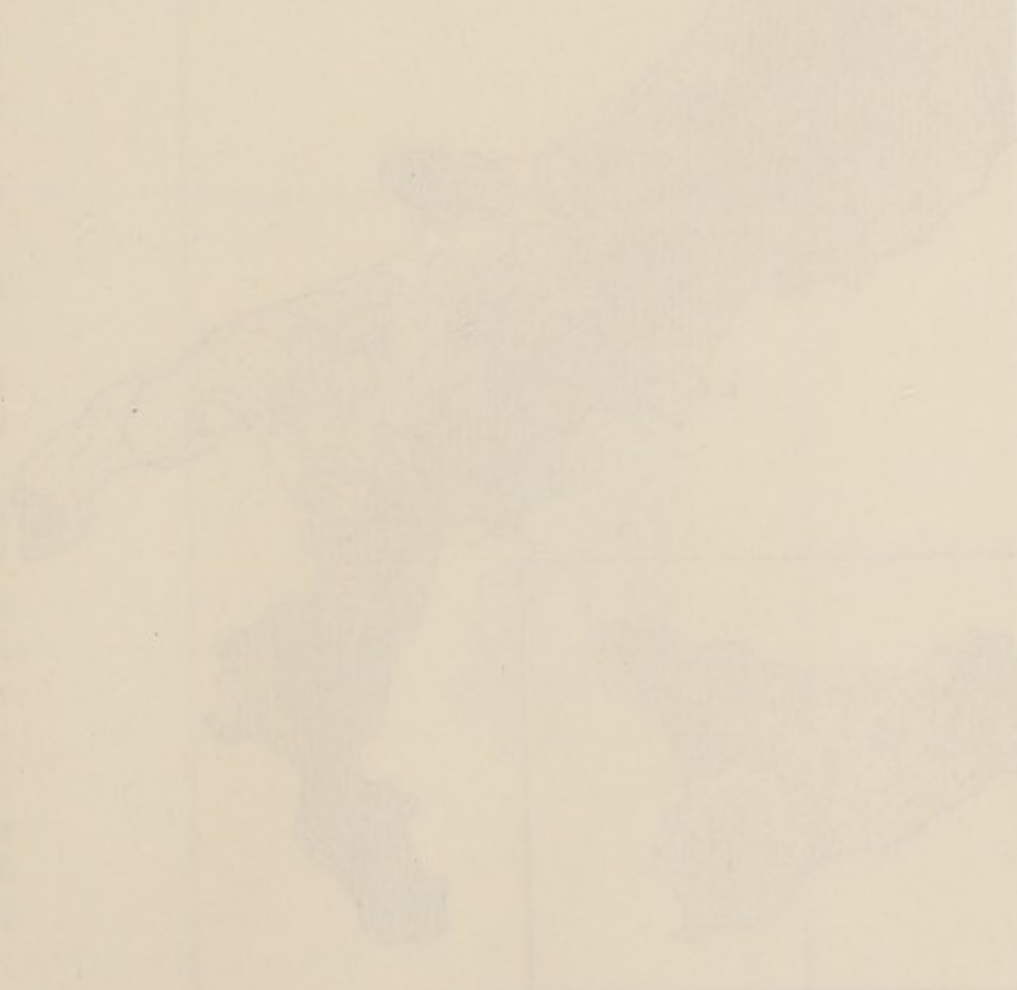


Figure 1. Map of the United States showing state boundaries and major cities.



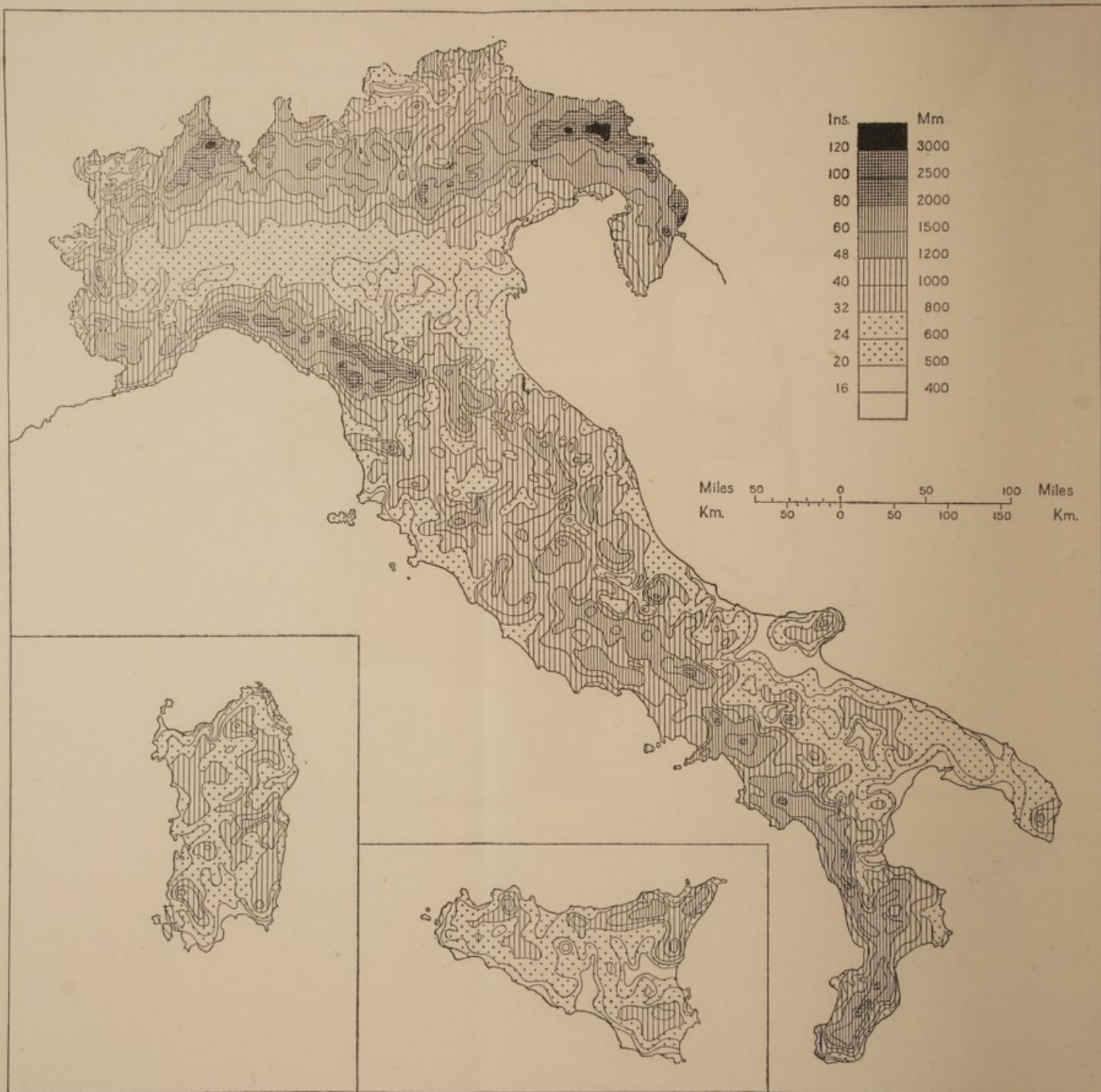


FIG. 74. Mean annual precipitation (1921-30)



*Rainfall* (Figs. 74, 75, and 76; Tables 6 and 7)

The mean distribution of rainfall is markedly influenced by relief. The annual rainfall map reproduces the main lineaments of the relief map, but with certain modifications. The heaviest falls occur, indeed, in the Alps and the lightest in the lowlands. With few exceptions, however, the general movement of rain-bringing air masses is from the west (even though the most rainy wind in any particular place is normally the onshore wind), and it is noticeable that, almost always, the west sides of the mountains have most rain and the plains on the sheltered east side are driest. The highest falls (over 120 in.) occur, not in the high western Alps, but in the much lower Julian Alps and the Carso, which lie more directly across the prevailing wind direction. The highest falls in the Peninsula are found, not in the centre where the Apennines are highest, but in Liguria and Calabria, where they are ranged closest to the west coast. In these two places there is a sharp contrast between the wet west (40-50 in.) and the exceptionally dry east side (15-25 in.), with a wet interior mountain area (70-80 in. in the south and up to 100 in. in the north). In the central part of the Peninsula the swing of the mountains to the east side produces a more even distribution and a much lower maximum in the interior, although the mountains themselves are higher. Here the fall is about 30 to 40 inches over the greater part, falling below 30 inches in the coastal districts and enclosed basins, and rising to 50 inches or more among the highest of the Apennines.

The general distribution of rainfall may be summarized in three broad generalizations (cf. the similar generalizations about the distribution of temperatures, p. 417). (1) The south is drier than the north. The least rainfall (15 in.) occurs in southern Sicily, in the north and south of Sardinia, and in the Apulian Region. (2) The east is drier than the west, except in the Alps. (3) The hills are wetter than the lowland, and more especially than the enclosed basins of the Apennines and the Alps (Cogne 16 in.; Sulmona 26.6 in.). Average falls have been computed for the following areas: Valley of the river Po, 40.4 inches; Peninsula, west side, 35.9 inches, east side, 27.3 inches; Apennines, 42.4 inches; Sicily, 24.3 inches; and Sardinia, 20.7 inches. The average precipitation for the Alpine region would be higher than these, but, being made up of wider extremes, would be of little descriptive value.

The rate at which rainfall increases with altitude is much more



irregular than the similar rate for temperature. The following data concern the south and the islands only.

*Average Rainfall (inches) in Altitude Zones*

	0-660 ft.	660- 1,300 ft.	1,300- 2,000 ft.	2,000- 2,600 ft.	2,600- 3,300 ft.
Sardinia . . .	23.1	29.9	33.6	35.2	32.2
Sicily . . .	26.6	28.7	30.7	31.4	29.1
S. Italy, E. side .	25.6	34.8	35.7	37.6	31.4

In each case the zone of maximum fall lies somewhere between 2,000 and 2,600 feet. On individual mountains the rainfall increases up to this zone, the height of which seems to vary with that of the mountains (e.g. Gennargentu, alt. 6,017 ft., maximum zone 3,250 ft.; Volturino, 6,024 ft. and 3,900 ft.; Sila Grande, 6,329 ft. and 4,062 ft.; Pollino, 7,451 ft. and 5,000 ft.; Etna, 10,741 ft. and 8,000 ft.).

*The season of rainfall* is no less important than the amount (Fig. 75). The rain of typical Mediterranean lands falls almost exclusively in winter, leaving a very marked and almost complete drought in the summer months. This regime occurs without qualification only in the southern half of the Peninsula and in the islands, and in its purest form with a single maximum in one of the winter months and a single minimum in July, only in Sicily (Table 6). Northwards there is an increasing tendency for two maxima, in autumn and spring, to appear, although the winter rainfall remains comparatively heavy. The length and completeness of the summer drought tend also to diminish northwards. Less than an inch of rain per month falls in Sicily and on the Ionian coast from May to August; in Sardinia and on the small plains of the Tyrrhenian coast south of Rome, from June to August; and along both coasts as far north as Leghorn and Ancona, in July and August. Elsewhere no month has less than an inch of rain. In the northern part of the Peninsula the summer drought still persists, but the rain falls in two well-marked periods in autumn and spring, with a noticeably drier period in winter (Genoa).

In the Alps and the Northern Plain the rainfall regime cannot be described as Mediterranean, but approximates quite closely to the continental type. North of a line which partly coincides with the course of the river Po (Fig. 75), the least fall occurs during the winter. To the south there is a further zone, occupying the rest of the plain to the foot of the Apennines, where the winter drought is practically as marked as the summer, although neither is by any means absolute.



Over the whole of the Plain most rain falls in spring and autumn, autumn being wettest in the south and spring in the north. The difference in rainfall regime between this area and the Peninsula is



FIG. 75. *Season of rainfall*

not great statistically, but most important agriculturally (Vol. II). Among the Alps the transition to the continental climate goes even further and the remote valleys have a single maximum in summer (July) and minimum in winter, the exact reverse of the Sicilian or true Mediterranean type (Colle Isarco, Auronzo, Domodossola).

The rainfall regimes of Italy thus vary between the two extreme types, Mediterranean and continental, found in Sicily and the Alpine



valleys respectively. The transition between the two takes the form of the development of the winter rainfall maximum of Sicily into two maxima, spring and autumn, the gap between which gradually widens farther north, until they come together again in a single summer maximum. The Apennines cut off the mainly Mediterranean (summer drought) from the mainly continental (no summer drought) areas. Istria, with a heavy fall, has a regime similar to that of the Alps.

The frequency of rainfall (Fig. 76 and Table 7<sup>1</sup>) also varies very much from place to place, in general directly with the amount of fall. Only the highland area has more than 100 days. Most of the rest, except for scattered sheltered areas, has between 60 and 100 days. The Riviera di Ponente and a large area extending into the Tanaro valley as far as Alessandria, as well as much of southern Sicily and the Ionian coast, have less than 60.

The greater part of the rain falls in heavy showers, particularly in the southern part of the Peninsula and during summer in the Northern Plain. In the central sectors of the Adriatic and Tyrrhenian coasts, however, steady continuous rain may occur with onshore winds, and drizzle is characteristic of the scirocco in the Adriatic. All over the country the rainfall of higher districts is much more continuous and steady. As a rule the rain-bearing winds are onshore.

#### *Snow* (Figs. 58 and 77; Table 8)

A certain amount of the precipitation which has been included under the title of rain actually falls as snow. Information about snow is meagre and relates mainly to the number of days with snowfall. This indicates that snowfall is very irregularly distributed, although in general becoming gradually less frequent from north to south. It is of importance mainly in the mountain areas and in the north. The highest numbers of days with snowfall are in the Alps (Colle Isarco 38, Bressanone 17, Bolzano 11), but the Apennines have much more frequent falls than the low figures for the two coasts would suggest. Thus there are 14 days at Potenza (in the latitude of Naples, but at 2,710 ft.), 17 at Aquila, and certainly much more in the mountains.

<sup>1</sup> There is considerable disagreement between the figures in the table and those on which the map has been based. This depends on the definition of a day with rain—in neither source is it stated. The map has been followed in the text. In countries such as Italy, where rain falls mainly in heavy showers, the precise definition of a rain day is not so important as in those like England, where light showers form an appreciable proportion of the total precipitation.



Of the lower-lying regions, the Northern Plain has most frequent snowfall (*c.* 8 days), but it is curious to note that the Apennine slope has a much greater frequency than the Alpine, and that there is a

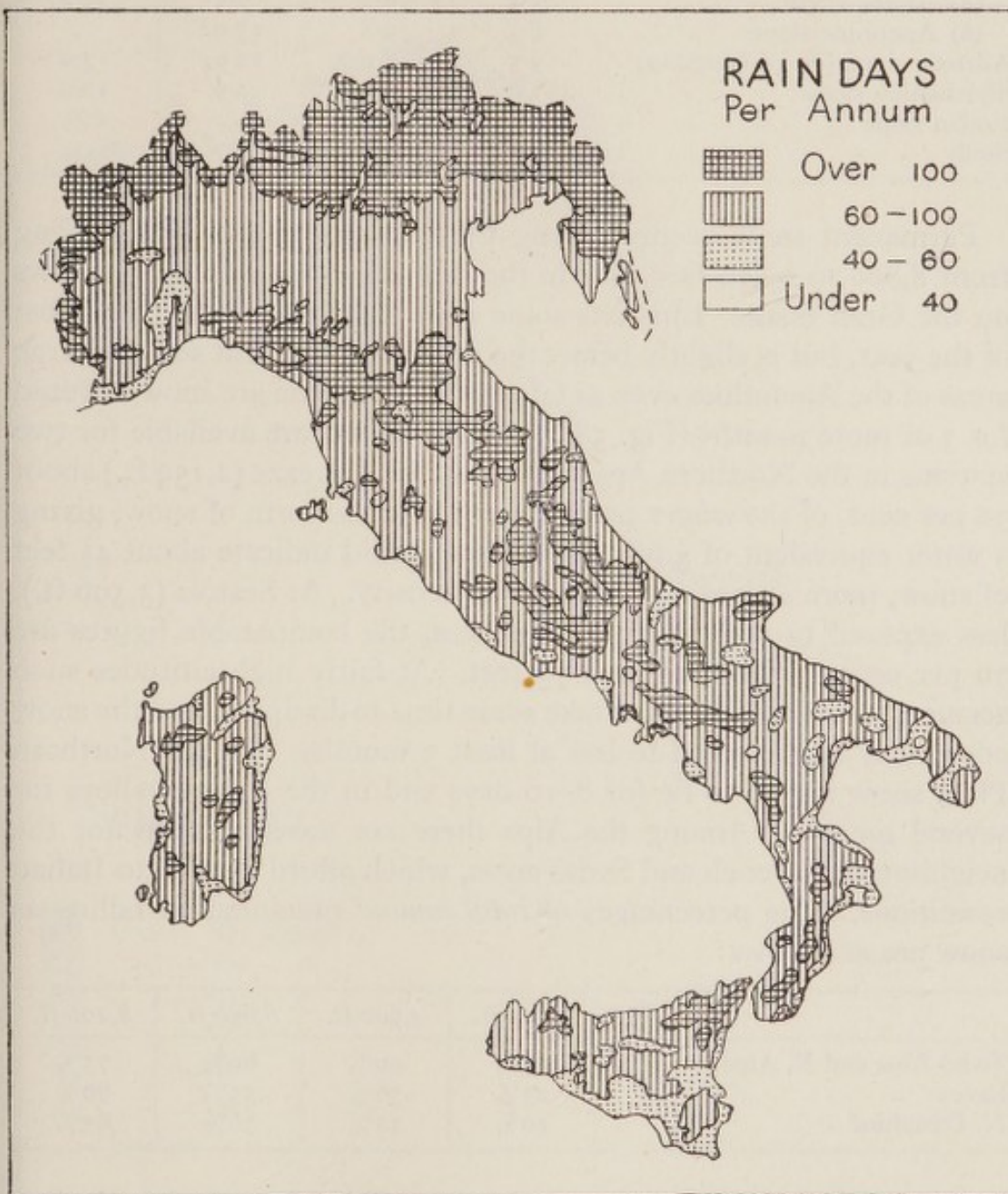


FIG. 76. *Number of rain days*

belt of low frequency along the foot of the Alps themselves. In the Peninsula the Adriatic coast (especially the northern portion) has very much more snow than the Tyrrhenian. The following table shows the relation between frequency of snowfall (in days) and altitude in different parts of the country.



	0-660 ft.	660- 1,300 ft.	1,300- 2,000 ft.	2,000- 3,300 ft.
Northern Plain:				
(a) Alpine slope . . . .	5.5	6.2	7.5	15.8?
(b) Apennine slope . . . .	8.3	9.8	13.0?	..
Adriatic slope (N. of Gargano) .	5.5	8.0	12.0	17.0
Tyrrhenian slope . . . .	1.9	4.0	5.9	10.9
Ionian slope . . . .	1.4	8.5?	..	20.9
Sicily . . . .	0.5	1.4	1.7	..

Permanent snow occurs among the Alps above a height varying from 8,800 to 9,800 feet, but in the Apennines is limited to hollows on the Gran Sasso. Etna has some snow near the summit for most of the year, but is slightly below the level of permanent snow. Large areas of the Apennines even as far south as Calabria are snow-covered for 3 or more months (Fig. 58). Certain figures are available for two stations in the Northern Apennines. At Le Lavezze (2,139 ft.) about 30 per cent. of the *winter* precipitation is in the form of snow, giving a water equivalent of 4.6 inches. This would indicate about  $4\frac{1}{2}$  feet of snow, more or less according to its density. At Sestola (3,596 ft.), less exposed to mild marine influences, the comparable figures are 76 per cent., 7.8 inches, and  $7\frac{1}{2}$  feet. At fairly high altitudes such accumulations of snow must take some time to dissipate, and the snow cover may be expected to last at least 3 months. On the Northern Plain snow is said to lie for 8-10 days and in the Alpine valleys for several months. Among the Alps there are measurements for the neighbouring French and Swiss areas, which afford a guide to Italian conditions. The percentages of *total annual* precipitation falling as snow are as follows:

	3,300 ft.	4,900 ft.	6,600 ft.	8,200 ft.
Swiss Alps and E. Alps . . .	27%	40%	60%	75%
Savoy . . . .	23%	36%	55%	70%
N. Dauphiné . . . .	20%	32%	50%	65%

Percentages of somewhat the same order will hold good of the Italian Alps, and can be used to find the total fall of snow.<sup>1</sup> In Switzerland at Lugano (902 ft.) and Castasegna (2,297 ft.) further figures are available which may be representative of the southern slope of the

<sup>1</sup> The water equivalent of snow is highly variable, but for convenience the following may be used:

$$\begin{array}{lcl}
 1 \text{ in. of precipitation (water)} & = & 1 \text{ ft. of snow} \\
 1 \text{ mm.} & \text{,,} & \text{,,} = 1 \text{ cm.} \text{,,}
 \end{array}$$



western Alps. At these two places the number of days with snowfall are comparatively low (12 and 24). The number of days with snow-cover are 24 and 57, occurring in a series of discontinuous spells

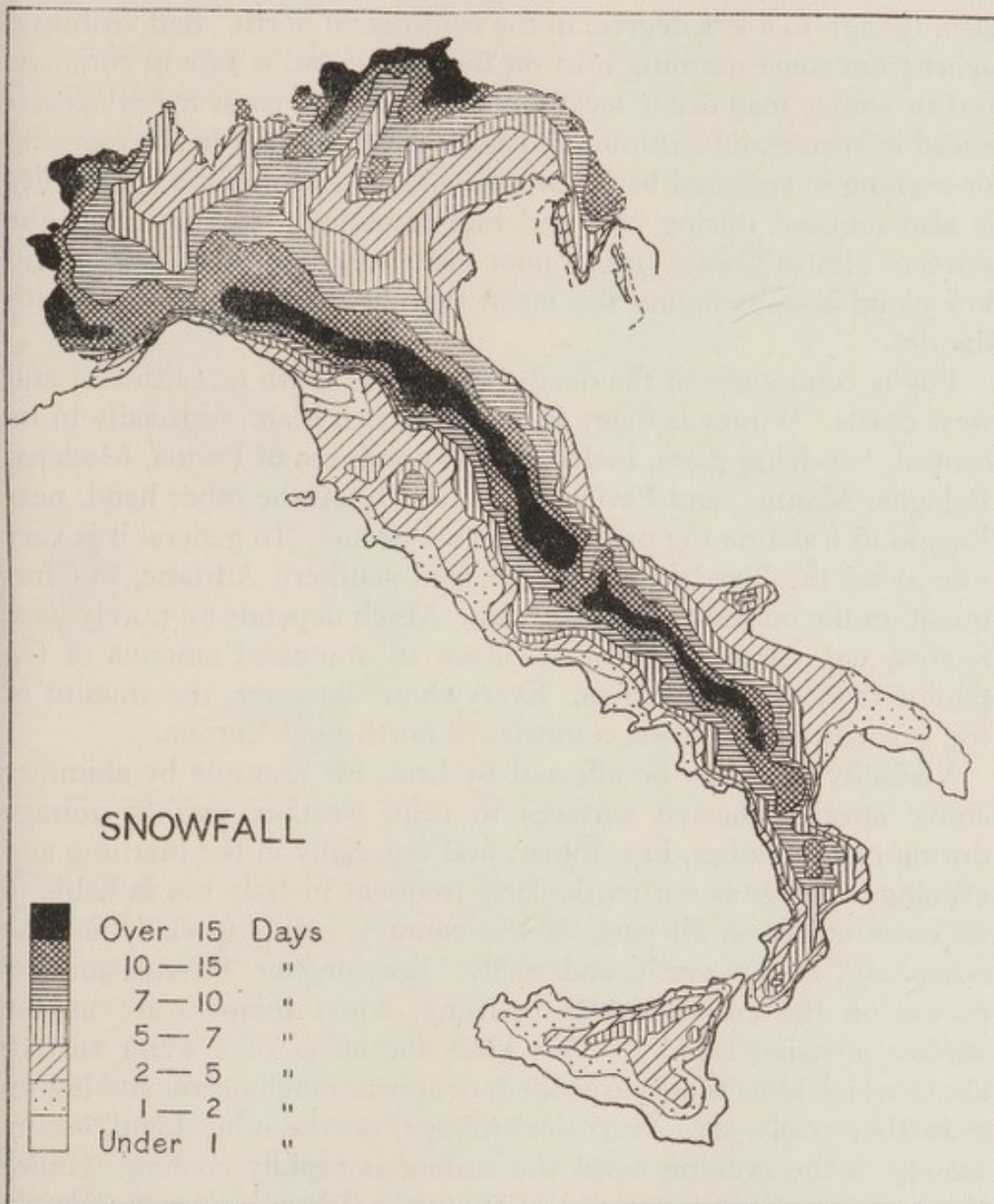


FIG. 77. *Number of days with snowfall*

during which snow lies on the ground only to be dispersed after a short time. The same is true of all Italy except the higher areas, and the practical importance of the snow-cover is small but for its influence on trans-Alpine routes.



*Visibility* (Tables 9, 10, and 11<sup>1</sup>)

Clearness of the sky and good visibility are among the most characteristic elements of the Mediterranean climate, and prevail also, though to a less degree, in the continental north. Bad visibility, apart from some morning mist on the west coast, is rare in summer, but in winter may occur locally inland. On the coast fog is experienced in spring and autumn. Inland it is commonest in the morning or evening in enclosed basins where cold air accumulates. Visibility is also reduced during rain and rainy weather. In particular, the scirocco almost always brings poor visibility, due to the drizzle and low cloud accompanying the moist type or the dust and haze with the dry.

Fog is commoner in the north than in the south on both east and west coasts. Winter is foggy in the Northern Plain, especially in its central, low-lying parts, including the provinces of Parma, Modena, Bologna, Mantua, and Pavia. In the south, on the other hand, near Reggio di Calabria fog practically never occurs. In general it is very rare along the Tyrrhenian, Ionian, and southern Adriatic, but frequent on the northern Adriatic coast. Much depends on purely local factors, e.g. Ancona appears to have an abnormal amount of fog (about 10% of winter days). Everywhere, however, the amount of fog is smaller than in the countries of north-west Europe.

Visibility may also be affected by heat, for example by shimmer above strongly heated surfaces in calm weather, and by mirage during calm weather, in summer, and especially in the morning and evening. Mirage is not particularly frequent in Italy but is liable to be encountered in all parts of the country, and especially on the coasts and in the south, and Sicily. Looming or 'inferior mirage' occurs on the coasts in the morning, when temperature at the surface is rising rapidly. This gives the effect of a water surface above which objects are suspended, or appear much nearer and higher than they really are. 'Superior' mirage, on the other hand, occurs mainly in the evening when the surface is rapidly cooling. Under these conditions objects beyond the normal horizon can be clearly seen with great distinctness. Details of churches in Sicily have been seen from Malta 70 miles away. The Fata Morgana, which is frequently seen in the Straits of Messina in the evening or before a

<sup>1</sup> Little reliance can be placed on the figures for days with fog when no definition of fog is given. They serve to show reliably the annual variations at a station, but caution must be used in comparing one station with another since much depends on the observer's estimate of what constitutes a fog.



scirocco, consists of an apparent vertical elongation or multiplication of objects on the other side of the strait, and is due to the presence of successive layers of air at very different temperatures.

*Cloud* (Fig. 78; Tables 12 and 13)

Sunshine is a further characteristic of the Mediterranean climate. Compared with England, the whole of Italy has little cloud at all times of the year, but some parts are more favoured than others.

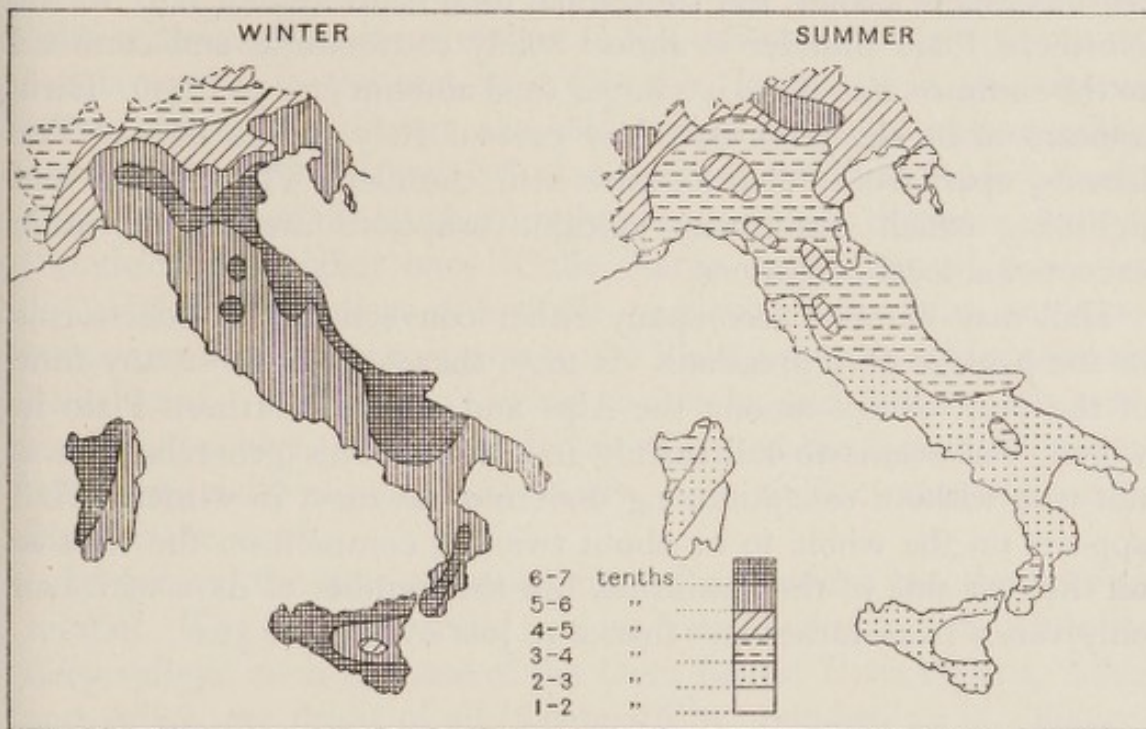


FIG. 78. *Cloud*

The chief difference is again between the north and the south. In the far south the period when depressions are liable to bring cloud is short. The summer months are very sunny (Lecce 77% of possible in July) and in the interior there is practically no cloud (Caltanissetta summer average 1 tenth). In winter there is much less sunshine (35-40%). In the north the area of semi-continental climate has much less sunshine in summer (Turin, 50% in August); in winter also, in spite of the high pressure prevailing and the comparative lack of rain, the amount of cloud is fairly high (Turin 4-5 tenths, sunshine 18-35%). The Alpine stations, on the other hand, have most cloud in summer and comparatively bright winters. In spite of the reputation of the Riviera, Genoa has a remarkably large amount of cloud, varying from 6 tenths in May to 4 tenths in July.<sup>1</sup>

<sup>1</sup> Detailed information about the amount of low cloud and its relation to wind direction for coastal stations in *Weather in the Mediterranean*, vol. ii.



*Thunder and Hail* (Tables 14<sup>1</sup> and 15)

Two types of thunder can be distinguished. In the Peninsula and islands thunderstorms accompany the passage of depressions, which are most frequent in spring and autumn. There are also thunderstorms due to local heating and convection in summer, especially in the interior of the Peninsula (Agnone, 5 days in June). A moderate number of days with thunder may, therefore, be expected at all seasons except winter, but the annual total is low (about 10). In the Northern Plain thunder is almost solely convectional and confined to the summer, and there is a larger total amount (15–30 days). Istria appears to be the most thundery part of Italy (20–40 days). The islands, apart from Palermo, have little thunder. The thunder and lightning which accompany volcanic eruptions are due to quite exceptional local conditions.

Hail may likewise accompany either convectional thunderstorms or the passage of depressions. It may, therefore, occur at any time of the year, except among the Alps and on the Northern Plain in winter, but seems to fall mainly in spring. This generalization is not true without exception, e.g. Palermo has most in winter. Hail appears on the whole to be about twice as common on the west as on the east side of the Peninsula, but the number of days with hail only varies from rather less than 2 to just over 7 per year.

## REGIONAL

The following main climatic regions may be distinguished: 1. The Alps, including Istria; 2. The Northern Plain; 3. The West of the Peninsula; 4. The East of the Peninsula; 5. The Apennines; 6. Sicily; 7. Sardinia. It has been necessary to depart somewhat from the regional division adopted in the other chapters and Fig. 3. Climatologically the west coast region extends in a narrow strip along the coast of Calabria to the 'toe', and the east coast region embraces the whole Apulian region with the east coast of Calabria, while the central or Apennine climate extends through the mountains as far as the Aspromonte.

*Continental Italy*

*The Alps.* Most of the inner slopes of the Alps, including some of the highest ground in Europe, are in Italy. Nowhere, however, are

<sup>1</sup> In comparing different stations it must be remembered that much depends on the attentiveness of the observer.



the mountains massively developed, so that the areas affected by the extreme Alpine type of climate—the areas above the tree line—are relatively small. Furthermore, the Alps are penetrated by a number of deep transverse valleys with smaller longitudinal sections and tributaries, which have their own type of climate.

The most marked features are the low temperatures and high rainfall. The temperatures vary directly with altitude, except that in the deep valleys inversions of temperature often occur during the calm winters. This is infrequent in the valleys opening to the south, but is normal in the east-west Pusteria (Pustertal) in the extreme north, where the winters are colder than in the Austrian valleys north of the Alps. Although the temperature may fall very low during winter in some of the northern valleys, especially in the more enclosed (Sondrio) and higher ones (Colle Isarco, mean annual minimum 18°), the Alpine valleys as a whole, particularly the more numerous transverse sections opening on to the Plain, are little colder than the Plain itself. In summer, owing to height and latitude, they are somewhat cooler. The south-facing valleys at the foot of the mountains, especially around Lake Garda, have milder winters than the Plain to the south.

In general the first or inner<sup>1</sup> ring of mountains has the heaviest rainfall. The higher frontier regions have distinctly less, while the deep valleys, such as those of the Dora Baltea, Dora Riparia, Adda, and Adige, are driest of all (Cogne 16 in., Sondrio 34 in., Bolzano 29 in.). Much the wettest area is in the east, where the ranges face the westerlies (Udine 61 in.), and the rainfall in parts exceeds 120 inches. There is another rainy area immediately north-west of Lake Maggiore. In each region, however, the highest frontier range is much less wet than the lower mountains fringing the plain.

The rain falls mainly in summer, and this is the most distinctive climatic mark of the Alps. Cloud is also most abundant in summer and the winters are clear and bright, very different from those of the northern slopes of the Alps. Snow is a practical difficulty on most of the passes in winter (p. 191).

*Istria.* The climate of Istria resembles that of the Alps in its heavy rainfall, mostly with a winter minimum (Trieste, Udine), and in its control by altitude; it differs in its direct maritime contact and Mediterranean rainfall regime. The maritime influence keeps the temperatures, at any rate on the west coast, mild in winter. The Quarnero has, not without some justification, the reputation of being

<sup>1</sup> Working outwards from the Plain.



a second Riviera, although the winter mildness is apt to be confined to certain especially sheltered coastal places such as Abbazia. The Mediterranean rainfall regime is betrayed in a very distinct summer drought, although the winter minimum, except on the east coast, is actually more marked than the summer. Everywhere, however, the fall is highly seasonal, coming predominantly in autumn. The little rain falling in summer is mainly from thunderstorms which are comparatively frequent.

The interior has a harsh climate, and contrasts strongly with the mild coast, though the rainfall regime is the same. Temperatures on the plateaux are extreme; here the bora brings bitterly cold weather, and during calm periods the drainage of cold air into the enclosed depressions (p. 245) may give rise to exceptionally low temperatures within them. Precipitation reaches some of the highest totals in Italy (over 120 in.), and much snow falls in winter. While the coasts have only 3-5 days with snowfall, this total rises to 40-60 in the central parts of the mountains, where, on the flanks of M. Nevoso, the depth of snow may amount to as much as 5 and even 8 feet. On the lower Carso Tergestino (Triester Karst) the depth only occasionally reaches more than 8 inches. Except in the higher interior, the period of snow-cover is discontinuous. On the coast snow lies for a few hours only.

The bora blows strongly both inland and on the coast, except in places sheltered by precipitous escarpments such as Miramare, north-west of Trieste, and Fiume. This wind must rank as one of the main features of the climate, since it is stronger, drier, and more frequent here than elsewhere in Italy, and goes far to counteract the maritime tempering of the climate. At Trieste the average wind velocity for the three winter months is 10 knots, and 55 per cent. of the observations give a wind from the north-east or east.

*Northern Plain.* The Northern Plain, with Istria and the Alps, has the most extreme climate of Italy. Hot summers, only slightly cooler than Sicily 9° farther south, cold winters, rainfall mainly in autumn and late spring, frequent frost and snow in winter, together with grey, overcast skies reminiscent of northern Europe, make it very different from the Riviera, which is sharply cut off by the crest of the Ligurian Alps. Furthermore, it is advisable to distinguish the east from the west of the Plain. The west is the more continental, being colder in winter than the east (Piacenza, Jan. mean 31.3°; Venice, 36.7°). In summer, mean temperatures are similar in both parts, but the maxima are higher in the west.



Rain falls mostly in spring and autumn, but in the north the summer minimum is less marked than the winter. The annual isohyets<sup>1</sup> are arranged concentrically around the Plain. Parts of the east and a small area south of Monferrato have less than 20 inches. Around the Mi. Berici and Euganean hills the fall is somewhat higher. Otherwise it is very uniform, increasing to about 40 inches on the Alpine and Apennine margins. In winter, cloud is about 6-7 tenths, but in summer only 2-4 tenths. Rainfall is usually sufficient for a central European type of agriculture, accompanied by dairying. The appearance of the landscape is, therefore, owing to this slight but distinct climatic difference, unlike that of the Peninsula. The absence of the olive witnesses to the cold of winter, except in the region of the lakes which is especially favoured by the presence of bodies of water and the sunny, south-facing slopes (Fig. 81, p. 189).

### *The Peninsula*

Peninsular Italy as a whole differs from the north in having a more or less Mediterranean climate. The east is very different, however, from the west. The dividing line between the Adriatic and the Tyrrhenian slopes swings from one side to the other, including a greater or less strip within the east and west regions. The higher parts of the Apennines and their semi-enclosed basins have climates of their own. This region has no precise boundaries, and its climate changes gradually into those of the lowlands on either side.

*West.* The west coast of Italy includes in the centre a number of small plains, separated by hills reaching the sea. In the north, from the French frontier to the river Arno, and in the south, from Point Licosa to the 'toe', the Apennines fall straight into the sea. Inland, in the central stretch, the Arno, Tiber, and Volturno valleys give varying degrees of access to a number of basins, such as those of Florence, Perugia, Rieti, and Benevento. Each type of area has its own climatic features. The high coasts in the north and south are wet (over 30 in.), except for the sheltered Riviera di Ponente. The hilly promontories dividing the central lowlands are also wet, particularly that of Sorrento. The lowlands are drier, but not so dry as the east coast. All have over 20 inches of rain, but little of this falls in the summer half-year. In the highlands the rain is more evenly distributed throughout the year, but the interior basins suffer from summer drought, although their total fall is seldom below 25 inches.

<sup>1</sup> Lines joining points with equal rainfall.



The greatest contrasts between the different portions of the west coast are found in temperature and particularly winter temperature. In the north the Riviera di Ponente is very mild and comparatively protected from cold winds, although occasional cold, dry, northerly winds, rather similar to the mistral, blow in winter. The mean annual minimum at Genoa is only  $30^{\circ}$ , although the absolute minimum is  $17^{\circ}$ . Frost is rare and the daily range of temperature in winter and summer small, the mean being never greater than  $9^{\circ}$ . The Riviera di Levante is wetter and also slightly colder in winter, though still mild. South of the gulf of Genoa the winters become  $2^{\circ}$  or  $3^{\circ}$  colder, although the summers remain much the same. It is not till Naples is reached that the winter temperatures are as warm as at Genoa, and here the summers are still only very slightly warmer. The distribution of orange groves reflects the comparative freedom from frost on parts of the coast. South of Naples the temperature rises quite rapidly. Maritime influence is also strengthened as the mountains come closer to the shore. At Messina the lowest temperature ever recorded is only  $33^{\circ}$ .

Away from the coast temperatures are colder in winter and hotter in summer; Leghorn (Jan. mean,  $44.8^{\circ}$ ; July mean,  $75.9^{\circ}$ ), Rome ( $44.1^{\circ}$  and  $76.6^{\circ}$ ), and Florence ( $40.5^{\circ}$  and  $76.3^{\circ}$ ) illustrate this transition, which is more marked in the mean extremes—Genoa  $90^{\circ}$  and  $30^{\circ}$ , Rome  $95^{\circ}$  and  $27^{\circ}$ , Florence  $97^{\circ}$  and  $22^{\circ}$ .

*East.* The east side of the Peninsula is more uniform, both topographically and climatically, than the west. North of the Gargano peninsula the Apennines are everywhere near to the coast, though they fall gradually in a series of foothills, gashed by short streams, which seldom form large lowlands or penetrate to interior basins. South of Gargano the east side widens to include the whole of the 'heel' and the valleys draining into the Ionian Sea.

North of Gargano the climatic differences run in altitudinal bands parallel with the coast. The winters are colder and the summers warmer than at corresponding heights in the west. Rainfall, brought mainly by easterly winds among which the scirocco is important, is moderately heavy owing to the relief, and only falls below 20 inches in the south (Vasto, San Severo). It increases inland to 50 inches and more on the main crest of the Apennines. The prevailing winds along this coast are markedly W. and NW. in winter and E. and SE. in summer, but the cold dry bora, from the NE. or E., and the hot, oppressive SE. scirocco are liable to blow, mainly in the cold season.

South of Gargano there is a sharp change in temperature. Summer



and winter are both warmer. The Adriatic itself is warmer south of the Gargano-Lagosta sill and, on the coast, winter conditions are almost as mild as in the west. Pelagosa has a January mean of  $48.4^{\circ}$  and Bari of  $46.4^{\circ}$ , compared with  $46.8^{\circ}$  at Naples. Rainfall, however, is much less, and this is the hottest and driest part of the mainland. The coastal plains of the gulf of Taranto, including the Crati lowland, have the highest temperatures at all seasons; even the Tavoliere, although colder in winter than the plains farther south, has a July mean of  $79^{\circ}$ , with mean maxima up to  $97^{\circ}$ . The same areas, with the addition of the middle Bradano valley, have least rainfall (less than 20 in.). The Murge, which owing to their altitude have a precipitation of 25-40 inches including some snow in winter, are cooler in summer and slightly colder in winter than the lower lands. The most favoured part of the region is the Apulian coast from Barletta to Monopoli, where there is somewhat more rain than on the rest of the coast and a very mild winter with few frosts. South of Gargano the bora is rare and is a N. wind, tempered by a longer passage over the sea. The scirocco is relatively frequent in winter and spring. At Pelagosa SE. winds exceeding 27 knots blow for about 41 hours in winter, 77 in spring, 4 in summer, and 21 in autumn (2 years' observations only). Land and sea breezes are common even in the cold season.

*Apennines.* The central region shows a diminution in maritime influence, proportionate to distance and protection from the sea. On the whole this region is wetter and cooler than the coastal areas, although some of the basins are remarkably hot in summer. In the north the valley of the Arno admits marine influence right into the middle of the Peninsula, but to the south the central region is more clearly distinguishable. The basins have a comparatively high rainfall (Perugia, 36.4 in.; Potenza, 25.9 in.), which, although far less than on the surrounding hills, is comparatively well distributed over the year. The basins tend to be cold in winter owing to their height, but abnormally warm in summer (Perugia, 1,706 ft., July  $73.6^{\circ}$ ; Aquila, 2,408 ft.,  $70.5^{\circ}$ ). On the hills the normal decline in temperature takes place (p. 417). Precipitation, much of which falls as snow in the winter and spring, is high, especially in the north and south. Snow may lie for 3 months or more even in Calabria (Fig. 58).

### *The Islands*

The islands of Sicily and Sardinia have a strongly maritime climate, accompanied, however, by a remarkably low rainfall. In Sardinia



relief is moderate, and in Sicily the winds blow parallel to its trend, so that both fail to receive as much rain as might be expected.

*Sicily.* Sicily combines a maritime climate with a southerly position and is consequently very warm both in summer and winter. As it is only within reach of the westerlies for a short period, the rainy season is confined to the winter and the rainfall is low. Even the mountains of the north-east do not appear to get as much as 80 inches; the north and south coasts as well as much of the interior have less than 25 inches. The extreme south has only 15 inches. The lower-lying areas have only about 1 inch altogether in the three summer months. The effect of this drought on vegetation is accentuated by the high temperatures. In summer there are very high means of  $75-79^{\circ}$  near sea-level, with extremes of  $100^{\circ}$ . The mean daily maxima are about  $85-90^{\circ}$  in August; these are, indeed, higher than at Rome, but the mean (night) minima are over  $70^{\circ}$  near the coast, so that there is very little relief from the daytime heat. The annual range is also small. The absolute minima are around  $32^{\circ}$ , and the mean January temperatures are over  $50^{\circ}$  near the coast, so that frost is very rare. Inland frost is more common, but the mean January temperatures are over  $40^{\circ}$  (Caltanissetta  $43.3^{\circ}$ ). This warmth is reflected in the growth of special crops such as oranges and cotton. In the mountains it is much colder and snow lies for some time.

Sicily, especially the north coast, is remarkable for the exceptional frequency of the dry type of scirocco, which is not infrequently accompanied by falls of dust. It seems that the extreme dryness and warmth of the wind, in spite of its having crossed the sea, are due to warming by descent from the northern highland. At Palermo, on 29 August 1885, the thermometer rose to  $120^{\circ}$ , with a relative humidity of 10 per cent. During a scirocco  $95^{\circ}$  has been recorded at midnight. Such hot, dry winds are very harmful, especially to young children. The effect is, however, local in this extreme form. Land and sea breezes are well developed throughout most of the year as in all southern Italy.

*Sardinia.* Sardinia's climate is affected by the plateau-like relief. Temperature and rainfall are comparatively uniformly distributed. Only the very narrow coastal fringe and the Campidano plain are slightly warmer and drier than the rest. The January and July means at Sassari in the north (735 ft.) are  $47.3^{\circ}$  and  $75.6^{\circ}$ , and at Cagliari in the south (246 ft.) only  $48.9^{\circ}$  and  $76.6^{\circ}$ . The range of temperature is moderate (Cagliari, mean extremes  $96^{\circ}$  and  $35^{\circ}$ , daily ranges from  $12^{\circ}$  in Jan. to  $19^{\circ}$  in July). On the higher ground the means are



lower and the ranges greater. Rainfall is low (Cagliari 19.1 in.) and only reaches 40 inches in the mountains of Gennargentu and north of Iglesias. It falls mostly in late autumn and in spring, and there is a very marked summer drought. Snow lies on the Gennargentu summits for about 9 months.

Maritime influence delays the advent of the seasons: autumn is quite hot; the dry period of December and January is fine and warm; February and March are relatively cold and wet; spring does not begin until April. The growing season for unirrigated crops lasts until the end of June when it is closed by the unremitting drought.

The generally prevailing wind, especially on the west coast, is the NW. (*maestrale*), the effect of which may be seen in the trees inclined to the SE. A west wind is dominant in the Tirso valley. On the east coast the *greco* (NE.) is frequent and brings rain, as does the *scirocco* (also called the *levante*) which here is of the moist type and blows from the SE.



## CHAPTER VI

# VEGETATION AND ANIMAL LIFE

### VEGETATION

#### *Flora and Vegetation*

THE *flora* of Italy (i.e. the kinds of plants of which the vegetation is composed) consists of about 4,000 species of seed-bearing plants and an unknown number of flowerless and seedless plants. While the flora is rich when compared with the floras of areas of equivalent size in northern Europe, it is poor, even numerically, relative to those of the Iberian, Balkan, and Anatolian peninsulas. Not only this, but the vast majority of the species occurring in Italy have a wide range throughout either the whole or a large part of the Mediterranean region or of Central Europe, or of both. The number of Italian endemics (i.e. plants limited in their natural distribution to Italy) is low, and many of them are concentrated in a few areas. In other words, the flora has little individuality, except in restricted districts. Taking the country as a whole, it is doubtful if many, or indeed any, species have been exterminated by man, but the range of some, more particularly woody plants, has, without doubt, been greatly restricted. On the other hand, man has introduced a great many (over 600) plants by intention or accident, and of these over 200 species have so established themselves as to become, at least locally, conspicuous features of the flora: for instance, agaves, prickly pear, Canadian pond-weed.

There are two main floristic elements, the Central European and the Mediterranean. The former is typically developed in northern Italy, but extends southwards in the Apennines, while the latter dominates in the south and in the islands. There is, however, a very considerable interpenetration of the two main floristic types, and the botanical divisions cannot be satisfactorily based on their distribution alone.

The *vegetation* (i.e. the grouping of plants in communities such as forests, meadows, and marshes) depends on three groups of environmental factors: climatic, edaphic, and biotic. The climatic factors, which include not only temperature, precipitation, and humidity, but also their seasonal distribution and their interaction, are the most important in the extent of their influence. There are



also more local climatic factors, such as winds and exposure to light. The edaphic or soil factors modify the vegetation within the broad climatic zones. They act especially through the chemical nature of the soil and its water content. In Italy it is especially the differences between calcareous and non-calcareous soils which are important in controlling floristic distribution and vegetation. The biotic factors are those involving the influence of animals on plants and of plants on one another. In Italy, as in so many other parts of the world, man is the most important biotic factor, and it is impossible to understand the vegetation without constant reference to human activities, such as the cultivation of crops, grazing of domesticated animals, and gathering of wood for fuel.

Two main botanical regions, based on flora and vegetation, and closely correlated with climatic conditions, overlap in Italy: these are the Central European and the Mediterranean regions. The Central European region is characterized by forests and brushwoods, in part of conifers and in part of deciduous broad-leaved trees and shrubs, by a large proportion of perennials dying down to ground-level in the autumn, and by meadows and pastures, green except when snow-covered. The characteristic flora consists of species which have, for the most part, spread into Italy from the north. This vegetation and flora is correlated with a cool to warm summer, a cold winter, and precipitation fairly well distributed throughout the year, or, at least, not restricted to the winter season. The Mediterranean region is characterized by forests and brushwoods of conifers (certain pines and junipers) and of broad-leaved trees and shrubs of the hard-leaved, evergreen variety, by high proportions of annuals and bulbous plants, and by pastures which largely dry up in the summer and are often of a tufted rather than a sward type. The flora consists of species which have spread into Italy from the south or east. This botanical region is closely correlated with a warm to hot summer, a mild winter, and lack of rainfall during the summer.

There is, particularly in peninsular Italy, no sharply marked boundary between the Central European and Mediterranean regions. Attempts by different authors to delimit the regions differ greatly, mainly because special emphasis is given to one or another botanical feature. Taking into account as many distributional facts as possible, it is reasonable to include the Italian Alps and the greater part of the Northern Plain in the Central European region, and peninsular Italy and the islands in the Mediterranean region, at the same time recognizing a coastal belt of Mediterranean flora and vegetation



extending westwards round the gulf of Genoa and eastwards over parts of Istria and the Quarnero islands. There are also enclaves of Mediterranean plants around the north Italian lakes, while deciduous

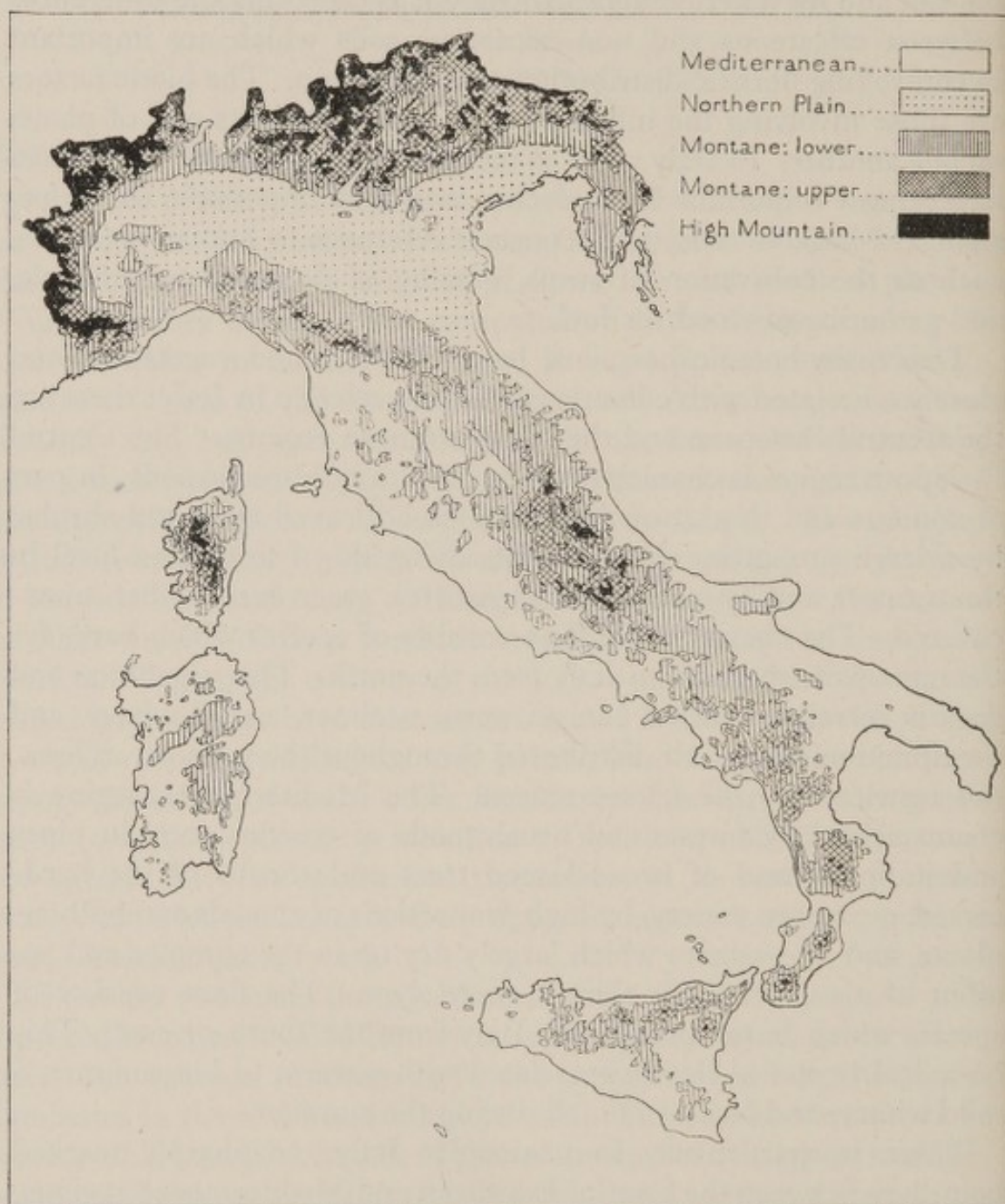


FIG. 79. *Types of vegetation*

forests, especially of beech, extend through the Apennines to the mountains of northern Sicily.

While the broad botanical divisions referred to above are correlated primarily with certain climatic conditions, the more local variations of flora and vegetation can only be understood when the edaphic and



biotic factors are also taken into account. It must be remembered, however, that these three groups of environmental factors in fact interact in a complicated manner. Moreover, they have suffered considerable changes in the course of geological time, for example during the Pleistocene Ice Age, and these have left a deep impress on the present flora and vegetation. Also, although strictly speaking the three groups of factors referred to cover the effect of altitude which acts on plant life mainly through variations in climate and soil, yet altitudinal zonation is such an important feature of floristic and vegetational distributions that it is sometimes useful to consider them from this point of view. It is more the effect of altitude, in modifying climate, than the range of latitude, which allows the development in Italy of plant communities varying from alpine pastures to subtropical brushwoods. (Plate 82.)

On the basis of altitude (given in feet) the following plant zones can be recognized (Fig. 79):

	<i>Central European region</i>	<i>Mediterranean region</i>
High mountain . . . . .	5,300-7,000 upwards	5,700-6,700 upwards
Montane . . . . .	2,000 to 5,300-7,000	300-3,600 to 5,700-6,700
Lowland and hill . . . . .	0 to 2,000	0 to 300-3,600

In general the lower the latitude within either of the regions, the higher the zones, but the zones also tend to rise with increasing mass and altitude of particular mountain blocks. There is often no sharp line of demarcation between the different zones, and local factors, such as topographical variations, cause many irregularities, quite apart from the modifying influences of man.

The main facts shown by an analysis of the flora are that (1) trees are absent from the high mountain zone; (2) deciduous trees are confined to the montane zone or extend from this into the lowland and hill zone; (3) within the Mediterranean region the lowland and hill zone has a high proportion of evergreen shrubs and trees; (4) another important group of evergreen trees occurs in the montane zone, though actually none of the evergreen trees is common to both zones; the species of the montane zone are mainly conifers, those of the lowland and hill zone mainly broad-leaved trees; (5) bulbous plants are concentrated in the lowland and hill zone of the Mediterranean region; (6) the high mountain and montane zones have a high proportion of perennial herbs, and the lowland and hill zone in the Mediterranean region of annuals.

In the following account of the plant life only the main com-



munities are considered. Short accounts of vegetation are included in the regional accounts (Chapter IV). It must, however, be noted that vegetation is subject to natural change, which though generally

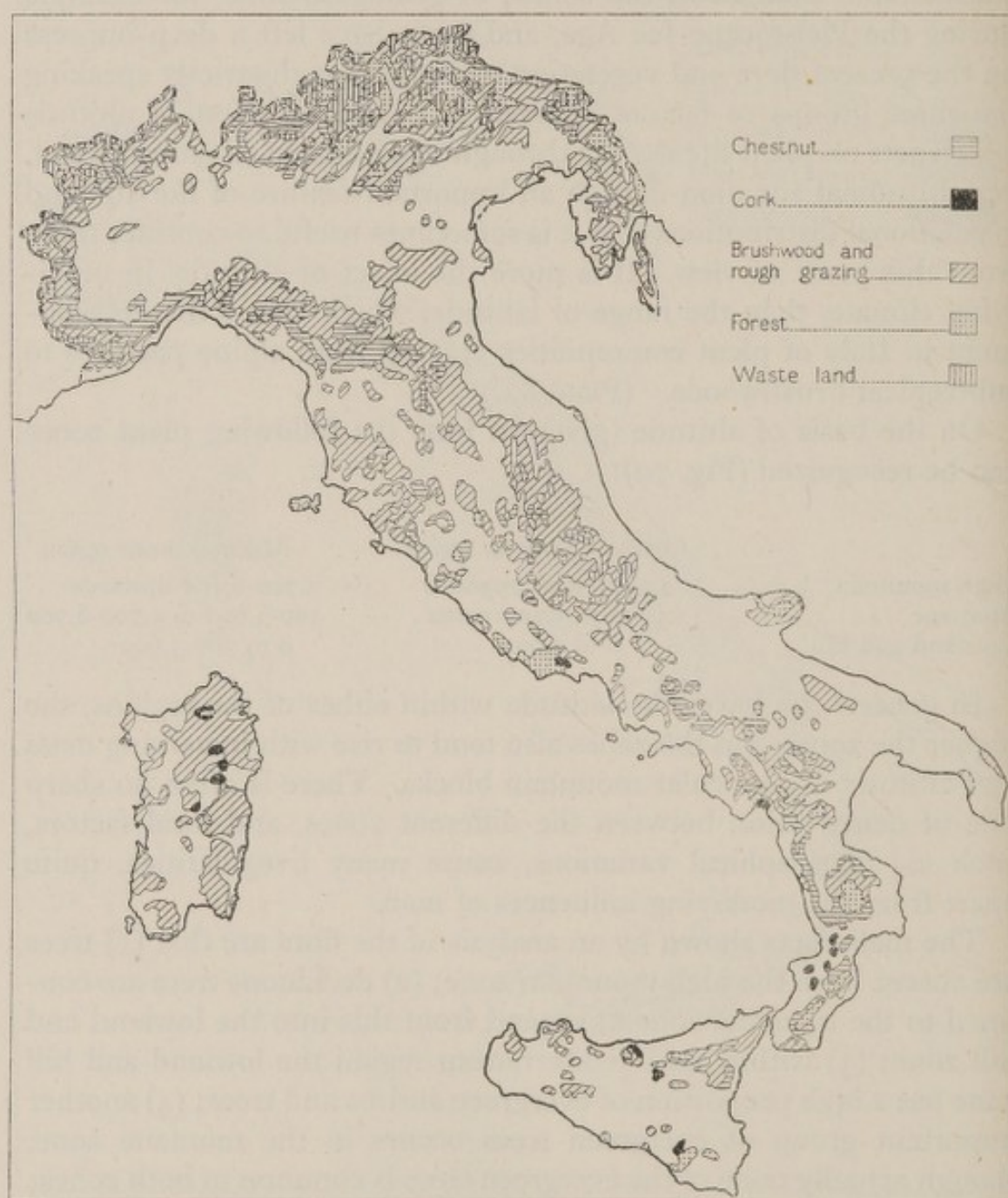


FIG. 80. *Forests and Rough Grazing*

slow may, for some communities, become marked in a decade or less. More important, however, the activities of man may often cause more drastic or even catastrophic change. This is especially true of forest destruction. Areas described as forest-covered may, by human exploitation or misuse, become mere scrub or even bare rock, with



little chance of natural regeneration of the forest cover. On the other hand, afforestation is also being undertaken, particularly in the montane zone, and this too brings about considerable changes in flora and vegetation, not limited to the trees planted or even to the area actually afforested. Land reclamation, and particularly the drainage of marshes, has also proceeded apace in some low-lying districts, with considerable modification of the natural vegetation.

The appearance of the plant cover also varies with the season. In the north there is a winter resting season, like that in England. The trees except when evergreen (mainly conifers in the higher zones) are bare, and the arable land lies fallow and brown, though the pastures remain green. Since spring-sown crops are here relatively important, the arable land remains under cultivation until the late summer and autumn, and during the summer months the countryside is green. Farther south it is during the summer drought that the landscape is at its barest. At lower altitudes everything but the woody plants has been burnt up in the heat of the sun, and the ground is bare and brown, cracked by the drought and covered with dust. Autumn-sown crops, particularly winter wheat, are here more important, and the harvest comes at the beginning of the summer. Thus during the summer the landscape is only colourful where there are trees, or where irrigated patches stand out sharply. With the autumn rains the grass reappears, the wheat is sown, and the country becomes rapidly green once more. The trees, being mainly evergreen, add to the general impression of verdure at this season.

The plant communities are impossible to describe adequately without reference to plant species. As far as possible English names are used in the general text, botanical names only being given when needed for precision, and Italian names when English names do not exist or are for some reason inappropriate. Since for some purposes it may be desirable to define a given plant very exactly, a list of the plant names referred to in the text, with, their English, Italian, and botanical names, is given on pages 463-466.

### *Forest Communities (Fig. 80)*

These are now most extensive in the montane zone of the Alps and Apennines. They have been very greatly reduced in extent by man, and those that are left have often been much modified by cutting, grazing, and replanting. There can be no doubt that extensive reafforestation would be of the greatest benefit to many parts of the country, not only in increasing timber supply, but also as a means of



reducing soil erosion, the effects of which are often serious. The forest communities represented include woods of various conifers, and deciduous and evergreen broad-leaved trees. In addition, a number of cultivated woody plants form an important element in the plant cover. Coniferous woods in Italy are of two kinds, which have no species in common: (1) montane, including mountain, Swiss stone, black, Scots, and white-barked pine, larch, white fir, and spruce woods, and (2) lowland and coastal (Mediterranean) pine-woods. The montane coniferous woods are much more extensive in the Alps than in the Apennines, while beech, chestnut, and oak occur in both. There has, however, been some tendency for the proportion of conifers to be increased by man at the expense of deciduous trees. The widespread distribution of beech from the Alps right through the Apennines to the mountains of northern Sicily is particularly interesting. Beech is, however, absent from Sardinia, as also are natural montane coniferous woods.

The approximate limits (in feet) of forest trees in the montane zone are:

*Montane zone: upper*

	<i>Alps</i>	<i>Etruscan Apennines</i>	<i>Central Apennines</i>	<i>South Apennines</i>	<i>Sicily</i>
Spruce . .	3,300-6,600	..	..	..	..
White fir .	2,600-4,900	2,950-5,000	?	2,950-5,830	..
Larch . .	3,300-6,600	..	..	..	..
Scots pine .	1,000-4,300	1,000-4,300	..	..	..
Cembra pine .	4,300-6,900	..	..	..	..
Black pine .	1,300-3,300	..	?	3,300-5,250	4,300-4,900
White - barked pine	..	..	..	2,950-6,600	..
Mountain pine	3,900-7,200	..	5,900-8,850	..	..
Beech . .	2,300-5,250	2,950-5,250	3,300-5,900	3,300-6,600	4,300-6,600

*Montane zone: lower*

	<i>Alps</i>	<i>Etruscan Apennines</i>	<i>Central Apennines</i>	<i>South Apennines</i>	<i>Sicily</i>	<i>Sardinia</i>
Sweet chestnut	1,000-2,950	1,000-2,950	1,300-3,300	1,300-3,300	1,600-4,900	2,600-4,300
Pedunculate oak	1,000-2,950	330-2,950	1,300-3,600	1,300-3,600	2,160-5,900	?
Turkey oak	1,000-3,300	1,000-3,600	1,000-4,300	1,000-4,300	2,160-4,900	..

*Mountain Pine Woods.* These are at the upper tree limit on flatter ground in certain parts of the Alps. There is also a limited development of them in the Central Apennines (Abruzzi). The erect form of the mountain pine grows to a maximum height of 50 feet. The



species, however, very often occurs in a dwarf variant, and then becomes a constituent of the high mountain brushwood (p. 454). In the taller woods of mountain pine there is often an undergrowth of dwarf shrubs, including rusty-leaved rhododendron or alpine rose, bilberries, flesh-coloured heath, and common juniper.

*Swiss Stone or Cembra Pine Woods.* These often occur at the forest limit in the Alps, but are not found in the Apennines. The trees are generally low, 15 to 35 feet in height. Pure woods are not extensive, but in some areas the species is commonly mixed with larch, spruce, and Scots pine.

*Larch Woods.* Unlike most conifers, the larch is deciduous. The tree grows to a height of 75 to 110 feet and develops relatively quickly to maturity. It forms extensive and valuable woods in the Alps and has been planted here and there in the Apennines. Larch woods are most common in parts of the Ligurian Alps, in the Maira valley, and in the Val di Susa, Val d'Aosta, and in parts of the Dolomites. The most usual members of the shrub layer in the larch woods are the rusty-leaved rhododendron, the common juniper, and mezereon. Barbery, raspberry, drooping rose, black honeysuckle, and alpine honeysuckle are also frequent, and on steep slopes mountain ash occurs. The herb layer is very varied, and is best developed in young woods.

*White Fir Woods.* The common or white fir grows to a height of 60 to 80 feet, and occurs in the Alps, Apennines, and Sicily, but not in Sardinia. Woods of this species are less extensive than those of either larch or spruce, and the fir usually occurs mixed with other conifers.

*Spruce Woods.* These have a very extensive development in the Alps, but the spruce is not native in Italy outside the Alps and Northern Apennines. Artificial plantations, however, occur in various parts of the Apennines. The tree attains about the same height as the white fir, 60 to 80 feet. It may form practically pure woods or be mixed with pines and larch or, more rarely, with white fir. The shrubby undergrowth is often well developed, with common juniper, flesh-coloured heath, bilberries, and rhododendrons as common constituents. The herb layer varies greatly, the contrasts between north and south exposed slopes being especially marked.

*Black Pine Woods.* The species black pine is frequently divided into two varieties or subspecies, the Corsican pine and the Austrian pine. The former, which has smaller and less rigid leaves than the Austrian pine occurs in the southern areas of the Peninsula and in Sicily; the latter is widely distributed in Friuli, Istria, Abruzzi, and



Calabria. Both varieties grow to a height of 90 to 110 feet. In closed woods the shrub and herb layers are poorly developed owing to the dense shade and to the bed of fallen needles beneath the trees. In more open woods a brushwood vegetation forms an undergrowth which is generally light.

*Scots Pine Woods.* The Scots pine, which attains a height of 50 to 100 feet, is distributed in the Alps and the Ligurian and Etruscan Apennines, mainly in the lower parts of the montane zone, though in the eastern part of the Po basin it descends as low as 600 feet. Locally it may form nearly pure communities, or it may occur mixed with other conifers. Towards its higher limits it is sometimes accompanied by the white birch. The shrubby undergrowth and the herb layer are usually patchy, but in the more open parts of the wood, ferns, grasses, flesh-coloured heath, and other plants occur.

*White-Barked Pine Woods.* The white-barked pine has been reported in Italy from only a few localities in Lucania and Calabria, though it has a fairly wide distribution in the Balkan Peninsula. It forms small woods in the montane zone. The species may prove important in the reafforestation of higher hill slopes in peninsular Italy and in the islands.

*Beech Woods.* The beech is widely spread in the montane zone in the Alps, Apennines, and Sicily. It often forms extensive woods and reaches its greatest altitude of over 6,000 feet on Etna. In the Alps it is particularly well developed on north-facing slopes. The tree normally grows to a height of 40 to 90 feet, but at high altitudes is often stunted, and forms no more than a brushwood shrub. It is also often prevented from attaining its normal development by drastic cutting of the lower branches for fodder or fuel. The woods are sometimes pure beech or definitely dominated by beech, but not infrequently, towards its lower limits, there is a considerable admixture of conifers. In woods dominated by beech, other trees commonly found are mountain ash, whitebeam, aspen, lime, white birch, ash, holly, maple, sycamore, and hairy oak. In the mature woods these generally form a lower tree stratum. Hazel sometimes occurs as a shrub layer in less dense woods, occasionally accompanied by hawthorn, sloe, dogwood, alpine broom, black broom, dyer's greenweed, and raspberry. In the more open parts the herb layer may be rich and varied, but in closed woods both shrubs and herbs are scanty because the dense canopy prevents sufficient light from filtering through.

*Chestnut Woods* (Fig. 80). The chestnut of Italian woods is not the horse chestnut, which is not a native of Italy, but the sweet or



Spanish chestnut. These woods are very extensively developed in the Peninsula, mainly in the lower parts of the montane zone. In Sicily they are practically confined to the mountains of the north-east, and in Sardinia they are uncommon. They are, however, generally found on soils deficient in lime. The tree grows normally to a height of 35 to 100 feet, but is very frequently pollarded or coppiced. The full-grown trees are a source of nuts for food, and the coppices are cut for wood. The present distribution is not therefore entirely natural, for many of the woods have been established or at least extended by artificial planting. Moreover, since chestnut cultivation is a convenient method of utilizing rugged land for food production, the woods tend to be concentrated on such land, the less steeply sloping parts being cleared for other crops. In artificially planted and carefully tended woods the trees are of approximately uniform age and size, but in natural woods trees of very diverse ages and sizes are mixed together. Near the upper limits, chestnut is frequently mixed with beech, and, in the Alps, with larch and pine. Other tree associates at various altitudes are holly, aspen, oaks, hornbeam, and hop hornbeam, and more rarely ash, white birch, and lime. Hazel sometimes forms a shrub layer, while in the central and southern parts of the Peninsula shrubs of the Mediterranean *macchia* may occur locally as subordinate elements. The herb layer varies with the density, situation, and treatment of the woods. In the Alps there may be a heath type of flora, with heather, grasses, and members of the rush family. Sometimes ground orchids are abundant. In the south herbs of the Mediterranean flora enter the woods from neighbouring communities.

*Deciduous Oak Woods.* In both the Alps and Apennines the lower part of the montane zone would naturally be an area of either oak or chestnut. The oakwoods have, however, almost all either disappeared in favour of agricultural land or pasture, or have been converted by selection into chestnut forests. There are four principal deciduous oaks native to Italy: the stalked (or pedunculate) oak, the sessile oak, the hairy oak, and the Turkey oak. The differences, especially between the first three, are not always clearly marked. Mature and normally developed trees attain 45 to 100 feet in height, but, in the hairy and Turkey oaks especially, brushwood forms, in part due to human interference, are common. Oak woods occur on both calcareous and non-calcareous soils, but, where competition with chestnut occurs, the oak woods tend to be restricted to the calcareous soils. The shrubby undergrowth is frequently fairly dense, and includes



common juniper, Judas tree, wayfaring tree, and flowering ash. The herb layer is often rich and varied.

Mention should be made of the valonia and Macedonian oaks which occur only in a few localities in the extreme south of peninsular Italy, and represent floristic connexions with the Balkan Peninsula.

*Holm Oak Woods.* The holm oak is typical of the Mediterranean region. It is evergreen with hard foliage. The tree varies greatly in size, but reaches a height of 50 to 80 feet when allowed to develop naturally to maturity. The natural area of holm oak woods is that of the lowlands and lower hill slopes in central and southern Italy and in the islands. It is most frequently associated with Mediterranean evergreen brushwood (*macchia*), and either forms the top layer in high *macchia*, with or without other species such as the strawberry tree, or constitutes woods with *macchia* shrubs as undergrowth.

*Cork Oak Woods.* The cork oak is economically much less important in Italy than in parts of the Iberian Peninsula or in north Africa. It occurs, however, in the lowlands and on the western slopes of the Peninsula, and in the islands, but much more rarely in the east (Fig. 80). In parts of Sardinia, and to a certain extent in Tuscany, cork oak forests are systematically exploited and maintained. In its evergreen character the tree resembles the holm oak, but is less common on calcareous soils, and does not attain so large a size, as it rarely exceeds 20 to 40 feet in height.

*Lowland and Coastal Pine Woods.* Three species of pine, the maritime pine, the stone pine, and the Aleppo pine, occur in small woods, clumps, or as isolated trees in the Italian lowland and coastal areas within the Mediterranean region. Pine woods (*pinete*) occur here and there near the Tyrrhenian coast, and locally in the islands and elsewhere. On the Adriatic side is the famous pine wood of Ravenna, now broken up into three fragments. Of the three species, the stone pine is the most valuable, since it is grown for its fruit as well as for its resin and timber. Man's interference has, therefore, tended to increase its importance, relative to the other two. The Aleppo pine forms characteristic woods on limestone soils, though it is not limited to these, while the maritime pine is found chiefly on siliceous soils, and the stone pine prefers sandy soils. On the coast the last is usually sheltered behind a belt of maritime pine. These Mediterranean pines, however, frequently grow mixed, especially where the woods have been planted or modified by man. The maritime pine, which grows to a height of 60 to 80 feet, is a handsome tree, with long and stiff sharp-pointed needles and large cones, and a





PLATE 151. *Olive tree*



PLATE 152. *Stone pines*





PLATE 153. *Messina earthquake*



PLATE 154. *Messina earthquake*



fairly close, almost conical canopy; the stone pine reaches 45 to 70 feet and has shorter needles of a rich green colour and an umbrella-shaped canopy with wide-spreading branches (it is sometimes called the umbrella pine); the Aleppo pine attains 25 to 60 feet in height and has a rather open canopy with short needles of a light green colour. The shrubby undergrowth and herb layer consist of Mediterranean species, the density depending largely on the spacing of the trees and on the proportions of the different species. When grazed the pine woods are often very open. In open Aleppo pine woods the lower strata of vegetation are practically of *macchia* type. (Plates 11, 152.)

*River-bank Woods.* In all zones, except that of the high mountains, the rivers and perennial streams have their banks fringed with woods of varying density and width. These woods are largely composed of many kinds of willow, white and black poplars, and alders. In the lower part of the high mountain zone and in the higher part of the montane zone the alder is most often *Alnus viridis*, in the montane zone *Alnus cordata*, and in the lower parts of the montane and in the lowland zone *Alnus glutinosa* or *A. incana*. The trees attain a height of 30 to 80 feet and are often accompanied by a fairly thick shrub growth and a herbaceous flora of marsh plants. The larger willows are frequently pollarded, and a considerable number of shrubby and herbaceous plants establish themselves on the tops of the trunks.

#### *Cultivated Woody Plants (Fig. 81)*

Since so large an area of Italy is cultivated, especially in the plains and in the hill and montane zones, crop plants play a large part in the landscape. This does not, however, mean that the landscape is treeless. Although the Mediterranean forest, for instance, has been reduced to very small remnants, and may even be said to have been destroyed altogether, trees are an essential part of the scenery of this region. Apart from numerous more or less isolated individuals of the characteristic Mediterranean species, growing between the fields and especially round the dwelling-places, the common cypress is a widespread and striking feature, being planted round farms and houses, and particularly in cemeteries. In addition, tree-crops are a mainstay of the Mediterranean type of agriculture, and are also found to a less extent in the north of Italy. Although the trees are usually accompanied by other more lowly crops, vegetables and so forth, growing beneath them, this means that, except for the Tavoliere di Puglia and the interior and south of Sicily, there are no large treeless stretches of land in the whole country. The numerous and varied



tree crops, which contribute much to the appearance of the landscape, are grown either in compact groves (*coltura specializzata*) or among the fields (*coltura promiscua*: Plate 108). Apart from the sweet chest-

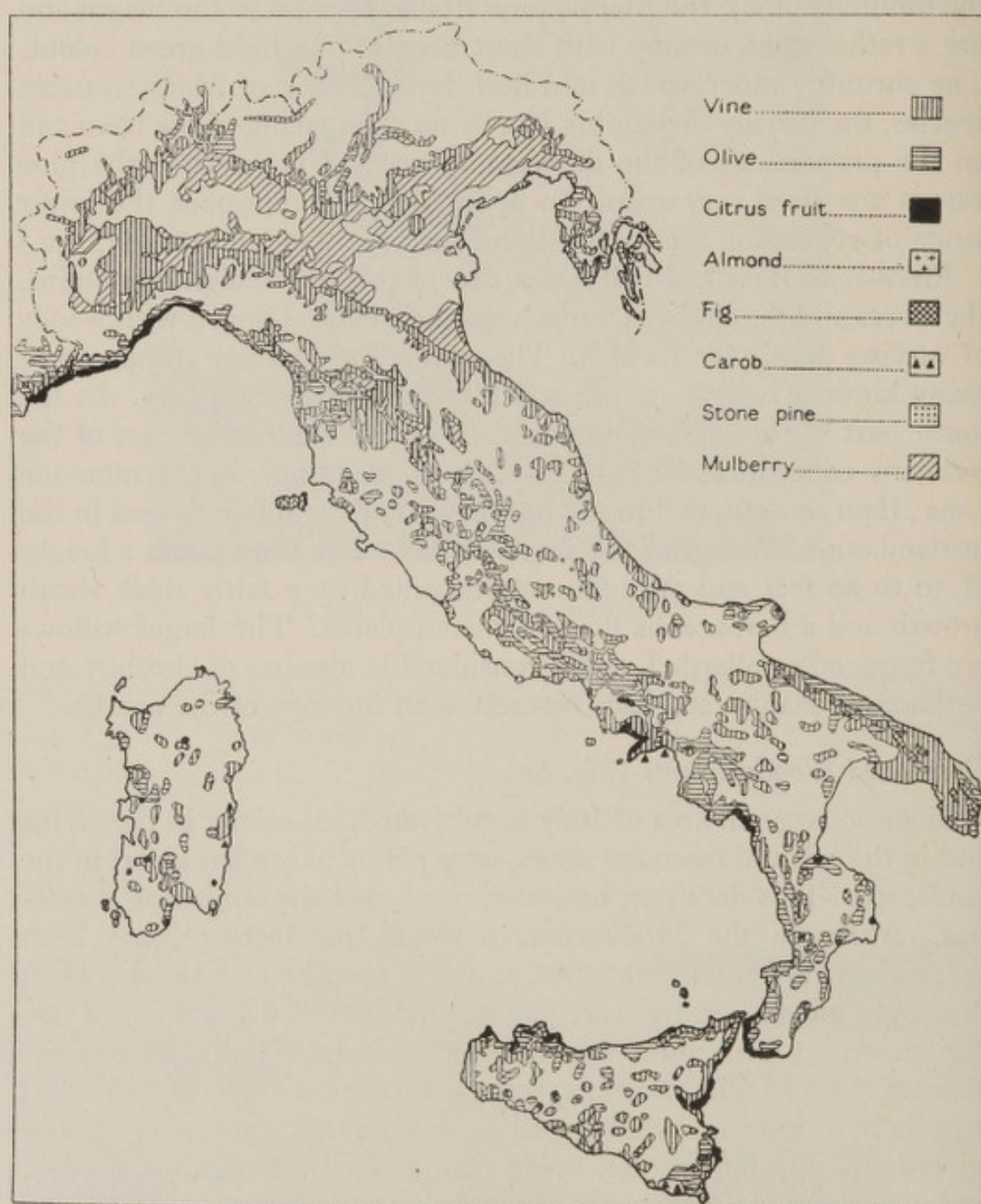


FIG. 81. *Distribution of fruit trees*

nut, which has already been mentioned, the most important cultivated trees are the olive, vine, mulberry, citrus fruit trees, and numerous other fruit trees of less individual importance, such as the almond, peach, apricot, apple, pear, cherry, and so forth.



The olive (Plate 151), a wild variety of which occurs in the *macchia*, is probably the most important of all. It is limited almost entirely to the Mediterranean region, where it is extensively planted, either scattered about in gardens and fields, or in groves, and occasionally, as in Apulia, in very large groves. The olive is a tree of small stature, often pruned low to make the fruit more easily accessible, and exceedingly gnarled and contorted in old age. Its evergreen foliage has a characteristic, grey-green colour, and because of the long, narrow shape of the small leaves, casts a light shade. Its root system is relatively shallow but widespreading. The trees, therefore, flourish best when they are well spaced, and other crops are often grown between them. The olive flourishes on rocky ground, and is thus predominantly a hill-side plant, growing on all types of rock and restricted only by an upward limit which varies widely with locality (Chapter IV).

The vine, which sometimes occurs wild, is widely cultivated in the lower and montane zones in Italy, including the islands. It is much more widespread than the olive. Although characteristic of Mediterranean agriculture, it is found well outside the limits of the Mediterranean climate, in Italy as in other countries. The vine is not evergreen, having large, tender, deciduous leaves, and, being by nature a climbing plant, does not develop a substantial trunk. The vineyard has, therefore, a very different appearance in winter and in summer; during the winter only the stock is left, while in the summer a thick growth of shoots covered with large leaves makes a dense vegetation which casts a heavy shade. The vine has a deep root system, and, in contrast to the olive, is usually cultivated in close ranks. Its appearance depends not only upon the season but also upon how the annual shoots are trained. There are three main methods. The vine may be trained up trees planted for the purpose, such as elms, mulberries, and poplars, or sometimes olives. This method lifts the vine well above the ground, and so enables the cultivation of other crops, such as wheat, underneath. It also helps to give the countryside its well-wooded appearance. The second main method consists in training the vines separately up poles or reeds, and the third, used mainly in the Trentino, in growing the vines in arcades. Wiring, the usual practice in France, is not so common in Italy. (Plate 108.)

Other tree crops play individually a less important part in the 'artificial' vegetation. The orange and lemon groves consist of shrubs with dark evergreen foliage, often closely planted (Plate 38). The



white mulberry is very widely cultivated, especially for its leaves, which are used as food for silk-worms. The black mulberry is also cultivated for the same purpose, but more rarely, and for its edible fruits. Neither mulberry is native to Italy. The trees are frequently pollarded and are a conspicuous feature of the Northern Plain, where they are grown in the carefully cultivated country, along the roadsides, and in between the fields. The carob is extensively cultivated, particularly in south-east Sicily. In much of the Mediterranean part of the country, thick, tall hedges of prickly pear divide the small fields and gardens (Plate 150).

### *Brushwoods*

Brushwoods are a common feature of the landscape in many parts of Italy. They may represent natural communities prevented by the lack of suitable conditions from developing into forest, or on the other hand they may be successional stages leading to the development of forest. A great many brushwoods, however, are, in varying degrees, artificial, and may be either essentially undergrowth of woods from which the tall trees have been removed, or scrub prevented from developing into forest by grazing of domesticated animals and by constant cutting. Three main types of brushwood have to be distinguished: the high mountain brushwoods, deciduous brushwoods, and macchie.

*High Mountain Brushwoods.* These are found as a natural development above the forest limits, and even above the tree limits in the Alps, some parts of the Apennines, and on Etna. The composition of these brushwoods varies considerably. A frequent dominant in the Alps is the green alder associated with dwarf juniper and other prostrate shrubs, such as rusty-leaved rhododendron, crowberry, and bog whortleberry. Sometimes the rusty-leaved rhododendron is the dominant plant. The mountain pine, in its low and sometimes prostrate form, frequently constitutes a dwarf or 'elfin' wood (the German name *Krummholz* is often used in the Alps for this community). The flesh-coloured heath is also a common component of the brushwoods of higher altitudes, where other woody plants are crowberry and dwarf willows (*Salix reticulata*, *S. herbacea*, *S. retusa*). In the Apennines the high mountain brushwood is rarely well developed, though stunted beech grows locally as a small bush. On the higher slopes of Etna brushwood is common, but very different in appearance from the Alpine brushwoods, as it is composed of dwarf junipers, the Etna greenweed, and certain plants peculiar to



the mountain, including the Etna barberry and Sicilian milk-vetch.

*Deciduous Brushwoods.* In the montane zone woods are the most common natural communities. There has, however, been such extensive deforestation that much even of the uncultivated area is now covered with brushwoods or open herbaceous vegetation. The hairy oak and other species of oak are commonly kept to shrub size by coppicing, and together with a large number of small trees and shrubs, mostly deciduous, make a dense scrub. In the more open parts, and after severe cutting of the shrubs for fuel and other purposes, the herb layer is very varied and usually well developed. Deciduous brushwoods are very characteristic of parts of the Carso north of Trieste, and elsewhere in Istria, where common constituents are hairy oak, common juniper, hazel, oriental hornbeam, dogwood, hawthorn, and buckthorns.

Boxwoods are not common, but occur locally in the Alps, in central Italy, and in Sardinia on dry hill slopes. The box most often forms a thin brushwood not more than 6 feet tall with a varied herb layer. Pines, oaks, junipers, and even larch accompany the box, which ascends to over 3,000 feet in the Alps.

*Macchie.* The evergreen, hard-leaved brushwood termed macchia (*Fr. maquis*, *Sp. matorral*) is one of the most typical of all Mediterranean plant communities, but is not as extensive in Italy as one would suppose. It varies considerably in origin, height, and density. A distinction has been made between 'high' and 'low' macchia. The high macchia is dominated by tall-growing shrubs or even trees, such as the holm oak and strawberry tree, and merges into forest of evergreen trees. The low macchia is typically represented by communities of shrubs not more than a few feet tall such as the rock-roses and rosemary. Macchia sometimes occurs, in almost typical form, as undergrowth to Aleppo or other pines, or to holm oak or cork oak woods. Thus these forms of brushwood are often the relicts of these woodlands from which the trees have been cut out. Often they would develop into such woods but for the constant interference of man. Burning, cutting, and heavy grazing, with resultant soil erosion, frequently degrade macchia to low brushwood from which, if the destructive actions are continued to excess, the woody plants may disappear entirely and leave stony or rocky open herbaceous communities. Stretches of low, rock-rose brushwood or of spiny burnet often represent late stages of macchia degradation. The long-continued utilization of land in the lowland and hill zone, whether



for cultivation or for pasturage, has limited high macchia to a relatively few protected or not easily accessible parts, particularly on some of the islands. Many uncultivated hill-slopes are covered with degraded macchia, amongst and on which the sheep and goats browse; such degraded macchia is occasionally known as *gariga* (Plates 11, 132).

Typical macchia shrubs are the strawberry tree, mastic tree, turpentine tree, junipers (*Juniperus oxycedrus*, *J. macrocarpa*, *J. phoenicea*), a buckthorn (*Rhamnus alaternus*), myrtle, legumes (species of *Genista*, *Spartium*, *Calycotome*, *Anagyris*), heaths, labiates (rosemary, lavenders, germanders, and thymes), wild olive, and Judas tree. In high macchia these are often linked together by woody climbers and clambers such as smilax, species of clematis and honeysuckle, asparagus, wild madder, asclepiads (*Cynanchum acutum*, *Periploca graeca*), brambles, hops, wild vines, and ivy. These bind the whole into an impenetrable mass, within which it has at all times been possible to lie hidden with little fear of discovery. Brigandage and robbery have always been associated with the shelter afforded to outlaws by the macchia.

The herbaceous flora is very poor in dense macchia, but in low and open macchia is often floristically rich. Flowering is mainly in the spring, but also in the autumn. Annuals form a temporarily conspicuous but very ephemeral flora, while plants with bulbs, tubers, or underground stems are frequently dominant amongst the perennials. It is typical of macchia to have no humus or, at most, a very shallow layer, on the surface of the soil. This is one of the characters distinguishing macchia from heath.

Mention must be made of the dwarf palm which is the only species of palm native to Europe. It is still common in parts of Sicily and Sardinia and locally in the west and south of the Peninsula. It maintains itself particularly in rocky and dry habitats from which macchia shrubs have been more or less exterminated. A tree spurge is also common and conspicuous in dry, stony areas in the west and south of Italy.

### *Heaths*

This term (or its equivalent in other languages) has been applied to very diverse communities in Italy and elsewhere. Some montane and high mountain brushwoods approximate to the heaths of north-western Europe in a few of their characters and in some of their components. Many so-called heaths, however, are communities of stony and rocky ground having little in common with English or German heaths. Mention should, however, be made of a belt in the north of



the Northern Plain along the foothills of the Alps (p. 252), termed, not very happily, 'the zone of subalpine heaths'. These heaths are low shrubby and herbaceous communities with much heather, which have replaced oak woods. Parts of them have been planted with pines.

*Communities of Herbs and Low Shrubs (Fig. 80)*

*Pastures and other Communities of the High Mountain Zone.* Above the forest limit there are areas of high mountain pastures which merge on the one hand into boggy and marshy ground, and on the other into rock outcrops or stony screes. The vegetation is largely composed of members of the grass, sedge, and rush families, but also includes numerous 'alpines', often with brightly coloured flowers, such as gentians, saxifrages, primulas, buttercups, violas, campanulas, louseworts, stonecrops, and orchids. Growth and flowering are limited to the summer months, and the pastures are at their gayest in August. These pastures are largely used for summer grazing associated with some form of seasonal migration. They have been extended by shepherds in order to increase grazing, by cutting and burning, and by intensive grazing itself. There is no doubt that in places the natural tree limits have thus been artificially depressed.

Below the high mountain zone 'pastures', or more precisely grazing grounds, are most often either degraded forms of forest or brushwood, open stony and rocky communities, or sometimes partially drained marshlands. Perennially green pastures are practically absent from Italy below the high mountain zone. More or less extensive clearings in *macchia* often have a large number of grasses and serve in winter and spring as grazing grounds for animals. Unlike more northerly and high altitude pastures, however, they contain a large percentage of drought-resisting plants (xerophytes). The lower-lying pastures also differ in that bare patches of ground remain between the individual plants. The 'pastures' of the montane, hill, and lowland zones owe their existence to some extent to the system of *latifundia*, or large estates practising very 'extensive' cereal agriculture and the grazing of huge flocks of sheep, cattle, and sometimes buffaloes. Since the Roman period and until quite recent times this type of land tenure has tended to favour the extension of grazing grounds at the expense of agricultural land and particularly of forest, especially in the lowland and hill zones. Much of this pasture could only be used by the aid of a system of seasonal migration which would provide some other grazing during the summer drought. This was found mainly at higher levels among the Apennines, and so led



indirectly to the extension of natural and artificial grasslands in the montane and high mountain zones.

*Meadows.* Herbaceous communities cut annually for hay occur in Italy in the lower part of the high mountain zone and in the montane zone, and in the marshlands or semi-marshlands of the river valleys and deltas. The irrigated meadows (*marcite*) of the Po plain (p. 255) could be placed in this category. The meadows contain a large variety of perennial herbs, by no means all grasses. Hay-making in the mountains usually takes place in the second and third weeks of July. True meadows, in the Central European sense, are scarce outside the mountainous areas and the Po valley, and especially so in peninsular Italy and the islands.

*Communities of Stony and Rocky Ground.* In all districts of Italy and in all the altitudinal zones considerable patches of stony and rocky ground are not infrequent and cover in the aggregate a very large area. These areas are uncultivated but frequently roughly grazed, and, in the lower zones, constantly and ruthlessly exploited for fuel. While the vegetation of such habitats is dwarf, and its economic value very low indeed, its floristic composition is generally rich and varied. In the clefts of the Alpine rocks, house-leeks, stone-crops, edelweiss, thymes, varieties of kidney-vetch, white dryas, trailing azalea, alpine toadflax, and many other plants flower during the short summer period. Some of the same plants flourish also on the screes and morainic slopes, together with alpine pinks, alpine buttercups, gentians, saxifrages, dwarf rhododendrons, thymes, and Alpine lady's mantle. On some flatter areas mats of turf-like vegetation may form. The winter snow cover is an important factor in protecting plants from the harmful effects of low temperatures. In lower zones, rock and scree vegetation very largely consists of plants adapted to resist dry rather than cold conditions. Growth is low, and often compact; leaves are small and sometimes hard; often there are hairy coverings and extensive root-systems. Composites, labiates, legumes, members of the pink, stonecrop, and rock-rose families, and grasses are particularly well represented.

#### *Marshlands and Aquatic Vegetation*

The marshlands of Italy occur either in swampy lowlands and river deltas or around the margins of lakes. Drainage has been carried out spasmodically from early historic times onwards, but neglect of drainage works has meant frequent relapses to marshy conditions. Marshy areas, particularly in the western parts of the



Peninsula, have been considerably reduced in extent during the past two decades, and the reclaimed ground turned into farmland (Plate 98).

There is usually a tendency for areas of fresh water to silt up slowly through the natural accumulation of inorganic materials and of the dead remains of plants. The open water is gradually silted up to marsh level, the marsh itself being in turn replaced by brushwood and finally forest, or, under artificial management, by pasture or meadow, or even by arable fields. This leads to zoning of the vegetation, the main divisions being an inner aquatic zone composed of plants growing under water, and a marsh zone in which the plants have their stems and leaves above the water level.

The *aquatic zone* is composed of plants, either completely submerged or with floating leaves, and with flowers projecting above the water surface. Plants constituting this vegetation include pond-weeds (especially *Potamogeton natans* with floating leaves), frogbit, white and yellow water-lilies, water violet, water chestnut, fringed water-lily, hornwort, water-milfoil, bladderwort, and, in deep water, stoneworts. These aquatic plants themselves show some zonation according to the depth of the water. They occur not only in lakes and ponds but also in numerous drainage canals and in slowly flowing parts of rivers. The Canadian pond-weed has spread into many Italian inland waters, especially those of the Northern Plain.

The *marsh zone* normally consists of a dense belt of vegetation in which the plants have their lower parts in water and waterlogged soil but the main mass of their stems and leaves above the water-level, which may vary considerably from season to season. On the inward margins of the marsh zone tall reeds often predominate. These include sedges, reed mace, and bulrush. There are also often very extensive areas of common reed-grass, sometimes mixed with sedges. Where the water-table is lower the vegetation is dense and lush with a flora too varied to list here, but including many grasses, sedges, and rushes as well as irises, buttercups, and marsh orchids. By natural or artificial drainage the marsh may pass into wet meadow, but often it is invaded by shrubs and finally by trees. These woody plants help to dry out the soil, and the last stage is naturally most often forest of a type depending largely on latitude and altitude.

### *Coastal Communities*

Near the coast the vegetation is everywhere influenced by the degree of proximity to the sea. The composition and structure of the different types are largely controlled by the nature of the soil and



the extent to which salt water affects them. Four communities can be distinguished.

*Submerged Vegetation.* In the open sea plant-life is represented entirely by microscopic plants of the group known as algae. Near the land where the shore is suitable, there are rich communities of large seaweeds and also a limited number of peculiarly adapted flowering plants. The grasswack in sheltered bays and estuaries forms green submarine 'meadows' to a depth of 30 feet. It is very common on some of the Italian shores, both of the Adriatic and the Tyrrhenian seas, and is important in providing a major source of food for coastal water birds. Another sea plant of importance, known botanically as *Posidonia oceanica*, grows entirely submerged to a depth of 100 feet. Its leaves and creeping stems are either cast up on the shore and their fibrose remains rolled by the waves into dense balls which may attain a diameter of 4 or 5 inches, or the plant debris may accumulate as banks of pale straw-coloured fragments easily moved when dry by the wind. The balls are sometimes collected for use as fuel.

*Salt Marshes.* Salt-marsh vegetation occurs on mud banks submerged at least at the highest tides, and in deltaic areas where deposition of silt causes an advancing coast-line, often with lagoons. Plants of the salt marshes are well adapted by their structure and behaviour to withstand the high concentration of salts around their root systems. Such plants are technically termed halophytes. On the margin of the mud there often grow very open communities of glasswort. These are frequently submerged and serve to build up the level of the salt marsh, which in time becomes clothed with a dense, low but lush vegetation of sea-coast grasses, sea rushes, sea-blite, sea lavenders, sea purslane, sea aster, sea spurrey, and many other plants. Such halophytic vegetation is characteristic of the lagoons of the north-west Adriatic.

*Sand Dunes.* There are no extensive areas of mobile dunes in Italy. The herbaceous vegetation usually stabilizes them effectively and there is then a natural succession to brushwood, generally of the macchia type. The dune plants are adapted not to saline conditions, but rather to drought. In the early stages of colonization by plants, herbs predominate—in part ephemerals which flower and fruit before the hot, dry summer shrivels them up, and in part perennials with deep and wide root systems. A very characteristic plant of sand dunes, which is also a great aid in stabilizing them, is the marram grass, a variant of which is widely distributed around the coasts of Italy and the larger islands. The jointed couch grass is another valuable sand-binder.



Other widely spread dune plants are the sea spurge, the sea holly, sea convolvulus, and yellow-horned poppy. In the south are many dune plants which are mainly or entirely limited to the Mediterranean region, such as the sea knotgrass, sometimes extending almost to high-water mark, two remarkable umbellifers (*Echinophora spinosa* and *E. tenuifolia*) whose aerial parts dry off in the autumn and are rolled over the dunes by the wind as great balls which are sometimes collected and used as fuel, several strange composites (*Diotis*, *Santolina*), and the sea 'lily', a plant with large bulbs whose white flowers deck the yellow sand in July.

*Cliff and Rock Vegetation.* On many parts of the coast inland vegetation extends very close to the sea. Much of the coast is rocky and on this macchia frequently grows almost to sea level. Where salt spray is thrown by waves the vegetation may be limited to specially adapted plants growing in the rock clefts, e.g. samphire, a plantain (*Plantago coronopus*), a ragwort (*Senecio leucanthemifolius*), sea lavenders of several kinds, golden samphire, white alyssum, and sea heath.

### *Introduced Plants*

A very considerable number of exotics have established themselves in the lower and montane zones of both the Mediterranean and central European regions of Italy. Over 350 species are recorded as occurring spontaneously in such a manner as to seem almost part of the natural vegetation. Particularly in the lowlands of the Mediterranean region, for instance parts of the Riviera, introduced plants tend to dominate the landscape, even outside the gardens. Agaves (especially *Agave americana*), aloes, prickly-pear, and a host of other subtropical plants make the cliffs and slopes resemble a botanic garden. Of wide distribution are the false acacia or 'locust' from North America, bastard indigo, a shrubby plant from Carolina, the tree of heaven from China, and the mulberry-like paper tree from Japan. Amongst the herbs must be mentioned the drooping yellow-flowered 'wood-sorrel' (*Oxalis cernua*) from South Africa, which is now almost ubiquitous in the lower zones, two composites, the one (*Erigeron canadensis*) from North America and the other (*Galinsoga parviflora*) from Brazil, and the strange composites of the genus *Xanthium*, called in Italian *spino d'asino* or *lappolone* and for the most part probably of American origin. Two aquatic plants have also taken an important position in the natural flora by their rapid spread, namely the Canadian pond-weed and a peculiar water fern, known as *Azolla caroliniana*, from North America. The former has now spread as a



submerged plant through many of the lakes and waterways, while the latter is widespread in still water and floats on the surface in such closed masses as to make any unwary traveller suppose it to be firm ground covered by moss.

### *Cover and Penetrability of Chief Woody Communities*

In the following table certain characteristics of military importance of the more important woody communities occurring in Italy are given in a generalized form. The heights are those attained by average mature woods, brushwoods, or plantations. Density refers to the closeness of the dominant largest elements; in an oakwood, for example, reference is to the oak trees, not to the undergrowth. All woody communities in Italy are penetrable with fair ease by men on foot, with the exception of some high *macchia* and rare closed deciduous brushwoods. Penetrability, as judged from the densities given in this table, must therefore refer to medium- and large-sized vehicles. In general terms canopy determines overhead cover, but must be read with regard to seasonal aspect. It refers to the tallest components, i.e. except in brushwoods to the trees.

<i>Community</i>	<i>Height in feet</i>	<i>Density</i>	<i>Undergrowth</i>	<i>Canopy</i>	<i>Seasonal aspects</i>
Larch . . .	75-110	Close.	Low and fairly continuous.	Open upwards.	Winter bare.
Fir and spruce . .	60-80	Often close.	Low and fairly continuous.	Open upwards.	Evergreen.
Black pine . . .	90-110	Fairly close.	Poor, often little or none.	Dense.	Evergreen.
Scots pine . . .	50-100	Fairly close.	Poor to none.	Moderately dense.	Evergreen.
Beech (woods) . .	40-90	Moderately spaced.	Little in closed woods but a lower tree layer 20-30 ft. high may be present.	Dense.	Winter bare.
Beech (scrub) . .	10-20	Close.	..	Low but dense.	Winter bare.
Chestnut (woods)	35-100	Moderately spaced.	Usually poor and low.	Dense.	Winter bare.
Chestnut (coppice)	10-30	Close.	..	Low but dense.	Winter bare.
Summer-green oaks (woods)	45-100	Moderately spaced.	Often fairly dense.	More or less closed.	Winter bare.
Summer-green oaks (scrub)	10-20	Close.	..	Low but dense.	Winter bare.
Holm oak (woods)	50-80	Moderately spaced.	Poor.	Dense.	Evergreen.
Lowland pines . .	25-70	Fairly close.	Often poor, but varies.	Usually dense.	Evergreen.
Macchia . . .	5-30	Very close.	..	Low but dense.	Evergreen.
Olive. . . .	20-30	Spaced.	Arable crops often between.	Dense but discontinuous.	Evergreen.
Vine . . . .	5-50	Usually in rows.	..	Dense when grown tall.	Deciduous.
Mulberry . . .	20-50 (often pollarded)	In rows or spaced.	Arable crops often between.	Dense but discontinuous.	Deciduous.



*Index of Plants*

In the following list the names, which refer to plants mentioned in the text, are arranged alphabetically in English. The botanical (Latin) names are given in the third column and, where available, the common Italian name or names in the middle column. The abbreviation 'spp.' which occurs from time to time in the third column after a generic name indicates that more than one species of the genus is included under the one vernacular name. Thus '*Quercus* spp.' means 'several species of the genus *Quercus*' or, more simply, 'several kinds of oak'.

<i>English name</i>	<i>Italian name</i>	<i>Botanical name</i>
Agave	agave, pitta	<i>Agave americana</i>
Alder	ontano or alno	<i>Alnus</i> spp.
Aleppo pine	pino d'Aleppo	<i>Pinus halepensis</i>
Alpine broom	..	<i>Cytisus alpinus</i>
„ honeysuckle	..	<i>Lonicera alpigena</i>
„ lady's mantle	..	<i>Alchemilla alpina</i>
„ toadflax	..	<i>Linaria alpina</i>
Ash (common)	frassino	<i>Fraxinus excelsior</i>
Asparagus	corruda, &c.	<i>Asparagus acutifolius</i>
Aspen	pioppo tremula	<i>Populus tremula</i>
Asphodel	asfodello, porraccio	<i>Asphodelus microcarpus</i>
Barberry	crespino	<i>Berberis vulgaris</i>
Bastard indigo	..	<i>Amorpha fruticosa</i>
Beech	faggio	<i>Fagus silvatica</i>
Bilberry	piuri, bagole	<i>Vaccinium myrtillus</i>
Black broom	..	<i>Cytisus nigricans</i>
„ honeysuckle	..	<i>Lonicera nigra</i>
„ mulberry	moro nero	<i>Morus nigra</i>
„ pine	pino di Corsica	<i>Pinus nigra</i>
„ poplar	pioppo	<i>Populus nigra</i>
Bladderwort	erba pennina	<i>Utricularia minor</i>
Bog wortleberry	..	<i>Vaccinium uliginosum</i>
Box	basso, bassolo	<i>Buxus sempervirens</i>
Bramble	rovo, rogo	<i>Rubus</i> spp.
Buckthorn	..	<i>Rhamnus</i> spp.
Bulrush	giunco di palude, nocco	<i>Scirpus lacustris</i>
Buttercup	ranunculo	<i>Ranunculus</i> spp.
Canadian pond-weed	peste d'acqua	<i>Elodea canadensis</i>
Carob	carrubo	<i>Ceratonia siliqua</i>
Chestnut	castagno	<i>Castanea sativa</i>
Clematis	vitalba	<i>Clematis</i> spp.
Common juniper	ginopro	<i>Juniperus communis</i>
Cork oak	sughera	<i>Quercus suber</i>
Cowberry	vigna d'orso	<i>Vaccinium vitis-idaea</i>
Crowberry	..	<i>Empetrum nigrum</i>
Cypress	cipresso	<i>Cupressus sempervirens</i> var. <i>fastigiata</i>



<i>English name</i>	<i>Italian name</i>	<i>Botanical name</i>
Dogwood	sanguine	<i>Cornus sanguinea</i>
Drooping rose	..	<i>Rosa pendulina</i>
Dwarf juniper	ginepro	<i>Juniperus communis</i> var.
„ palm	palma nana	<i>Chamaerops humilis</i>
Dyer's greenweed	baccellina, &c.	<i>Genista tinctoria</i>
Edelweiss	pie di leone	<i>Leontopodium alpinum</i>
Elm	olmo	<i>Ulmus campestris</i>
Etna barberry	crespino	<i>Berberis aetnensis</i>
„ bedstraw	..	<i>Galium aetnensis</i>
„ dock	..	<i>Rumex aetnensis</i>
„ greenweed	..	<i>Genista aetnensis</i>
„ ragwort	..	<i>Senecio aetnensis</i>
„ violet	..	<i>Viola aetnensis</i>
False acacia	acacia, cascia	<i>Robinia pseudacacia</i>
Fir	abete or abete bianco	<i>Abies alba</i>
Flesh-coloured heath	..	<i>Erica carnea</i>
Flowering ash	orniello	<i>Fraxinus ornus</i>
Frogbit	morso di rana	<i>Hydrocharis morsus-ranae</i>
Germanders	..	<i>Teucrium</i> spp.
Glasswort	salicornia	<i>Salicornia</i> spp.
Golden samphire	salsume	<i>Inula crithmoides</i>
Grasswrack	alega	<i>Zostera marina</i>
Green alder	..	<i>Alnus viridis</i>
Hairy oak	..	<i>Quercus lanuginosa</i>
Hawthorn	bianco spino	<i>Crataegus monogyna</i>
Hazel	nocciolo, avellano	<i>Corylus avellana</i>
Heather	grecchia	<i>Calluna vulgaris</i>
Heaths	eriche	<i>Erica</i> spp.
Holly	agrifoglio	<i>Ilex aquifolium</i>
Holm oak	leccio, lice, or elcio	<i>Quercus ilex</i>
Honeysuckle	..	<i>Lonicera</i> spp.
Hop hornbeam	carpinella	<i>Ostrya carpinifolia</i>
Hops	luppolo	<i>Humulus lupulus</i>
Hornbeam	carpino	<i>Carpinus betulus</i>
Hornwort	coda di volpe	<i>Ceratophyllum demersum</i>
Horse chestnut	..	<i>Aesculus hippocastanum</i>
House-leek	semprevivo	<i>Sempervivum</i> spp.
Italian everlasting-flower	tignamica	<i>Helichrysum italicum</i>
Ivy	ellera, edera	<i>Hedera helix</i>
Jointed couchgrass	..	<i>Agropyron junceum</i>
Judas tree	albero di Guida, or sili-quastro	<i>Cercis siliquastrum</i>
Kidney vetch	..	<i>Anthyllis vulneraria</i>
Laburnum	avornello	<i>Laburnum vulgare</i>
Larch	larice	<i>Larix decidua</i>



<i>English name</i>	<i>Italian name</i>	<i>Botanical name</i>
Laurel	alloro	<i>Laurus nobilis</i>
Lavender	steca, spigo, lavanda	<i>Lavandula</i> spp.
Lime	tiglio	<i>Tilia platyphylla</i>
Lombardy poplar	pioppo cipressino	<i>Populus nigra</i> var. <i>pyramidalis</i>
Lousewort	..	<i>Pedicularis</i> spp.
Macedonian oak	..	<i>Quercus macedonica</i>
Maple	acero, &c.	<i>Acer campestre</i> and <i>Acer</i> spp.
Maritime pine	pino selvatico	<i>Pinus pinaster</i>
Marram grass	sparto pungente	<i>Ammophila arenaria</i>
Mastic tree	lentisco	<i>Pistacia lentiscus</i>
Mediterranean juniper	appeggi	<i>Juniperus oxycedrus</i>
Mezereon	camelea, mezzereo	<i>Daphne mezereum</i>
Mountain ash	sorbo degli uccellatori	<i>Pyrus aucuparia</i>
„ pine	mugo	<i>Pinus montana</i>
Mouse-eared chickweed	..	<i>Cerastium vulcanicum</i>
Mulberry	moro	<i>Morus</i> spp.
Nettle tree	bagolaro	<i>Celtis australis</i>
Oak	..	<i>Quercus</i> spp.
Oleander	leandro	<i>Nerium oleander</i>
Olive	olivo	<i>Olea europaea</i>
Paper tree	gelso da carta	<i>Broussonetia papyrifera</i>
Papyrus	papiro	<i>Cyperus papyrus</i>
Poplar	pioppo	<i>Populus</i> spp.
Prickly pear	fico d'India	<i>Opuntia ficus-indica</i> , and <i>Opuntia</i> spp.
Raspberry	lampone	<i>Rubus idaeus</i>
Red juniper	appeggi	<i>Juniperus phoenicea</i>
Reed-grass	canna di palude	<i>Phragmites communis</i>
Reed mace	stancia	<i>Typha</i> spp.
Rock rose	brentine, &c.	<i>Cistus</i> spp.
Rusty-leaved rhododendron	rosa delle Alpi	<i>Rhododendron ferrugineum</i>
Samphire	bacicci, cretamo	<i>Crithmum maritimum</i>
Scorpion senna	dondobino	<i>Coronilla emerus</i>
Scots pine	pino di scozia	<i>Pinus silvestris</i>
Sea aster	..	<i>Aster tripolium</i>
„ convolvulus	soldinella	<i>Calystegia soldanella</i>
„ heath	erba franca	<i>Frankenia laevis</i>
„ holly	..	<i>Eryngium maritimum</i>
„ knotgrass	..	<i>Polygonum maritimum</i>
„ lavender	..	<i>Limonium</i> spp.
„ 'lily'	narciso marino	<i>Pancratium maritimum</i>
„ purslane	..	<i>Obione portulacoides</i>
„ spurge	..	<i>Euphorbia paralias</i>
„ spurrey	..	<i>Spergularia media</i>
Seablite	..	<i>Suaeda maritima</i>



<i>English name</i>	<i>Italian name</i>	<i>Botanical name</i>
Sedge	carice	<i>Carex</i> spp.
Sessile oak	eschio, quercia, or rovere	<i>Quercus sessiliflora</i>
Sicilian milk-vetch	spini santi	<i>Astragalus siculus</i>
„ tansy	..	<i>Tanacetum siculum</i>
Sloe	prugnolo	<i>Prunus spinosa</i>
Smilax	smilaca	<i>Smilax aspera</i>
Spiny broom	..	<i>Cytisus spinescens</i>
„ burnet	spinaporci	<i>Poterium spinosum</i>
„ spurge	..	<i>Euphorbia spinosa</i>
Spruce	abete rosso	<i>Picea abies</i>
Stalked oak	farnia or rovere	<i>Quercus robur</i>
Stone pine	pino da pinocchi	<i>Pinus pinea</i>
Stonecrop	..	<i>Sedum</i> spp.
Stonewort	..	<i>Chara</i> spp.
Strawberry tree	corbezzola	<i>Arbutus unedo</i>
Swiss stone pine	pino zimbro	<i>Pinus cembra</i>
Sycamore	acerofico, loppone	<i>Acer pseudoplatanus</i>
Tamarisk	tamarice, bruca	<i>Tamarix gallica</i> and <i>T. africana</i>
Thyme	timi	<i>Thymus</i> spp.
Trailing azalea	..	<i>Loiseleuria procumbens</i>
Tree heath	scopa, scopone	<i>Erica arborea</i>
„ of heaven	..	<i>Ailanthus altissima</i>
„ spurge	..	<i>Euphorbia dendroides</i>
Turkey oak	cerro	<i>Quercus cerris</i>
Turpentine tree	terebinto, scornabecco	<i>Pistacia terebinthus</i>
Valonia oak	vallonea	<i>Quercus aegilops</i>
Vine	vite	<i>Vitis vinifera</i>
Water chestnut	..	<i>Trapa natans</i>
„ milfoil	millefoglio	<i>Myriophyllum verticillatum</i>
„ violet	fertro, erba scorpina	<i>Hottonia palustris</i>
Wayfaring tree	lantana, vavorna	<i>Viburnum lantana</i>
White alyssum	..	<i>Alyssum maritimum</i>
„ -barked pine	..	<i>Pinus leucodermis</i>
„ beam	farinaccio	<i>Pyrus aria</i>
„ birch	betula or bidollo	<i>Betula alba</i>
„ dryas	..	<i>Dryas octopetala</i>
„ fir	abete bianco	<i>Abies alba</i>
„ mulberry	moro bianco	<i>Morus alba</i>
„ poplar	alberello, gattice	<i>Populus alba</i>
„ water-lily	corfano, ninfea	<i>Nymphaea alba</i>
Wild madder	..	<i>Rubia peregrina</i>
„ olive	oleastro	<i>Olea europaea</i> var. <i>oleaster</i> .
„ vine	vite	<i>Vitis vinifera</i> var. <i>silvestris</i>
Willow	salcio	<i>Salix</i> spp.
Yellow-horned poppy	papavero cornuto	<i>Glaucium flavum</i>
„ water-lily	carfano, rannufero	<i>Nuphar luteum</i>
Yew	tasso	<i>Taxus baccata</i>



## ANIMAL LIFE

ALTHOUGH the fauna of Italy shows affinities with central Europe, the Balkans, and Africa, it is not as rich as might be expected. The number of species, especially of the larger mammals, has constantly diminished, and this process has only recently begun to be checked, for example, by the institution of National Parks such as those of the Gran Paradiso, of the Abruzzi, and of Monte Circeo.

Bears are extinct except for a very few in the Abruzzi, in the upper Sangro valley. Wolves are more common, although still rare, occurring particularly in Calabria and Lucania, Apulia, and the Abruzzi, and occasionally in other inaccessible parts of the Central Apennines, and in Sicily. Roebuck (*capriolo*) are the commonest of the deer and frequent most of the wilder parts of the country, including the Central and Eastern Alps, the Apennines, Maremma, and M. Gargano, but not Sardinia. Stags (*cervo*) are found in Sardinia, occasionally in the Venetian Alps, and in some preserves in Tuscany, and near the mouth of the Po; fallow deer (*daino*), in Sardinia, are still rarer. The chamois (*camoscio*) is scattered widely, though not in large numbers, throughout the Alps, and a few have been preserved in the Abruzzi National Park. The wild goat or ibex (*stambecco*) is confined to the Gran Paradiso National Park, where it was said in 1930 to number 3,000 in the communes of Valsavaranche and Cogne. The moufflon is only found naturally in eastern Sardinia, although it has been imported into some preserves in the Casentino. The wild pig (*cinghiale* or *cignale*) is the commonest of the larger mammals. It has recently spread from France into the Piedmontese, Maritime, and Ligurian Alps, and a few may remain in the Julian Alps, where they have spread from Yugoslavia. It is also frequent in the Tuscan Maremma, in the mountains of Lucania and southern Campania, in M. Gargano, in the coastal *macchia* of the gulf of Taranto, and throughout Sardinia. The wild pig is on the whole, apart from northern Italy, an animal of the *macchia*. All of these larger animals have in the past been strenuously hunted, and many have only been saved from total extinction by the protection of powerful landowners or, more recently, of the State. This is particularly true of the ibex and the chamois, the stag, and the fallow deer.

Among the smaller animals the hare is common throughout most of the country, but the Arctic hare, which changes its colour to white in winter, is confined to the higher parts of the Alps (above about 5,000 ft.). The rabbit is only indigenous in southern Sardinia and in



Sicily, although it is imported into preserves in many parts of the mainland, especially the Valle d'Aosta. Small carnivores such as the fox, marten, and weasel are widespread. The wild cat frequents the *macchia* of the Tuscan Maremma, Sardinia, and Sicily, and the coniferous zone of the Alps. The marmot and ermine are found in the higher Alps, the hedgehog, porcupine, and badger in Sicily and the mountains of Calabria, Lucania, Latium, and Tuscany. Squirrels and dormice inhabit many woods throughout the country, and moles are absent only from Sicily and Sardinia. Freshwater fish, apart from eels, are not abundant. Trout in the mountain streams, pike and perch in the north, tench and salmon are the principal species.

One of the most striking features of Italy to the northern visitor is the enormous number of lizards which frequent the sunny rocks, walls, *macchia*, and fields. Vipers are found in the mountainous areas, especially the Alps. Among the smaller, but poisonous animals are the centipede scolopendra, the little scorpion, the tarantula and vault spiders, and various mosquitoes. The bites or stings of all these are unpleasant but not deadly. Parts of the country, particularly the islands, are liable to the attacks of migratory grasshoppers.

The ruthless shooting of birds for sport and food has caused their absence to be one of the most noticeable points about the Italian countryside. The permanently resident birds have been sadly reduced in number and are now few and far between. Only in the mountains some of the larger game birds persist, of which partridges are most widespread. In the upper parts of the Alps the varying partridge (*pernice bianca*), in the Maritime Alps and Ligurian Apennines the *pernice rossa*, in Sardinia the *pernice sarda*, and throughout the Alps, Central Apennines, Calabria, and Sicily the *coturnice* occupy the mountains and other uninhabited regions. In the Alps are also found black cock (*fagiano di monte*) and capercailzie (*gallo cedrone*); in the Eastern Alps ptarmigan (*francolino*) and heath cock (*francolino di monte*). The lagoons and marshes of many of the coastal areas, especially on the Tyrrhenian and northern Adriatic coasts, harbour many water birds, of which, however, the greater part are migratory. Owing largely to the smaller population, birds are relatively more frequent in Sardinia than elsewhere, and include quail, little bustard, peewit, curlew, jackdaw, crow, many smaller birds, heron, ducks, coots, and sea birds. On the mainland, Liguria has the greatest number of species of birds.

Throughout the country birds of prey, not being good to eat, are common and help further to reduce the number of smaller birds.



Sardinia has three types of Italian vulture, no longer encountered on the mainland, including the lammergeier which was until recently found in the Western Alps. Eagles and falcons occur all over the country. The flamingoes which visit the marshes of Cagliari and Oristano in Sardinia, and the small colony of green ibis in the rice-fields of the Vercelli district are of particular interest.

Migratory birds pass over north and central Italy during spring and summer in a general north-east to south-west direction from central Europe to Africa, and vice versa. Wherever the opportunity presents, but particularly in certain places especially frequented by them, such as Liguria, the Tuscan coast, and the foothills of Lombardy and Venetia, they are snared in enormous quantities by means of various devices. Amongst these are the *roccolo*, a small, hilltop wood purposely left in deforested country, with nets for the birds; the *brescianella*, a small rectangular enclosure of trees in lowland also containing nets; and the *paretaio*, a pair of movable nets stretched over hazel boughs. Mainly small birds such as quails, ortolans, larks, thrushes, starlings, linnets, chaffinches, fieldfares, and so forth are caught in this way. Water birds are also caught and shot on the marshes and lagoons.

Every citizen has the right to hunt, and the landowner has no property in the game on his land. Game preserves for the restocking of the surrounding districts can, however, be instituted. Shooting is a popular sport with all classes, and is so thorough and unrestricted that much game is left only in some private and state preserves and national parks, or alternatively in unhealthy and depopulated or very inaccessible regions. In general the open season for shooting is from 15 August to 31 December, and for snaring (*uccellagione* or *aucupio*) from 15 August to 20 November. Special seasons are fixed for individual species. In Sardinia, where there is more game than on the mainland, the shooting of the stag, fallow deer, moufflon, and wild pig is known as *caccia grossa*, that of birds, hares, rabbits, and foxes as *caccia minuta*. The former is conducted in drives with beaters, or by stalking with guides. Moufflon shooting is considered the best sport. Dogs are used in the *caccia minuta*.

Although man's main effort has been directed to the impoverishment of the fauna, certain animals have been introduced. The ordinary domestic animals of temperate lands are all found. Compared with Britain goats are much more numerous and dairy cattle less so. On the other hand, oxen are widely used as draught animals. The enormous migrating flocks of sheep, cared for by mounted shepherds,



moving from mountain to plain and vice versa according to the season, although not as numerous as formerly, are still a great feature of the southern half of the Peninsula. The sheep dogs of Calabria and Lucania, wild and powerful animals, are protected by spiked collars against the attacks of wolves. In the marshes of the Tyrrhenian coast, particularly the Pontine marshes before their reclamation, are herds of buffaloes introduced from the east, and on the S. Rossore estate, near the mouth of the Arno, there are still some camels, descendants of those captured from the Turks at the siege of Vienna in 1683.



## APPENDIX I

### VOLCANIC ACTIVITY

#### *Types of Eruption*

THE active volcanoes of Italy differ greatly in size and shape owing partly to diversities in type of eruption. These types vary from Solfatara in the Campi Flegrei, where it is possible to walk about in the crater and watch the eruptions from close quarters, to Vesuvius and Etna, both capable of hurling millions of cubic yards of dust to a height of several miles; and from Ischia, where only a few eruptions have been recorded in 2,500 years, to Stromboli, which erupts gently every few minutes and has a more serious eruption almost every day.

In all active volcanoes the force of eruption is mainly supplied by pressure from underground steam. When this pressure is great enough to overcome the resistance of overlying rocks, eruption is liable to be extremely violent, and particularly so when part of the surface is blown into the air as dust and fragments of stone. Fortunately this type of eruption is comparatively rare. More often the steam is able to issue harmlessly and more or less continuously. Between these two extremes is a common form of eruption in which molten rock, forced up from below by the pressure of the steam, may emerge at the surface as a lava-flow. Such an eruption is often accompanied by a relatively slight ejection of dust and stones.

Vesuvius, Stromboli, and Solfatara have become world-famous for their particular types of eruption, and their names are now used to denote these types. As any volcano may pass from one type to another during its history, they are considered as phases in its development and are spoken of respectively as the Vesuvian, Strombolian, and Solfatara types.

(1) In the *Strombolian type* eruption is regular and frequent, and is usually accompanied by the ejection of lava, some stones, and dust.

(2) The *Vesuvian type* is subject to explosive eruptions, the main products of which are steam, dust, and stones, sometimes accompanied by lava. This type usually occurs after periods of quiescence.

(3) In the *Solfatara type* the floor of the crater is comparatively cool, but occasional pools of boiling water throw up jets of steam or fumaroles, some 15 or 20 feet high. Sulphurous and other vapours are also exhaled, and produce a number of rare minerals by entering into chemical combination with the surrounding rocks. The Solfatara type often occurs in dormant volcanoes, and sometimes indicates approaching extinction. This evidence cannot, however, always be relied upon, as the dormant state may prevail for a long time, but yet may be an indication of coming danger. This condition has been known to precede very violent eruption, as in the case of Krakatoa, in the East Indies.



The nature of the separate volcanoes can be described to some extent in terms of these types.

*Ischia.* The last eruption was in 1302, when a lava-flow reached the north-east coast near Porto d'Ischia. There are still hot springs on the island, which is subject to earthquakes of volcanic type. It is not certain whether the present is a dormant phase preceding a possible 'Vesuvian' outburst or whether the volcano is practically extinct.

*Lake Bracciano.* Similarly the hot springs near Lake Bracciano may indicate that the ancient volcano of the Mi. Sabatini is only dormant, although no serious eruption has been recorded.

The *Campi Flegrei* (the Phlegrean Fields) have had, during historic times, two kinds of eruption, the steam fumaroles of Solfatara and the more violent eruption of 1538, when the ash cone of M. Nuovo (455 ft.) was built in a few days. Gradual changes of sea-level connected with this eruption have been deduced from the evidence of borings by marine animals in the columns of the temple of Serapis near Pozzuoli. A local sinking of the land (maximum about 20 ft.) took place from the fourth to the sixteenth century, followed by a more sudden rise of the land prior to the 1538 eruption. Since 1538 the land had been slowly sinking again.

*Vesuvius*, which is believed to be unconnected with the Campi Flegrei, usually emits steam from its main crater and has frequent minor eruptions of lava. The violent explosive eruptions with large quantities of ash and hot stones are rare and mainly follow long periods of quiescence. Vesuvius was thought to be extinct until A.D. 79, when a catastrophic eruption destroyed the cities of Pompeii and Herculaneum. More normal eruptions followed until 1139, then ceased until 1631, in which year there was a tremendous outbreak. Normal activity has continued till the present day (List of Eruptions, p. 474). Lava sometimes reaches the bay of Naples, but large quantities of volcanic ash are comparatively rare. The highest part of the outer crater, M. Somma, being on the north and north-east sides, prevents lava from flowing in these directions. All known flows have been towards the north-west, south, and east, and intermediate points.

The eruption of Vesuvius in A.D. 79, which destroyed the cities of Pompeii and Herculaneum, was typical of outbreaks of 'Vesuvian type'. Two letters written by the younger Pliny to Tacitus give a vivid eyewitness account of what happened. Before the eruption earthquakes had been common in Campania, but Vesuvius had shown no sign of activity within living memory. When a cloud shaped like a pine-tree appeared, it was not known at first from which mountain it was issuing, but was later seen to be from Vesuvius. Pliny's uncle, who was in command of the imperial fleet at Misenum (modern Miseno), took a ship to the foot of Vesuvius to investigate the phenomenon more closely. As, however, the eruption increased in violence his expedition changed into an attempt to rescue inhabitants of the coast who were in danger. The eruption mainly took the form of an enormous cloud of ash and stones, and the darkness was



described not only as that of a dark night, 'when there is no moon, but of a room when it is shut up', and all the lights extinguished. This darkness lasted for three days, and when the sun reappeared it was 'very faintly, as when an eclipse is coming on'. As the light grew stronger 'every object' was seen to be 'changed, being covered over with white ashes, as with a deep snow'.

During the darkness people abandoned their houses, partly owing to the earthquakes, which were so frequent and violent that they surprised even those who had been used to the shocks of previous years, and partly because the falls of volcanic ash and fragments of pumice were so great that they feared they would not be able to open the doors of their houses to escape if they remained inside. Some carried torches to dispel the darkness, and some tied pillows on their heads to protect them from the falling stones. The escaping crowds were in a panic, and many believed that the end of the world had come. The terror of darkness was further increased by frequent and extremely vivid flashes of lightning, and the noise of the earthquakes, of the thunder, and of the eruption itself. Escape from various threatened parts of the coast was also made impossible by the retreat of the sea for some distance from the shore, and by the subsequent tidal waves. The elder Pliny was unable to escape, because the sea was running too high for his ship to put off, and he perished, apparently from suffocation.

*Lipari Islands.* Lipari island itself has hot springs. Vulcano has several craters, one of which was in constant eruption, like Stromboli, but since the outbreaks of 1887-1890 activity has consisted merely of fumaroles. Stromboli, the most continuously active volcano in Europe, has one main crater from which there has been an eruption almost every day since its existence was first noted in the eighth century B.C. by Greek colonists. In addition to occasional lava-flows, eruptions take the form of the ejection of ash and hot stones, which, however, usually fall back into the crater, or roll harmlessly down the uninhabited north-west slopes. Continuous activity has built up a cone rising 3,040 feet above the sea.

*Etna* in many ways resembles Vesuvius. Both emit steam at frequent intervals, and normally eject lava-flows during the more violent eruptions, and less frequently large quantities of ash (List of Eruptions, p. 474). Lava may issue from fissures near their bases as well as higher up. Etna, apart from its greater size, differs from Vesuvius in having an important secondary centre of eruption, the Valle del Bove east of the main crater. It also has several hundred parasitic cones on its sides, and lava may flow from Etna unchecked in any direction.

*Pantelleria* is only at the Solfatara phase at present, with hot springs and fumaroles ejecting steam. It is possible, though unproved, that the island of Pantelleria may be only dormant, as there was a violent submarine eruption not far off in 1831, preceded by earthquakes. This eruption seems to have been explosive, as a column of steam and dust rose to an



immense height. An island, variously known as Graham's island, Ferdinanda, Siarra, Giulia, or Nerita, appeared from the sea in July–August, and is said to have disappeared by December. The site is now marked by Graham's shoal ( $4\frac{1}{2}$  fathoms). The disappearance was probably due to erosion of soft volcanic ashes by the sea or else to subsidence. According to available data, there were no earthquakes which might indicate renewed eruption between the years 1913 and 1930.

### *List of Eruptions*

Only Etna and Vesuvius are included in this list, since the eruptions of Ischia are so few (p. 472) and those of Stromboli and Vulcano so many (p. 473.) Known details are noted briefly, and usually correspond with the more violent eruptions.

This list may not agree in detail with other published lists, as it excludes many minor eruptions. All the more important eruptions are, however, noted here, and the comparative history of the two volcanoes is stressed.

<i>Date</i>	<i>Etna</i>	<i>Vesuvius</i>
B.C. ? 1500	No details.	..
? 1200	No details.	..
? 693	No details.	..
? 525	No details.	..
477	Lava reached Catania.	..
426	Lava approached Catania.	..
396	Lava reached coast near F. Alcantara.	..
140	No details.	..
134	No details.	..
126	Lava.	..
122	Lava reached sea near Catania and fall of ash on this city.	..
49	No details.	..
43	No details.	..
38	No details.	..
32	No details.	..
A.D. 40	No details.	..
? 50	No details.	..
72	No details.	..
79	..	Violent explosion blew away the whole top of the mountain, Pompeii and Herculaneum destroyed by mud and ashes.
203	..	No details.
253	Lava threatened Catania.	..
420	No details.	..
472	..	Explosive eruption, ashes reaching Constantinople.
512	..	No details.
685	..	No details.
812	No details.	..
? 836	No details.	..



<i>Date</i>	<i>Etna</i>	<i>Vesuvius</i>
993	..	No details.
1036	..	Lava reached bay of Naples.
1049	..	Lava again reached sea.
? 1064	No details.	..
1138	..	No details.
1139	..	Lava reached sea.
? 1157	No details.	..
1169	Severe eruption, top part of cone collapsed into main crater.	..
1181	Big eruption from east side of mountain.	..
1285	Lava-flows for 15 miles.	..
1329	Lava reached sea; ashes blown as far as Malta.	..
1333	No details.	..
1371	(? 1381) Lava reached sea.	..
1408	Lava-flows; ashes reached Calabria.	..
1444	Lava threatened Catania.	..
1446	No details.	..
or 1447		
c. 1490	Lava reached Catania.	..
1536	Lava.	..
1537	Lava; falls of ash carried 300 miles.	..
1566	Lava.	..
1579	No details.	..
1595	Lava reached F. Simeto.	..
1607	Lava.	..
1610	Lava reached F. Simeto.	..
1614	Lava.	..
1619	Lava.	..
1631	..	Tremendous eruption. Lava reached coast at a dozen points. Height of ash cloud measured as several miles, and ash reached Constantinople.
1633	No details.	..
1646	Lava.	..
1651	Lava.	..
1660	..	No details.
1669	Lava reached Catania. Ashes carried for distance of 60 miles.	..
1682	Lava into Valle del Bove.	No details.
1685	..	No details.
1688	Lava into Valle del Bove.	..
1689	Lava from Valle del Bove.	No details.
1693	Unusually bad earthquakes accompanied eruption.	..
1694	Ashes reached Malta.	Ashes and lava-flows.
1697	..	No details.
1698	..	Ashes and lava-flows.
1701	..	No details.
1702	Lava from Valle del Bove.	..



<i>Date</i>	<i>Etna</i>	<i>Vesuvius</i>
1704	..	No details.
1707	..	Ashes fell on Naples.
1712	..	No details.
1714	..	No details.
1717	..	Lava.
1717-33	..	Eruptions at less than 4-year intervals.
1723	Lava.	..
1732	Lava.	..
1735	Lava.	..
1737	..	Lava reached sea.
1744	Ashes but no lava.	..
1747	Lava into Valle del Bove.	..
1751	..	No details.
1754	..	No details.
1755	Great flood of water (? melted ice).	..
1759	Ashes and lava (April and May).	No details (November).
1763	Ashes and lava.	..
1766	Ashes and lava.	..
1767	..	Lava; ashes fell in Naples.
1771	..	No details.
1779	..	Violent eruption. Big stones fell about 30 miles away, and ashes carried almost to M. Gargano.
1780	Lava.	..
1781	Lava into Valle del Bove.	..
1785	..	No details.
1787	No details.	..
1792	Lava.	..
1794	..	Lava reached sea.
1797	No details.	..
1798	No details.	..
1799	No details.	..
1800	Ashes.	..
1802	Lava from Valle del Bove.	..
1804	..	No details.
1805	No details.	Lava reached sea (August).
1806	..	Lava again reached sea.
1808	No details.	..
1809	Lava and ashes.	..
1811	Big lava-flows; ashes carried great distances (25 and 27 October).	No details (12 October).
1813	..	Discharges of ashes, some violent. Much local damage.
1819	Lava into Valle del Bove.	..
1822	..	Lava and ashes.
1831	Eruption 17 February.	Lava (Summer).
1832	Lava.	..
1834	..	Lava.
1838	Lava into Valle del Bove.	..
1839	..	Fall of ashes.
1842	Lava into Valle del Bove.	..
1843	Lava nearly reached F. Simeto.	..



<i>Date</i>	<i>Etna</i>	<i>Vesuvius</i>
1852	Big lava-flows.	..
1855	..	Large lava-flows westward.
1858	..	Lava.
1860	..	Lava.
1861	..	No details.
1864	No details.	..
1865	No details.	..
1867-8	..	No details.
1872	..	Large lava-flows north-westward; extensive falls of ashes.
1874	Lava.	..
1879	No details.	..
1883	No details.	..
1886	Lava.	..
1891-9	..	Lava-flows.
1892	Large lava-flows southward.	..
1905	..	Large lava-flows reached sea.
1910	Large lava-flows southward.	..
1911	Large destructive lava-flows.	..
1913	..	No details.
1917	Lava.	..
1918	Lava into Valle del Bove.	..
1923	Large lava-flows north-eastward.	..
1926-9	..	Large lava-flows eastward.
1928	Very destructive lava-flows eastward. Worse eruption than those of 1911 and 1923.	..
1938	..	Small lava-flows.
1940	Ashes reported carried as far as Messina.	..



## APPENDIX II

### EARTHQUAKES

#### *The Causes and Nature of Earthquakes*

ITALY lies in an earthquake belt extending from the Atlantic west of Gibraltar through Algeria, Spain, Italy, Greece, Turkey, and Persia to India. This belt coincides with (1) active volcanoes, e.g. in the Canary Islands, southern Italy, and Santorin in the Aegean Sea, and (2) the Alpine-Himalayan zone of mountain-folding.

The association of earthquakes with volcanic activity led for a long time to much confusion about the cause of earthquakes, but it is now known that at least two types of shock occur in Italy. These are connected with the two characteristic features of the earthquake belt, and are found together because this is a major zone of weakness in the earth's crust. One type is closely connected with active and dormant volcanoes, and can be used to predict volcanic eruptions (p. 471). The other type, which is more common in Italy, is not restricted to the volcanic districts and is due to underground movement of the rocks along faults and thrusts (p. 25) in the Alps and Apennines.

In the volcanic type of earthquake the depth of disturbance below the surface is relatively small and may amount to a few thousand feet, whereas in the type connected with mountain-folding or faults the depth is greater, and may be as much as several miles. This explains why the effects of the volcanic type are felt over a much smaller area than the other, since the vibrations from underground have had less space in which to spread out. Violent shocks connected with volcanoes may be scarcely perceptible 20 miles away; earthquakes of the other type may affect the whole country.

The mechanism of an earthquake is similar to the release of a compressed spring. The rocks are under strain, and when the pressure becomes too great they give with a sudden jar along underground planes of weakness. This jar gives rise to vibrations in the rocks, some of which can only be measured by seismographs and other delicate instruments. It also starts on the surface of the ground a train of waves which travel outwards, like ripples on a pond, and diminish in size as they diverge from the most disturbed area. The most disturbed area on the surface is situated immediately above the underground seat of disturbance and is known as the epicentre. The surface waves are responsible for the movement of the ground felt by people during an earthquake, and are the main cause of damage to buildings. Since the greatest intensity of surface movement is near the epicentre, its position can be determined after the earthquake by collecting accounts of damage done at different places. Concentric lines



may then be drawn on a map showing zones of diminishing severity round the epicentre, and a great many such maps have been made for individual Italian earthquakes.

The intensity of the earthquake surface waves is measured by arbitrary scales, similar to the Beaufort Scale used for wind-force. The best known is the Rossi-Forel Scale with intensities I to X, I being for tremors which pass almost unnoticed, and X for those causing general disaster. A similar system, also used in Italy, is known as the Mercalli Scale. There is also the Milne Scale which divides destructive earthquakes alone into three degrees of intensity: I. Slight damage, felt up to about 5 miles from epicentre; II. Serious damage, felt up to radius of about 20 miles; and III. Catastrophic, felt 100 miles away or more.

The more serious earthquakes are sometimes preceded by preliminary tremors, and are frequently followed by a series of after-shocks. For months or even years after the first main shock, earthquakes may continue, usually with diminishing intensity, but in the same district as the main shock.

Personal sensations during an earthquake vary with its intensity and the observer's situation. There is commonly a sudden loss of confidence in the stability of the land, which seems to take on the mobility of water. During a fairly bad shock (II on the Milne Scale) the wave-motion of the earth has often been described as similar to the motion of a ship, and many people have been known to suffer from sea-sickness if the tremors continue for more than a few seconds. In still more violent earthquakes (III on the Milne Scale) a rotary motion of the ground has been described, during which it is difficult to walk or even to stand. During mild tremors the sensation experienced while walking is like missing a step when going upstairs. The sound produced during earthquakes is at least partly due to air waves set up by the vibration of the surface of the ground, and is sometimes heard for great distances. This sound may resemble that of a lorry or train passing some distance away, and does not give the impression of coming from underground.

#### *Seismic Sea Waves and other Secondary Effects*

The list of Italian earthquakes (pp. 482-484) shows that some epicentres are situated beneath the surrounding seas, and that they have occurred in fairly equal numbers off the Tyrrhenian, Ionian, and Adriatic coasts. These shocks often cause waves on the surface of the sea, which travel out in all directions from a point above the epicentre. Unlike the waves which travel over the surface of the land, they are a secondary movement set up by displacement of the sea bed. Those parts of the coast which have been specially affected by these waves are the French-Italian Riviera (excluding Savona and Genoa), the bay of Naples, the gulf of S. Eufemia, both sides of the Straits of Messina together with the whole east coast of Sicily, the bay of Palermo, the gulf of Squillace and part of the



south side of the gulf of Taranto, the gulf of Manfredonia, the coast bordering lakes Lesina and Varano, and the coast south-east of Ancona. Major earthquakes not far inland also produce seismic sea-waves, which often cause great damage.

Large earthquakes have certain secondary results which alter topography, sometimes permanently. Slight changes of level, as after the great Messina earthquake of 1908, can usually be proved only by accurate instruments, but cracks in the ground are one of the most obvious changes. Fissures formed, for instance, during the Calabrian earthquake of 1783 have been described as several hundred yards long. Some tend to leave permanent banks on the surface of the ground, but many soon fill up with earth. Many Italian earthquakes also precipitate landslides, which sometimes add greatly to the damage done by the actual shocks. These surface changes may naturally alter the surface drainage, and hundreds of small lakes, temporary and permanent, have thus been formed, especially in Calabria. The temporary lakes are a special source of danger, as the banks of earth and rock which have impounded them have been known to give way quite suddenly, resulting in disastrous floods.

#### *The Messina Earthquake of 1908*

The most famous of recent Italian earthquakes destroyed Messina on 28 December 1908. Descriptions of this disaster illustrate some of the points mentioned above, and also the secondary effects of seismic sea-waves. Before 1908 Sicily and Calabria had frequently suffered from disastrous earthquakes, and although the Calabrian earthquakes of 1905 and 1907 may have been precursors of the greater disaster of 1908, no immediate preliminary shocks seem to have occurred. The main shocks took place at about 5.30 in the morning, local time, so that many more people were trapped in houses than might otherwise have happened. Some clocks, which were stopped by the earthquake but escaped destruction, stood as silent witness to the time of the major shocks (Plate 153). The main tremors lasted for nearly 40 seconds, but their most destructive phase was much less; and it is said that the city of Messina was obliterated in only 15 seconds.

In addition to Messina, Gazzi, Reggio, and most of the villages along both sides of the straits were entirely destroyed. Damage was general from Pizzo for a distance of about 50 miles southward, and some houses were wrecked as far away as Catanzaro and Caltanissetta. The main shocks were felt more feebly over an enormous area, including the whole of Sicily, Naples, Brindisi, Taranto, Albania, Cefalonia, Zante, and even Malta. Estimates of the death-roll were greatly exaggerated at first, but it has been put reliably at 40,000 to 80,000, and the damage at the equivalent of £22,000,000. It has been estimated that 98 per cent. of the houses in Messina were ruined, and some of the streets were entirely blocked by debris. Although the lower parts of Reggio suffered much more than the



higher parts, this is believed to have been due more to the earth-movement than to the masses of water which came in later from the sea.

The epicentre of this earthquake was beneath the Straits of Messina, and the water displaced by the disturbance of the sea bottom reached its shores in the form of seismic sea-waves from 'a few minutes' to 10 minutes after the main earthquake shocks. The captain of a ship which was in the straits at the time said that the ship seemed to leap out of the water 'as though a mine had exploded underneath her', and immediately afterwards 'the water was heaped up to starboard and rushed furiously towards Messina'. The greatest height of waves on the shore was 38 feet (at S. Alessio), but at most places along both sides of the straits more usual heights were from 6 to 14 feet. Outside the straits the height of the waves was greatly reduced, though tidal gauges were affected as far away as Civitavecchia, southern Sicily, Malta, and most of the Adriatic. The damage done by the waves included the destruction of a railway bridge between Pellaro and Lazzaro, a girder nearly 140 feet long being thrown down. Many houses in low-lying districts were washed away. Much damage was done to harbour works; a block of concrete, said to weigh about 15 tons, which formed part of a jetty at Reggio, was moved about 60 feet from its original position (Plate 154).

After the earthquake, surveys showed that very little permanent change occurred either in the sea bottom along the straits or in Reggio or Messina harbours, although telegraph cables were broken at a number of places. Land surveys were also made in Sicily and Calabria to discover any changes of level resulting from the earthquake, and both sides of the straits were found to be lowered as much as two feet over a distance of a few miles.

### *Frequency of Occurrence*

Minor tremors are frequent in Italy, where there are on an average over 400 every year. If, however, the after-shocks are deducted, the number of shocks sufficient to cause at least slight damage is about 19 during the year, although shocks causing serious damage (intensity II or III on the Milne Scale) only happen at intervals of about 3 to 10 years.

The accompanying list records the more severe Italian earthquakes, but the examples chosen depend to some extent on varying opinions as to their seriousness. As far as possible the earthquakes selected had an intensity III (Milne Scale); the inclusion of minor shocks would have made the list unduly long and complicated. The names of towns and districts refer to the areas of greatest damage, and thus indicate the general position of each epicentre.



*List of Earthquakes. A.D. 63-1939*

<i>Date</i>	<i>Locality</i>
A.D.	
63	Pompeii and Herculaneum.
177	Sicily.
258	Rome.
260 or 261	Vicenza and Padua.
324 or 344	Campania.
326	Sicily.
362, 365, or 369	Sicily and Reggio (Calabria).
365 or 369, July	Padua and Belluno; also affected Lombardy, Perugia, and Umbria.
376	Large areas in Italy and Sicily, and also felt in Egypt, Crete, and Greece.
558, Dec.	Ancona.
659	Sicily.
758	Felt over a wide area.
778	Treviso and other parts of Venetia.
801, Apr. 30	Felt over a wide area.
815	Especially Ravenna, but affected the whole of Italy.
847, June	Benevento and Isernia.
963	Sicily.
1000, March 29	No details for Italy, but has been described as having been felt 'throughout the known world'.
1083, Oct. 18	Catania.
1117, Jan. 3	Felt throughout Lombardy and Venetia. Many cities in ruins.
1169, Feb. 4	Catania and Syracuse, and felt throughout Sicily and Calabria.
1186, middle of Sept.	Probably severe in Italy: described as 'almost universal in Europe'.
1222, Dec. 25	Brescia, and throughout northern Italy.
1223	Manfredonia and Foggia.
1227, early in year	Maritime Alps.
1231, June 1	Latium.
1273	Lucania.
1279, Apr. 30	Especially at Forli, but also felt in Romagna and Marches.
1328, Dec. 1	Umbria.
1346, Feb. 22	Not so severe in Italy as in Egypt; said to have been felt 'throughout the world'.
1348, Jan. 25	Venetia; also felt in many parts of Austria.
1349, Sept. 9 or 10	Aquila and other places in Abruzzi.
1352, Dec. 25	Arezzo and Citta di Castello.
1361, July 17	Northern Apulia.
1448	Naples.
1453, Sept. 28	Florence.
1456, Dec. 5	Brindisi; also felt in Naples and Aquila.
1461, Nov. 27	Aquila and other places in Abruzzi.
1473, May 7	Especially Milan; also Pavia and Piacenza.
1509, Feb. 25	Messina and Reggio (Calabria).
1511, Mar. 26	Udine and many towns in Venetia.
1542, June 13	Florence and Pistoia.



<i>Date</i>	<i>Locality</i>
1542, Dec. 10	Catania and Syracuse; also affected Palermo and Trapani.
1561, July or Aug.	Campania and Lucania.
1564, July 20 to Aug. 5	Maritime Alps, especially the valley of the Vesubia.
1613, Aug. 25	Messina.
1618, Aug. 25	Widespread in the Alps.
1627, July 30	San Severo and other places near M. Gargano.
1638, Mar. 27	Wide areas in Calabria.
1646, May 31	M. Gargano and Foggia.
1654, July 23	District round Sora and Arpino, east of Frosinone.
1659, Nov. 10	Catanzaro.
1661, Mar. 22	Several towns in Romagna.
1670, Jan. 17	Widespread in the Alps, but not extremely severe.
1671, June 20	Chiefly Modena; also affected Verona and Reggio (Emilia).
1672, Apr. 14	Rimini and surrounding country.
1688, Apr. 11	District west of Ravenna.
1688, June 5	Chiefly Benevento; also affected Salerno, Foggia, Lecce, and most of Lucania.
1693, Jan. 11	From Catania to Syracuse.
1694, Sept. 8	Avellino and Lucania generally.
1695, June 11	District east of Lake Bolsena.
1702, Mar. 14	Benevento and the country eastward.
1703, Jan. 14-Feb. 2	Aquila and the country northward.
1706, Nov. 3	Campobasso and southern Abruzzi.
1716, May-June	Violent earthquakes at Algiers also affected Catania and Syracuse.
1732, Nov. 29	Chiefly Ariano and other places south-east of Benevento.
1741, Apr. 24	Chiefly Fabriano (Marches); also Urbino, Fano, and Pesaro.
1743, Feb. 20	Malta and from Messina to Otranto.
1755, Nov. 1	The great Lisbon earthquake felt in Italy; some damage, especially in the Ponza islands.
1755, Dec. 9	Widespread but not disastrous earthquakes affecting the whole of the Alps and regions from Turin and Milan to Naples. Possibly after-shock of the Lisbon earthquake.
1781, June 3	Marches.
1783, Feb.-Mar.	Calabria; also felt from Sicily to Apulia.
1786, Mar. 9 and July 24	Country round Messina; also felt in Calabria.
1789, Sept. 30	Especially Citta di Castello; also destruction at other places east of Arezzo.
1791, Oct. 12	Monteleone (now known as Vibo Valentia), and surrounding parts of Calabria.
1799, July 28	Apennines south-west of Ancona.
1802, May 12	Especially Soncino, between Bergamo and Cremona.
1805, July 26	District between Campobasso and the Matese plateau.
1808, Apr. 2	Alpine valleys of Pellice and Chisone, south-west of Turin.
1818, Feb. 20	Neighbourhood of Etna.
1823, Mar. 5	North coast of Sicily.
1832, Mar. 8	Valley of the Tacina, and the country between Crotona and Catanzaro.



<i>Date</i>	<i>Locality</i>
1835, Oct. 12	Calabria; felt especially around Cosenza.
1836, Apr. 24	Around Cosenza.
1846, Aug. 14	Hills south of Pisa and east of Leghorn.
1851, Aug. 14	Melfi and surrounding places.
1853, Apr. 19	Caposele, and several villages round the upper parts of the rivers Sele and Ofanto.
1856, Oct. 12	Widespread Mediterranean earthquake; especially affected Palermo.
1857, Dec. 16	Salerno, and several parts of Lucania.
1870, Oct. 5	Cosenza and surrounding places.
1875, Mar. 18	Widespread over all northern and central Italy, but nowhere very severe.
1883, July 28	Ischia. Town of Casamicciola destroyed, but damage entirely local.
1891, June 7	Nowhere severe, but felt all over northern Italy, and in Trieste.
1894, Nov. 16	Near Palmi (Calabria); not very severe, but felt over most of Sicily and southern Italy.
1903, May 22	Felt over most of Italy, but apparently nowhere severe.
1904, Feb. 24	Great damage in villages near Avezzano, in Marsica.
1905, Sept. 8	Epicentre near Vibo Valentia. Extremely destructive in southern Calabria; this and other centres continued to be disturbed till 1906.
1907, Oct. 23	Southern Calabria. Widespread damage.
1908, Dec. 28	The great Messina earthquake. Cities of Messina and Reggio destroyed, also nearly all the towns and villages along both sides of the straits. Death-roll 40,000-80,000. Damage estimated at £22,000,000. After-shocks continued probably till 1912.
1915, Jan. 13	Marsica district. Fairly severe, with after-shocks, especially in 1918.
1917, April 26	Near Perugia. Beginning of long series of shocks, none especially severe. Large number of lesser earthquakes in most parts of Italy during 1917.
1919, June 29	North-west of Florence. Started with 3 shocks in one day, followed by after-shocks for years, especially severe in 1920 and 1929.
1920, Sept. 7	North-west of Florence. Especially severe near Fivizzano.
1927, May 25	East of Melfi. 17 shocks in 2 days, but none especially severe. After-shocks till 1930.
1928, Mar. 26	Carnic Alps. After-shocks till Aug. 1929.
1929, Apr. 10	North-west of Florence. 8 shocks in 3 days, with numerous after-shocks till July.
1929, May 11	Modena, specially severe. 4 preliminary earthquakes in 1929; after-shocks continued for over a year.
1930, July 23	North-west of Melfi. Severe.
1930, Oct. 30	Ancona. Severe, followed by 25 further shocks the same day.
1935	Near Etna. Local damage only.
1936, Oct. 18	Belluno; nearly all old buildings damaged. Felt as far away as Milan.



It might seem from the above list that earthquakes have been more frequent in the last two or three centuries than in earlier times, but this apparent change in frequency is probably explained by the deficiency of early records. The opinion has been expressed that earthquakes are increasing in frequency, but there is no real evidence for this.

### *Distribution of Earthquakes*

The distribution of destructive earthquakes, belonging approximately to intensities I to III (Milne Scale), is shown on Fig. 82. Earthquakes are liable to occur in both continental and peninsular Italy, but the areas most affected are from the Abruzzi southward. The volcanic earthquakes centred round Vesuvius, Ischia, Etna, the Lipari islands, and Pantelleria have a high intensity only in small areas. The map, which is a combination of a large number of maps made for separate earthquakes, emphasizes the point, not brought out by the statistics, that some localities are comparatively free from shocks. The areas with most earthquakes in peninsular Italy follow the central ridges of the Apennines from Emilia to Calabria, with outlying patches in the Apuan Alps, near Ravenna, around Gargano, and in south-eastern Sicily. With some exceptions, the relatively free areas are south-eastern Tuscany, Latium, eastern Apulia, and western Sicily. Isolated areas of seismic activity occur in continental Italy along the inner margin of the Alps, especially of the Maritime and Venetian Alps. There are also patches in the Northern Plain, especially near Brescia and north-west of Ravenna. The Central Alps are more free of earthquakes than the Western and Eastern, and in the Northern Plain the area between Turin and Milan has been peculiarly exempt from major shocks.

The opinion has been expressed, but apparently on inadequate data, that severe earthquakes are seldom repeated at or near the same epicentre. If this theory were sound it would be important in predicting where earthquakes are unlikely to occur in future. As shown for Calabria, however, earthquakes are more rather than less liable to recur in the same places, and the same seems to be true of most of the seismic areas of Italy.

### *Practical Applications*

The prevention of earthquakes is impossible, but much can be done to reduce damage and loss of life by taking certain precautions in seismic areas. This can be achieved in two ways: (1) by some kind of prediction of the time and place of earthquakes, and (2) by designing buildings, bridges, and other structures so that damage will be reduced to a minimum.

(1) Earthquakes do not occur at strictly regular intervals, and recent records suggest that they have been more frequent in certain decades than others. Attempts have been made to find out whether this frequency is periodic, and it has been suggested that frequency agrees with the 11-year sun-spot cycle, with certain seasons of the year, and with other periods of time. Both semi-destructive and destructive earthquakes occur somewhat



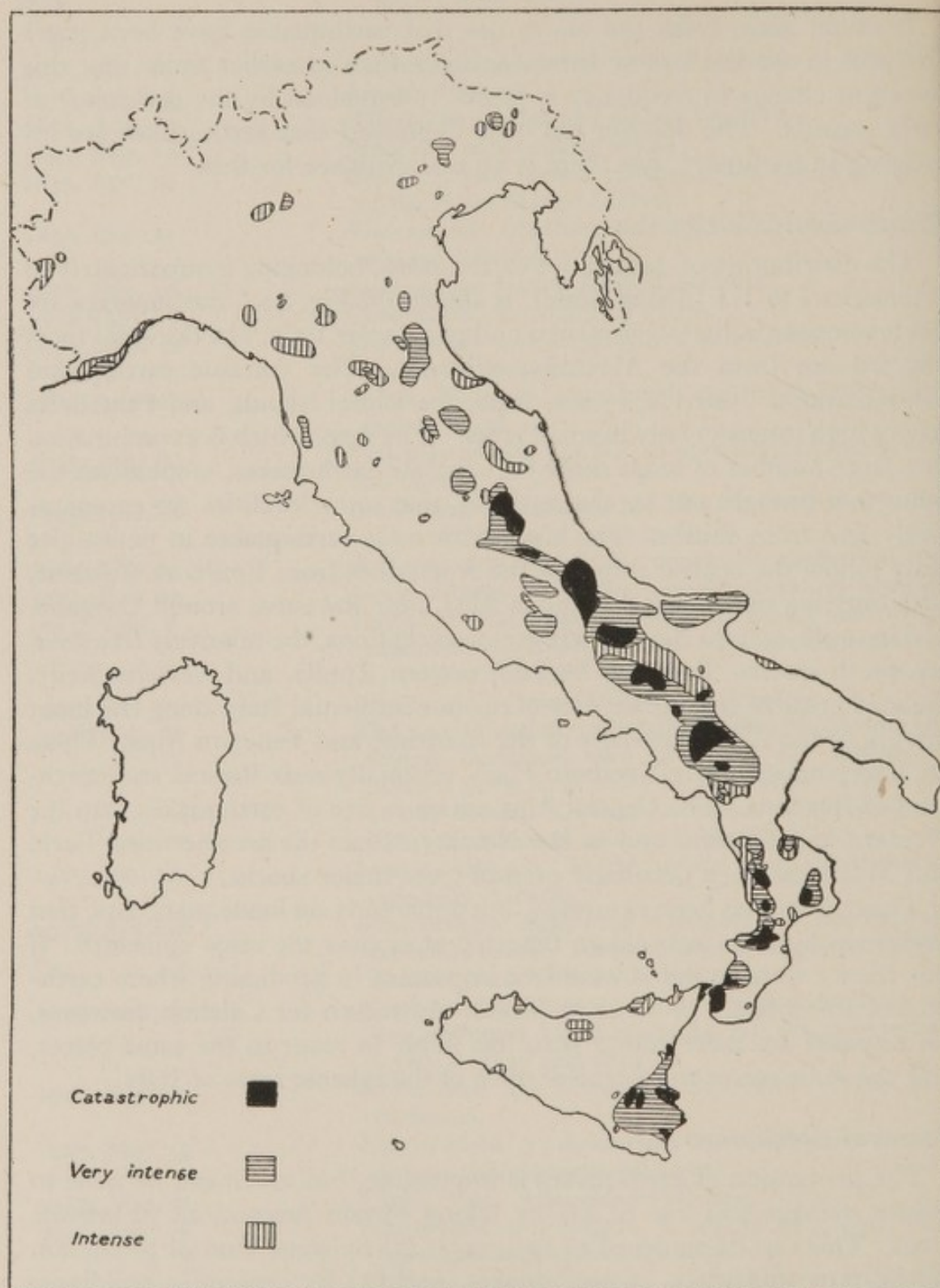


FIG. 82. *Intensity and distribution of earthquakes*



more frequently in years near the time of sun-spot maxima than minima, and in some years, but not in all, shocks seem to be more common at certain seasons. From the practical point of view neither correspondence is regular enough to act as a basis for prediction.

It has been suggested that in Calabria there is a tendency to progress from less to more violent shocks, excluding after-shocks, and that, after the culminating earthquake, pressure seems to be relieved and a period of quiescence to follow. In illustration of this, the earthquakes of 1783 have been quoted, the shock of 5 February being considered as preliminary to the greater one of the following day, which was followed by several quiet decades. In much the same way it has been suggested that if the shocks of 1905 and 1907 are considered as preparing the way for the 1908 earthquake, this might also be followed by quiet for some time in the Calabrian area. Except for volcanic earthquakes connected with Etna, this seems to have been true, at least until 1939.

In parts of Italy it is believed that earthquakes are more frequent at night than during the day. Records show that a great many do occur in the early hours of the morning, although this is not an invariable rule.

Past experience shows that precautions are more necessary in some districts than in others. Disasters may presumably happen in the future anywhere in the country, but the recurrence of epicentres near certain areas of weakness in the rocks has been frequent in the past, and future earthquakes are more likely in these districts. In the absence of preliminary shocks it is, unfortunately, not yet possible to foretell which seismic area will be the next to become active. One other feature of Italian earthquakes which might help in prediction needs further investigation. Records of sea-level at a number of ports show that there was a slight uneven upward warping of a large part of Italy in the years 1899, 1903, and 1908, with a corresponding fall of the land between. Correspondence between the last two years and major earthquakes may be fortuitous, but further work along these lines, like that done in Japan, might lead to important results.

(2) The chief considerations in protecting a building against earthquake shocks are the nature of its foundations, its shape, and the materials used in its construction. The principles underlying the most successful practice in Japan and California have been applied to some extent in Italy, and in Messina after 1908 some measure of safety was enforced by law. New buildings put up according to these principles remained undamaged during a more recent minor earthquake.

In general, firm rock makes a safer foundation than loose sand, gravel, or alluvium, but if rock is not available, the foundations must be as deep as possible. The earthquake waves travelling over the surface of the ground are believed to be relatively shallow. Experiment has shown that this movement is greatly reduced at a depth of 10 feet. Heavy, deep foundations which may reach down below the level of maximum wave movement are



especially safe for large buildings. An apparent exception is seen in some earthquakes in southern Italy, where less damage was done to buildings on the alluvial plains than to those on the surrounding hills. It is probable, however, that the greater damage to the hill villages was not due to the fact that they were on compact rock, but rather that they were built on steep ridges and hill-sides instead of on level ground. Incipient formations of landslides was probably an important factor here.

The best building material is reinforced concrete, built as compactly as possible, and in such a way that the structure can vibrate as a whole. Brick construction is not so good as concrete, because bricks are liable to crush under distortion, whereas good concrete is more elastic. Clay walls are more destructible than brick, especially if capped by a heavy roof. Where reinforced concrete is not used, joists should penetrate at least two-thirds of the width of the wall, or, better still, go right through. It is believed that much of the damage at Messina in 1908 was due to neglect of this principle. Top-heavy copings and chimneys should be avoided, and if brick is the easiest material available, the height of buildings should if possible be restricted to two or three stories. A weakness in design is to have large windows in straight lines with relatively little wall-space between them, and for the same reason the piers of bridges should be solid instead of perforated by arches. Finally, fire is a very real danger in all earthquakes. This is partly because people flee from their houses and are no longer able to cope with outbreaks, and partly because broken electric wiring and gas mains help to cause fires, and broken water mains prevent their extinction.



## APPENDIX III

### 'BADLANDS'

THE distribution of 'badlands' (*calanchi*) is fairly restricted. A special conventional sign is employed to represent them on the large-scale Italian maps (1:25,000 and 1:50,000), but too much reliance should not be placed on it (Plates 28, 99-102).

Occurrences of 'badlands' fall naturally into a small number of groups in which they have important effects on communications. The total area affected in each of the groups is approximately as follows:

Liguria-Piedmont	.	.	.	257	sq. miles
Emilia-Romagna	.	.	.	331	" "
Tuscany	.	.	.	70	" "
Umbria-Latium	.	.	.	43	" "
Marches-Abruzzi	.	.	.	109	" "
Lucania-Calabria	.	.	.	109	" "
Sicily	.	.	.	7	" "
Italy	.	.	.	926	" "

In the Liguria-Piedmont group *calanchi*, not of a very severe type, are widespread, mainly in the basins of short streams draining to the gulf of Genoa (Roia, Polcevera, Valle di Tron), of the Tegli, a tributary of the Magra, and of rivers draining northwards (Belbo, Stura di Demonte, Scrivia, Grue, Curone, Staffora, Schizzola, Coppa, Tidone). The *calanchi* of the Emilia-Romagna group, mostly in Pliocene and Miocene clays, are the most typical and occur in the basins of the Taro, Secchia, Panaro, Reno, Santerno, Lamone, Samoggia, Savino, Savena, Idice, Sillaro, Sellustra, Quaderna, Gaiana, Senio, Sintria, Marzeno, Montone, Savio, Rubicone, Ausa, Marano, Conca, and Foglia. In Tuscany they are frequently accompanied by steep escarpments (*balze*, p. 275) formed in superincumbent sandstones, and are practically confined to the lower Pliocene in the north-east of the Tuscan Upland (basins of the Orcia, Salarco, Foenna, Ombrone, Cecina, Era, Elsa, Roglio, Chiecina, and Arno). In Umbria and north-eastern Latium *calanchi*, mainly in Eocene rocks, affect the valleys of the Nese, Vallaccia, Paglia, Argento, Chiani, Nestore, Frosinone, and also the neighbourhood of Bagnoregio. In the Marches-Abruzzi group they are most common in the Marches (basins of the Foglia, Musone, Chienti, Tronto near Ripaberarda, Ripa, near Ischia, Porciano and Poggio Bretta, Castignano and Offida). In the Abruzzi *calanchi* occur in the Aventino, Foro, Alento, and Moro valleys. In Lucania and Calabria they are in three groups, (1) near the lower Sinni and Agri, (2) in the Pliocene rocks east of the Sila, particularly in the Marchesato, and (3) on the western side of the Aspromonte. The few



calanchi in Sicily are all in the valleys of the fiumare entering the Straits of Messina from the Mi. Peloritani.

*Geology.* 'Badlands' are almost exclusively confined to Tertiary rocks, and in particular to the 'laminated' clay (p. 36), the clay-sands of the Eocene, clays and marls of the Miocene, the white, grey, and blue clays of the lower Pliocene, the yellow sands, conglomerates, and gravels, with interbedded clays, of the upper Pliocene. It is only exceptionally that they are found in younger (Pleistocene) or older (phyllites of Calabria, schists of Sicily) rocks. The rock in which they are developed is invariably clayey or contains thin impermeable bands of clay. 'Badlands' are only found in regions of youthful or rejuvenated topography, i.e. recently folded or uplifted rocks, where the fall to base-level is still steep. They are not as a rule found at very high or very low altitudes. Their mean upper limit is 1,450 feet and mean lower limit 650 feet. In extreme cases, however, they are found up to 4,600 feet and down to 80 feet above sea-level.



## APPENDIX IV

### LANDSLIPS

*Distribution.* The distribution of landslips (*frane*, p. 36) depends upon the conditions determining each of the different types outlined below. Fig. 83 shows the main areas, outside the Alps, in which landslips are comparatively frequent. It also indicates certain areas which are exempt. It will be seen that the former are mostly on the eastern side of the Apennines, especially in the centre and south, and, in Sicily, in the northern highland and western interior. Sardinia is practically free. In the Alps landslips are fewer and tend to be mainly rock falls. The localities most frequently affected are Valle d'Aosta, Val Bregaglia (Chiavenna), and the Cortina district of the Dolomites.

*Types of Landslips.* The landslips are of several distinct types, each with different controlling conditions. Both the predisposing causes, largely geological and topographical, and the immediate occasion, usually attributable to the weather, vary from type to type. There are five prime types (distinguished by Almagia).

(1) Purely superficial soil movements or soil creep on a large scale. This type regularly affects quite large areas (*lame*), but only the surface soil. It may range from a mud torrent, moving with destructive rapidity, to an imperceptible mass-movement, betrayed only by the inclination of trees, the displacement of roads, &c. It is confined to areas of impermeable rock (chiefly Tertiary clay interbedded with sand), the surface layer of which becomes saturated with water. Slips occur after heavy and prolonged rain or with the melting of deep snow. There are considerable areas, especially in the Tertiary clays of the Molise, Lucania, and central Sicily, where this type of soil-slip is a regular and continuous feature of the rainy season.

A typical example of an area of this kind is offered by the system of little valleys forming the basin of the T. Ferrara, a right-bank tributary of the Biferno, including an area of nearly 8 square miles of blue, laminated clays, with thin sandy partings. In winter, after rain, the upper layers of clay are reduced to a slush which flows down the slope, collects in the valleys, and spreads out at their mouths. In summer the dry slopes are either covered with thin grass or remain quite bare.

(2) The second type differs from the first only in degree, being the subsidence of a mass of rock or soil, made over-heavy by infiltration of water, and often loosened by previous frosts. The landslide accomplishes a more definite displacement of a larger mass of rock, and is more sudden and catastrophic. Although there is no continuous movement as in the first type, this type is apt to be periodic in occurrence, since the removal



of a mass of rock exposes the underlying strata to the action of the same agents. This type is found mainly in (a) early Tertiary flysch (saline, pure and laminated clays, clay-shales with sand partings), (b) Pliocene blue clays, (c) phyllites of Calabria, micaschists of north-east Sicily.

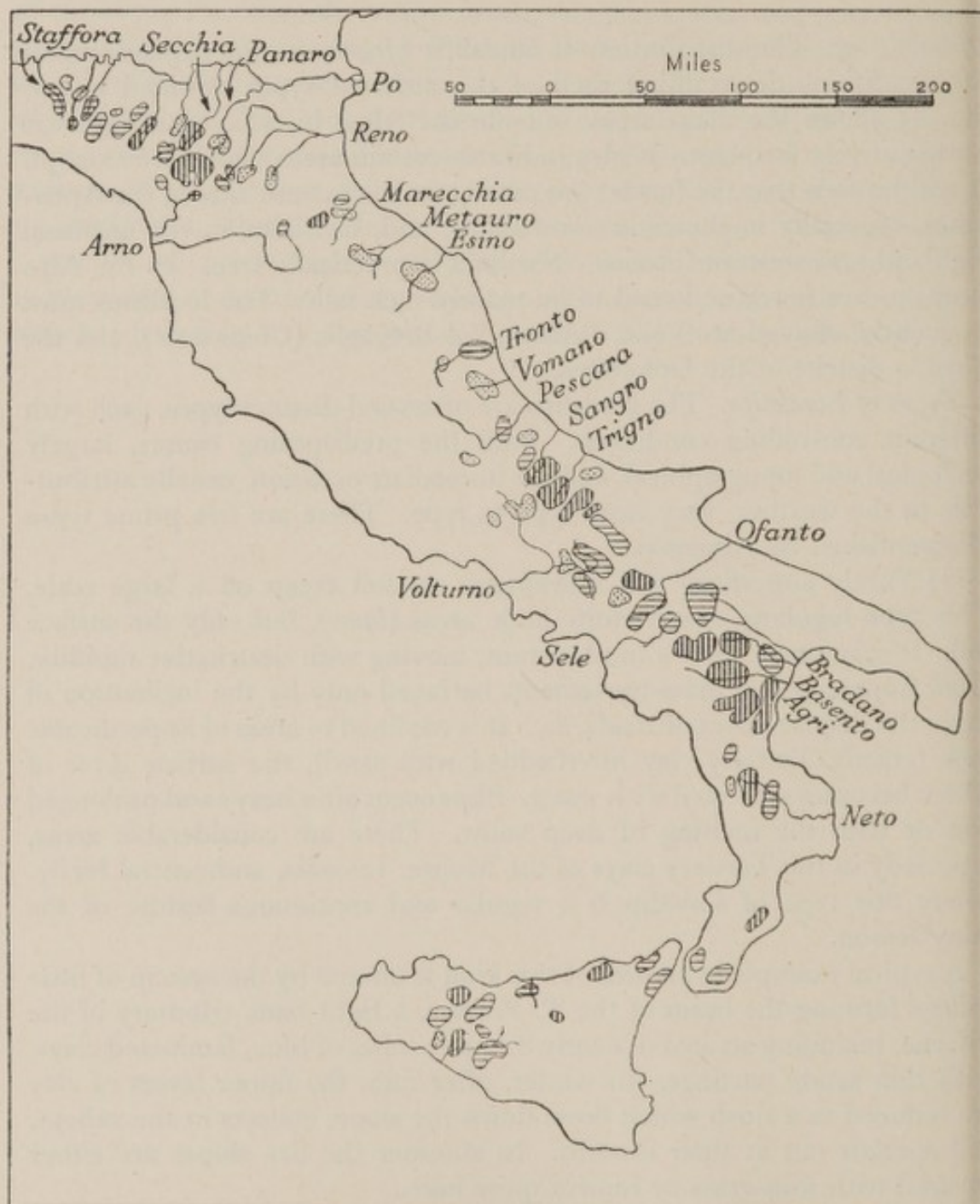


FIG. 83. Landslips: heavier shading denotes areas of greater frequency

An example is found at Brindisi di Montagna, 8 miles east of Potenza, on the steep right bank of the Basento. Here, to the north of the town, on the Basento valley-side, *lame* prevail, but to the west, on the slopes of Serra La Croce, the Valle del Monaco, although suffering also from *lame*,



has periodic landslides of this second type. Small movements take place every year with larger disasters from time to time. The largest of these covered about 150 acres.

(3) The third type, which is responsible for most of the major disasters outside the Alps, differs from the second in that the slip takes place along a bedding-plane. A mass of rock slides downhill along an underlying impervious bed dipping in the same direction as, but less steeply than, the surface of the ground. This process is favoured by the presence, immediately above the slip-plane, of a permeable layer of sand, gravel, or limestone. The water impregnating this layer lubricates the zone of contact between the two and facilitates the movement of the whole superincumbent mass. The rock parts laterally along lines of fissure caused by frost and leaves a precipitous cliff (*balza*). Such landslips are not periodic and are far less predictable than the other types. The necessary interbedding of rock types is found in many parts of the Peninsula and Sicily, and throughout the Tertiary rocks, but particularly in the Eocene flysch, the Pliocene yellow sands and blue clays, and the Miocene saline clays of Sicily.

The landslide at Campomaggiore on the left bank of the Basento, 16 miles to the east of Potenza, is one of the largest examples of this type. On 10 February 1884 the whole area between M. Crispo and the Timpa del Tempo, some 4 square miles made up of yellow sandstones interbedded with clays and shales, began to move slowly downhill. The houses were all badly damaged but not completely destroyed. Some, indeed, merely twisted round and changed their orientation. The road from the station in the bottom of the valley had to be completely reconstructed. The thickness of rock affected was in places 130–160 feet.

(4) Loosening by frost action causes masses of rock to fall, rather than to slide or slip, downhill. The rocks involved are usually hard (granites, limestones, and especially dolomites) and falls are confined to precipitous regions. This type is most frequent in the Alps, but is also common in the Sorrentine peninsula, and occasionally in the Pollino massif. In the Alps snow-slides and avalanches carry much rock with them.

It is only rarely that large masses of rock are involved. The prehistoric slips, however, that dammed back Lake Scanno, in the Sagittario valley (Abruzzi), were of this type. Another example occurred at Amalfi on 22 December 1899, when a mass of dolomitic limestone descended through houses and gardens and damaged the harbour.

(5) The fifth type of landslide is caused by undermining due to running water. Slips occur along the sides of valleys incised in soft clays or sands, capped by a bed of harder rock, such as limestone. They usually produce a typical scarp (*balza*) in the overlying harder rock where it has broken off along a vertical fissure. This type affects the same sort of rocks as the third type, but is frequent also among horizontal or slightly disturbed strata. It is found in the higher Emilian Apennines among sandstone-capped hills, along the Adriatic coast and in Tuscany and Lucania in the Pliocene yellow



sands resting on blue clays, and in Latium among the volcanic tuffs and underlying clays.

A landslide of this type in March 1905 (affecting 85 acres) undermined part of the limestone bed on which the city of Agnone is built. Many other towns similarly situated on hard cappings of rock are threatened in this way, e.g. Orvieto, Volterra.

Landslips of mixed types frequently occur and show features recalling more than one of the above. Combinations of the second and fifth types are most common.

*Geology and Topography.* In the Peninsula and Sicily landslips occur particularly in clays and rocks with large intercalations of clay, mainly of Tertiary age. They are particularly common in (a) the laminated clay and analogous rocks (clay-shales, marls, &c.), mainly Eocene, but sometimes Oligocene or Miocene; (b) the Pliocene blue clays; (c) the Primary phyllites and micascists of Calabria and north-east Sicily; and (d) the Miocene sandy and saline clays of west central Sicily. In the Alps hard rocks (gneiss, crystalline schists, dolomites, &c.) provide the most frequent landslips.

One of the essential conditions in all types of landslide is that there be steep slopes, down which the pull of gravity may be exercised. The slope may be less steep in soft rocks and in the first and second types. Valley-sides will obviously be most affected. Landslips most commonly occur at medium altitudes (1,600–3,300 ft.), but are not uncommon higher up (3,300–4,300 ft.).

*Frequency.* The rocks, the relief, and the hydrography explain the chief conditions of landslips, but the immediate occasions of them are usually due to the weather, i.e. continuous, heavy rain, or the melting of snow (types 1, 2, 3, and 5), and the loosening action of frost and thaw (type 4, and as an accessory in types 1, 2, 3, and 5). Occasionally, perhaps, earthquakes may stimulate movement, but probably not unless there has been some previous lubrication by rain. Road construction, especially along the flanks of hills where it increases the slope above and below the road, occasionally results in slides, but, again, only if the strata have been lubricated. Frost and thaw are of considerable importance only in the Alps. Throughout the Peninsula and Sicily it is rain and melting snow that occasion landslips, which are markedly concentrated within the rainy season. Summer storms may bring them about in the dry season, but this is exceptional. Landslips may, therefore, be expected, in conditions and districts liable to them, to occur normally after particularly heavy and continuous rain, and also after the melting of the snow in the Apennines.

Destructive landslides are not a regular feature anywhere, but small slips are quite common, and those of the first two types described above are often of annual occurrence. Attempts have been made to enumerate the major landslips in historical times, but figures are defective, particularly for the more remote times and for southern Italy. In the nineteenth century



about 16 are known to have occurred in the Italian Alps, 107 major slips in the Northern Apennines and Pre-Apennines, 174 in the Central and Southern Apennines, and 190 (including some smaller ones) in Sicily.

*Effects.* Landslips obviously threaten and damage roads, railways, and buildings. The need to avoid areas liable to them causes unnecessary detours and climbs. In such areas, often referred to as 'frane', settlements and roads tend to be situated on watersheds or ridges, and communications from valley to valley or from valley to ridge are few and difficult. Railways, however, seldom follow ridges, and lines along valleys (e.g. Naples-Foggia) are continually threatened.

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## APPENDIX V

### LAKES

OWING to the large number of small and relatively unimportant lakes, this list includes only those larger than 1 sq. kilometre in area, though exceptions are made in favour of some smaller lakes which have been altered for commercial use (e.g. Lake Fisch) or for others specially well known (e.g. Lake Averno).

In column 2 the river-names refer to the catchment-area in which the lake occurs, not necessarily to the actual river or tributary flowing in or out of the lake.

In Column 3 islands are excluded from the areas of the lakes. A very rough estimate of volume can be obtained by taking the mean depth as half the greatest depth and multiplying by the area.

The second row of figures for lakes which have been artificially enlarged refers either to the dimensions of the lake after alteration, or to the anticipated area following completion.

This list has been mainly compiled from *I Laghi d'Italia* (R. Riccardi), *Bollettino della Reale Societa Geografica Italiana*, Ser. VI, vol. ii (1925), pp. 506-587. This article contains a more complete list of lakes and references up to 1925, and includes data about bathymetrical maps.



## LAKES

497

1 Lake	2 River system	3 Area, sq. miles	4 Height, feet	5 Maximum depth, feet	6 Volume millions, cu. ft.	7 Catchment area, sq. miles	8 Remarks
PIEDMONT							
Fisch or del Toggia	Toce	{ 0.03 0.23 }	7,094 7,139	39 138	{ .. .. }	2.9	Enlargement begun c. 1925.
Kastel . .	Toce	{ 0.14 .. }	7,267 7,291	98 128	{ .. .. }	2.8	To be enlarged (no date).
Schwarz . .	Toce	{ 0.25 0.32 }	8,012 8,041	.. ..	{ .. 48 }	0.6	Enlargement begun c. 1925.
Vannino . .	Toce	{ 0.07 0.19 }	7,064 7,139	.. ..	{ .. 335 }	5.0	Enlarged 1917-1923.
Busin Inferiore .	Toce	{ 0.05 0.13 }	7,779 7,824	.. ..	{ .. 187 }	1.9	Enlarged 1927.
di Co', di Lago, or Devero	Toce	{ 0.08 0.39 }	6,057 6,118	62 138	{ 699 .. }	9.0	Enlarged 1920-1923.
di Mergozzo .	Toce	0.7	643	243	3,142	..	..
Maggiore or Ver- bona	Ticino	81.91	637	1,221	1,309,630	2,393.8	Steamer service: Locarno- Luino-Stresa-Avona. Enlarged 1922.
Gabiet . .	Lys-Dora Baltea	0.11	{ 7,674 7,792 }	49 98	..	1.4	..
d'Orta or Cusio .	Srona-Toce	7.05	951	469	45,643	48.3	Steamer service: Orta- Pella-Omegna.
di Candia . .	Dora Baltea	0.65	743	26	336	2.5	..
di Viverone or d'Azeglio	Dora Baltea	2.23	755	164	4,307	9.5	..
del Moncenisio .	Dora Ri- paria	{ 0.13 1.03 }	6,276 6,302	102 177	{ 635 1,126 }	21.6	Enlarged 1923.
Agnel . .	Beonia- Roia	0.07	{ 7,976 7,988 }	139 162	127	..	Enlarged c. 1925, 2 million cu. m. available for hydro-electric works.



1 Lake	2 River system	3 Area, sq. miles	4 Height, feet	5 Maximum depth, feet	6 Volume millions, cub. ft.	7 Catchment area, sq. miles	8 Remarks
PIEDMONT (cont.)							
Verde del Basto .	Beonia-Roia	{ 0.04 0.05	7,258 7,284	105 131 c.	{ 101 ..	0.7	Enlarged 1922.
Nero del Basto .	Beonia-Roia	{ 0.03 0.04	7,448 7,468	98 118	{ 63 ..	0.4	Enlarged 1916.
Soprano del Basto	Beonia-Roia	{ 0.08 0.09	7,657 7,674	166 182	{ 230 ..	0.9	Enlarged 1915.
Lungo Superiore	Beonia-Roia	{ 0.02 0.05	6,887 6,926	38 78	{ 10 ..	2.6	Enlarged 1915.
Poschiano .	..	1.10	3,150	289	..	..	..
LOMBARDY							
di Lugano or Ceresio	Tresa	19.48	889	945	..	231.3	Steamer services: 1. Por- lezza-Lugano-Porto Ceresio-Ponte Tresa; 2. Lugano-M. Generoso. Enlarged c. 1925.
di Truzzo .	Liro-Mera	{ 0.1 0.71	6,736 6,824	236 304	{ .. 56	3.9	No natural surface outlet. Artificially enlarged.
Pirola .	Mallero- Adda	{ 0.02 0.04	7,493 7,513	..	{ .. 71	0.5	..
di Mezzola .	Mera	3.26	656	226	..	..	..
di Como or Lario.	Adda	56.33	650	1,345	794,250	1,660.2	Level raised 8 in. in 1920, giving reserve vol- ume against winter low- water of 29 million cub. m. Steamer service: 1. Como-Colico; 2. Como- Tavernola-Cernobbio- Carate; 3. Como-Lecco.



LOMBARDY (cont.)	Adda	179	650	112	..	..	..
di Garlate or di Pescarenico	Oglio	{ 0.08 0.13	6,686	..	..	8.5	Enlarged c. 1925.
di Salarno . .	Adda	{ 0.03 0.15	..	..	..	3.2	Enlarged c. 1925.
di Venina . .	Oglio	{ 0.21 0.37	5,853 5,871 5,880	203 312	..	5.6	Enlarged.
d'Arno . .	L. Como	2.21	5,961	37	1,094	..	..
di Annone . .	Bardello-L. Maggiore	5.77	738	85	1,271	..	..
di Varese . .	Lambro		781		5,733	..	..
di Pusiano . .	Acquanera- L. Maggiore	2.03	853	80	2,859	..	..
di Monate . .	Lambro	0.97	873	112	1,599	..	..
d'Alserio . .	L. Varese	0.56	853	26	275	..	..
di Comabbio . .	Oglio	1.39	797	25	587	..	..
d'Iseo or Sebino .		25.28	610	823	268,280	690.4	Steamer service: Lovere- Iseo-Sarnico.
di Endine or di Spinone	Cherio-Oglio	0.82	1,109	33	..	..	..
d'Idro or Eridio .	Chiese	4.20	1,206	400	24,145	..	..
di Garda or Benaco	Sarca- Mincio	142.85	213	1,135	1,777,214	872.6	Steamer service: Desen- zano-Riva-Peschiera.
di Mantova Su- periore	Mincio	1.72	59	39	..	..	..
di MantovadiMezzo	Mincio	1.05	49	12.5	..	..	..
di Mantova In- feriore	Mincio	0.65	49	13.5	..	..	..
VENEZIA TRIDEN- TINA	Adige	0.58	682	23	..	..	..
di Caldaro or Kal- terersee							



1 Lake	2 River system	3 Area, sq. miles	4 Height, feet	5 Maximum depth, feet	6 Volume millions, cu. ft.	7 Catchment area, sq. miles	8 Remarks
VENEZIA TRIDEN- TINA (cont.)							
di Molveno .	Sarca	1.26	2,694	389	5,690	..	..
di Cavedine .	Sarca	0.39	794	164	565	..	..
di Levico .	Brenta	0.41	1,444	118	706	..	..
di Caldonazzo .	Brenta	2.07	1,473	159	4,956	..	..
di Ledro .	Ponale- L. Garda	0.84	2,149	155	2,513	..	..
VENEZIA EUGANEA and							
VENEZIA GIULIA di Cavazzo or di Alesso	Tagliamento	0.67	640	127	755	..	..
di S. Croce .	Rai-Piave	1.96 { 3.01	1,250 1,266	115 144	3,546 4,942	98.1 ..	Expected enlargement. No natural surface outlet. Enlarged 1925 to allow 3 million cu. m. to be used for industry. Reclaimed.
Morto .	..	0.29	906	183	836	..	
ISTRIA							
d'Arsa or di Cepich or di Sissol	Arsa	2.56	79	10	..	..	
ISOLA CHERSO							
di Vrana .	..	2.02	53	256	..	..	No natural surface outlet.
LIGURIA and EMILIA							
Ballano .	Enza	0.03 ..	4,387 4,422	66 102	24 ..	0.3	Enlarged.
Verde di Val Cedra	Enza	0.02 ..	4,911 4,964	79 131	23 ..	0.46	Enlarged c. 1925.



TUSCANY and THE MARCHES							LAKES			
di Massaciucoli .	..	2.66	3	10	..	..	..	Artificial outlet under-	..	
di Montepulciano .	Chiana-Arno	0.73	817	..	..	..	..	ground. Steamer service:	..	
di Chiusi .	Chiana-Arno	1.47	824	..	..	..	..	Castiglione-Passignano.	..	
Stagno di Orbetello	..	10.13	0	5	..	..	..		..	
Stagno di Burano .	..	0.79	0	..	..	..	..		..	
UMBRIA										
Trasimeno or di	..	46.4	850	20	113.5	..	..	Artificial outlet under-	..	
Perugia								ground. Steamer service:	..	
di Piediluco .	Velino	0.61	1,206	64	27.8	602	..	Castiglione-Passignano.	..	
LATIUM										
di Bolsena .	Marta	44.11	1,001	479	..	314,947	..		..	
di Ripa Sottile .	Velino	0.41	1,221	25	17.9	142	..		..	
di Vico or Cimino	Vicano	4.67	1,663	162	16.2	9,466	..		..	
di Martignano or	..	1.73	679	177	2.4	2,513	..	No natural surface outlet.	..	
Alseantino										
di Bracciano or	Arrone	22.19	538	525	57.53	174,735	..		..	
Sabatino										
Regina .	..	1.95	226	98	..	..	..	No natural surface outlet.	..	
di Albano or di	..	2.33	961	558	3.8	16,388	..	No natural surface outlet.	..	
Castel Gandolfo										
di Nemi .	..	0.65	1,043	112	4.1	1,147	..	No natural surface outlet.	..	
di Fogliano .	..	2.57	3	..	..	..	..	Coastal lagoon.	..	
di Paola .	..	1.51	3	3	..	..	..	Coastal lagoon.	..	
di Canterno .	..	? 0.37	1,765	98	..	..	..	No natural surface outlet.	..	
ABRUZZI and MOLISE								Level of lake very	..	
								variable.	..	
di Scanno .	Sagittario- Pescara	0.36	3,051	102 to 106	..	638 to 678	..	Level of lake variable.	..	



1 <i>Lake</i>	2 <i>River system</i>	3 <i>Area, sq. miles</i>	4 <i>Height, feet</i>	5 <i>Maximum depth, feet</i>	6 <i>Volume millions, cub. ft.</i>	7 <i>Catchment area, sq. miles</i>	8 <i>Remarks</i>
<b>CAMPANIA</b>							
del Matese . .	..	{ 1.16 (average) 1.991	3,304	9.5 to 19.7 c. 32.8	.. } 551	15.8	No natural surface outlet. Enlarged 1924 by closing subterranean outlets.
di Fondi . .	..	1.77	3.3	..	..	..	Coastal lagoon.
di Patria . .	..	0.73	c. 1	..	..	..	Coastal lagoon.
del Fusaro . .	..	0.38	c. 3.3	..	..	..	Coastal lagoon.
di Averno or Can- nito	..	0.21	35	113	428	..	No natural surface outlet.
<b>APULIA</b>							
di Lesina . .	..	19.83	0	5	..	..	Coastal lagoon.
di Varano . .	..	23.36	0	18	..	..	Coastal lagoon.
Salso . .	..	1.86	0	..	..	..	Coastal lagoon.
Salpi . .	..	22.92	0	3	..	..	Converted into salt-pans.
<b>LUCANIA</b>							
Grande di Montic- chio	Ofanto	0.16	2,133	115	122	..	..
<b>SICILY</b>							
di Pergusa . .	..	0.71	2,211	15	205	2.3	No natural surface outlet.
di Lentini or Bi- viere	S. Leonardo	5.0	49	5	..	..	Reclaimed.



## APPENDIX VI

### PRINCIPAL RIVERS

*Columns 5, 6, and 7.* The width and depth (columns 5 and 6) refer to normal low water. As the figures in column 7 show the rise from ordinary level to flood level, the addition of the figures in columns 6 and 7 give the approximate depth during flood. All rivers vary in width and depth at places quite close together, and therefore the figures given are very approximate.

*Column 8.* The figures refer to the maximum velocity of the surface current. As the velocity changes from place to place, it is unsafe to estimate velocities at places far distant from those mentioned in column 4. As a rough guide, a current of 1.5 feet per second is approximately 1 mile per hour.

*Columns 9, 10, and 11.* Authorities differ over these figures, especially for well-known rivers like the Po. These differences are due to the number of observations included, which particularly affect the maximum figure. Those rivers with '0' for their minimum discharge are dry at low water, but at such times a river bed, though consisting mainly of spreads of dry shingle, may also have pools of water here and there. Figures of discharge have been converted from cubic metres per second; this accounts for the frequent occurrence of 35, 71, &c. (1 and 2 cu. m.).



1 River	2 Approx. Length, miles	3 Approx. Catchment area, sq. miles	4 Place	5 Min. Width, ft.	6 Min. Depth, ft.	7 Rise in flood, ft.	8 Max. Surface current, ft. per sec.	9 Discharge, cu. ft. per sec.		
								Min.	Max.	Mean
RIVER PO										
Po	417	26,788	Moncalieri	..	..	..	..	318	34,400	2,680
"			From Casale Monferrato to the delta	650	6	20	..	..	..	..
"			Piacenza	..	..	..	..	11,100	394,500	34,100
"			Casalmaggiore	..	..	..	..	10,590	350,000	44,100
"			S. Nicolo	..	..	..	..	12,050	344,500	48,400
"			S. Benedetto	..	..	..	..	14,600	322,000	50,500
"			Pontelagoscuro	..	..	..	..	13,400	312,000	54,300
ALPINE TRIBUTARIES OF THE PO										
Chisone	c. 49	..	Fenestrelle	..	..	..	..	18	1,160	106
Dora Riparia	77	475	Oulx	..	..	..	..	35	2,260	212
"			Avigliana	..	..	..	..	318	3,530	670
Bardonecchia	..	..	Oulx	..	..	..	..	35	1,640	212
Stura di Lanzo	c. 41	..	Germagnano	..	..	..	..	106	10,700	776
Orco	c. 50	..	Pont Canavese	..	..	..	..	70	8,725	740
Dora Baltea	99	1,669	Pré S. Didier	..	..	..	..	35	3,425	740
"			Ivrea	..	..	..	..	706	30,400	3,740
Lys	..	..	Gressoney	..	..	..	..	14	990	141
Sesia	86	1,127	Piode	..	..	..	..	28	8,750	247
"			Borgosesia	..	..	..	..	106	33,450	1,020
"			Vercelli	..	..	..	..	106	31,150	2,080
Ticino	154	2,791	Bellinzona (Switz.)	..	..	..	..	388	38,100	2,390
"			Sesto Calende	..	..	..	..	1,235	75,050	11,050
"			From Sesto to Tornavento	200	c. 2	10	c. 10	..	..	..







1	2	3	4	5	6	7	8	9	10	11
River	Approx. Length, miles	Approx. Catchment area, sq. miles	Place	Min. Width, ft.	Min. Depth, ft.	Rise in flood, ft.	Max. Surface current, ft. per sec.	Min.	Max.	Mean
VENETIAN RIVERS (cont.)										
Rienza	..	..	Chienes	..	..	..	..	353	6,950	1,310
Gadera	..	..	Rina	..	..	..	..	71	2,080	318
Isarco	c. 55	..	Bressanone	..	..	..	..	106	3,840	775
"			Ponte all'Isarco	..	..	..	..	740	10,880	2,790
"			Bolzano	100	..	..	..	..	..	..
Talvera	..	..	Campolasta	..	..	..	..	71	1,841	258
Travignolo	..	..	Predazzo	..	..	..	..	12	1,940	106
Avisio	c. 51	..	Vigo di Fassa	..	..	..	..	35	1,520	212
"			Capriana	..	..	..	..	106	3,740	565
"			Cembra	..	..	..	..	176	7,840	740
Valsura	..	..	Lana	..	..	..	..	35	1,590	247
Noce	c. 47	..	Fucine	..	..	..	..	71	1,700	388
Gua	..	..	Cologna Veneta	..	..	..	..	35	8,000	176
Bacchiglione	69	618	Saccolongo	130	4	7	2.5	460	8,500	1,060
Brenta	108	892	Levico	..	..	..	..	35	211	73
"			Primolano	..	..	..	..	35	1,450	282
"			Bassano	..	..	..	..	495	23,800	2,330
"			Between Piazzola and Limena	185	3	4	1.5	..	..	..
Cismon	..	..	Arsie	..	..	..	..	176	4,240	740
Sile	60	..	Treviso to mouth	65	5	5	1.75	..	..	..
Piave	137	1,583	Lozzo Cadore	..	..	..	..	247	6,600	740
"			Vidor	..	..	..	..	885	42,400	3,460
"			From Zenson to mouth	230	16	..	6.5	..	..	..
Boite	70	..	Valle di Cadore	..	..	..	..	106	1,310	353
Livenza	32	..	Sacile	200	6.5	..	6	247	2,260	565
Lemene				40	5	6	6	..	..	..



Tagliamento	106	1,000	Villa Santina	..	..	..	..	176	12,400	1,060
"	c. 22	..	Latisana	300	8	..	..	353	60,000	2,300
Corno	15	..	Palazzolo	165	16	..	..	845	2,330	1,305
Ausa	14	..		65	8	..	..	..	..	..
Isonzo	84	..		100	10	..	..	..	..	..
"		1,266	Saga	..	..	..	..	106	10,230	1,060
Idria	c. 35	..	Canale d'Isonzo	..	..	..	..	565	35,800	3,280
			Zelin	..	..	..	..	106	10,760	670
ISTRIAN RIVERS										
Timavo (superiore)	..	..	S. Canziano	..	..	..	..	35	..	..
Quieto	c. 33	..	Montona	..	..	..	..	12	1,590	247
RIGHT-BANK TRIBUTARIES OF THE PO										
Varaita	c. 53	..	Sampeyre	..	..	..	..	35	1,690	212
Tanaro	171	3,083	Ormea	..	..	..	..	35	2,300	212
"			Clavesana	..	..	..	..	71	10,500	1,165
"			Govone	..	..	..	..	71	15,800	1,800
"			Alessandria	..	..	..	..	106	96,600	2,650
"			Alessandria below mouth of	..	..	..	..	282	56,500	4,200
			Bormida	..	..	..	..			
Bormida	c. 96	..	Alessandria	..	..	..	..	35	47,500	1,200
Scivia	56	422	Busalla	..	..	..	..	0	7,000	212
"			Serravalle	..	..	..	..	35	16,250	565
Trebbia	71	422	Rovigno	..	..	..	..	35	12,000	353
"			Corte Brugnatella	..	..	..	..	35	32,200	812
Taro	93	804	Ostia	..	..	..	..	35	13,500	635
"			Noceto	..	..	..	..	18	8,900	1,100
"			Parma	..	..	..	..	0	10,450	388
Parma	72	278	S. Ilario	..	..	..	..	0	17,300	424
Enza	57	388	Bastiglia	..	..	..	..	0	13,800	775
Secchia	98	483	Camposanto	100	6	23	..	0	17,300	635
Panaro	103	885	Bondeno	..	..	..	..	..	..	..
"				150	3	11	1.5	..	..	..



1	2	3	4	5	6	7	8	9			10	11
River	Approx. Length, miles	Approx. Catchment area, sq. miles	Place	Min. Width, ft.	Min. Depth, ft.	Rise in flood, ft.	Max. Surface current, ft. per sec.	Min.	Max.	Mean	Discharge, cu. ft. per sec.	
RIVERS TO THE TYRRHENIAN COAST												
Roia	34	..	Tenda	..	..	..	..	18	3,060	142	..	
Nervia	18	..	Dolceacqua	..	..	..	..	0	2,120	71	..	
Taggia or Ar- gentina	19	..	Badalucco	..	..	..	..	0	2,755	141	..	
Arroschia	c. 25	..	Borghetto	..	..	..	..	0	8,600	141	..	
Letimbro	c. 10	..	Santuario	..	..	..	..	0	1,590	35	..	
Bisagno	c. 19	..	Bavari	..	..	..	..	0	2,580	35	..	
Lavagna	c. 22	..	Coreglia	..	..	..	..	0	6,800	212	..	
Sturla	..	..	Mezzanego	..	..	..	..	0	3,065	176	..	
Magra	40	584	Tresana	..	..	..	..	106	23,000	1,550	..	
Vara	..	..	Borghetto de Vara	..	..	..	..	35	15,900	670	..	
Bagnone	..	..	Bagnone	..	..	..	..	0	2,010	106	..	
Serchio	68	542	Borgo a Mozzano	..	..	..	..	176	18,700	1,620	..	
Arno	154	3,260	Subbiano	..	..	..	..	0	8,700	530	..	
"	..	..	Pontassieve	..	..	..	..	35	32,100	1,800	..	
"	..	..	From Florence to mouth	330	5	10	2	..	..	..	..	
"	..	..	Below mouth of T. Ombrone	..	..	..	..	35	52,800	2,400	..	
Chiana	..	..	Cascina	..	..	..	..	71	72,700	3,490	..	
Era	..	..	Arezzo	..	..	..	..	0	10,900	282	..	
Sieve	c. 40	..	Capannoli	..	..	..	..	0	8,650	141	..	
Cecina	46	282	Contea	..	..	..	..	0	11,900	4,940	..	
Ombrone	103	1,622	Buonconvento	..	..	..	..	..	..	..	..	
"	..	..	Paganico	..	..	..	..	0	15,900	246	..	
Orcia	..	..	M. Amiata Station	..	..	..	..	35	33,600	1,020	..	
Merse	..	..	Monte Pescini	..	..	..	..	0	8,350	176	..	
	..	..		..	..	..	..	35	5,900	212	..	



Fiora	50	329	Ponte S. Pietro	..	..	35	5,900	282
Marta	c. 30	..	Tarquina	..	..	35	3,320	212
Tiber (Tevere)	250	6,645	Citta di Castello	..	..	35	15,250	530
"			Perugia	..	..	35	22,200	917
"			Ponte Nuovo	..	..	106	29,800	1,660
"			Baschi	..	..	176	37,000	2,440
"			Otricoli	..	..	2,400	68,800	6,270
"			Rome	240	4	3,600	69,500	7,720
"			Bettونا	..	..	35	6,450	353
Topino	..	..	Castelsantangelo	..	..	71	176	106
Nera	78	1,575	Castelvechio	..	..	176	670	318
"			Vallo di Nera	..	..	565	2,330	740
"			Ferentillo	..	..	740	2,470	990
"			Terni	c. 80	..	1,550	7,815	2,939
Velino	c. 48	903	Marianitto	..	..	0	600	35
"			Cittaducale	..	..	0	148	106
"			S. Francesco	..	..	1,130	8,700	1,620
Aniene	62	546	Subiaco	..	..	106	1,550	282
"			Lunghezza Station	..	..	495	12,700	1,060
Chiani	..	..	Cantone	..	..	0	7,500	212
Paglia	..	..	Orvieto	..	..	0	9,450	388
Treja	..	..	Civita Castellana	..	..	71	3,880	176
Liri	77	..	Drainage from Fucino basin	..	..	0	1,160	176
"			Borgo Liri	..	..	141	635	388
"			Sora	..	..	141	5,570	460
"			Fontana Liri	..	..	282	3,740	706
Garigliano + Liri	104	1,938	Last 5 miles of course	130	6	..	..	..
Melfa	..	..	Atina	..	..	0	5,750	106
Volturno	109	2,193	Capua	..	..	776	45,000	2,900
Sele	46	1,226	Caposele	..	..	106	247	..
"			Eboli	..	..	176	37,000	1,620
"			Albanella Station	..	..	600	32,800	2,220



1 <i>River</i>	2 <i>Approx. Length, miles</i>	3 <i>Approx. Catchment area, sq. miles</i>	4 <i>Place</i>	5 <i>Min. Width, ft.</i>	6 <i>Min. Depth, ft.</i>	7 <i>Rise in flood, ft.</i>	8 <i>Max. Surface current, ft. per sec.</i>	9 <i>Discharge, cu. ft. per sec.</i>		11
								Min.	Max.	
RIVERS TO THE TYRRHENIAN COAST ( <i>cont.</i> )										
Tanagro	<i>c.</i> 55	..	Polla	..	..	..	..	35	10,000	318
Calore (Lucania)	..	..	Altavilla	..	..	..	..	71	36,800	882
Savuto	<i>c.</i> 35	..	Parenti	..	..	..	..	0	882	71
Mesima	<i>c.</i> 31	..	..	..	..	..	..	..	..	..
Metramo	..	..	Feroleto della Chiesa	..	..	..	..	0	458	35
RIVERS TO THE IONIAN COAST										
Neto	<i>c.</i> 50	..	..	..	..	..	..	..	..	..
Arvo	..	..	Below L. Arvo	..	..	..	..	0	495	71
Crati	55	942	Terranova di Sibari	..	..	..	..	0	16,350	920
Esaro	<i>c.</i> 35	..	Spezzano Albanese Station	..	..	..	..	0	5,540	353
Sinni	58	550	Masseria Acinapura	..	..	..	..	0	9,400	212
Agri	69.	648	Paterno	..	..	..	..	35	2,120	141
"	..	..	Grumento	..	..	..	..	35	9,750	353
Basento	93	582	Pignola Station	..	..	..	..	0	2,260	35
"	..	..	Campomaggiore Station	..	..	..	..	0	26,400	282
Bradano	87	1,056	Irsina	..	..	..	..	0	5,540	106
"	..	..	Ponte S. Giuliano	..	..	..	..	0	45,200	388
RIVERS TO THE ADRIATIC COAST OF PENINSULAR ITALY										
Ofanto	90	1,067	Ponte S. Venere	..	..	..	..	0	10,200	282
Cervaro	..	..	Ponte della Madonna	..	..	..	..	0	7,280	106
Fortore	56	651	..	..	..	..	..	..	..	..
Biferno	53	506	Lucito	..	..	..	..	71	6,300	388
Trigno	52	463	Celenza	..	..	..	..	0	2,580	212







1	2	3	4	5	6	7	8	9	10	11
River	Approx. Length, miles	Approx. Catchment area, sq. miles	Place	Min. Width, ft.	Min. Depth, ft.	Rise in flood, ft.	Max. Surface current, ft. per sec.	Min.	Max.	Mean
RIVERS TO THE ADRIATIC COAST OF PENINSULAR ITALY (cont.)										
Ronco <sup>1</sup>	49	441	Meldola	..	..	..	..	0	5,900	353
Montone <sup>1</sup>	56		Faenza	..	..	..	..	..	..	..
Lamone	62	226	Pontepetri	..	..	..	..	0	4,020	176
Reno	137	1,811	Porretta Terma	..	..	..	..	0	1,484	71
"			Praduro e Sasso	..	..	..	..	0	3,780	141
"			Lavezzola	..	..	..	..	35	19,250	915
"			Vado	..	..	..	..	0	15,500	1,200
Setta	..	..	Budrio	..	..	..	..	0	1,800	141
Idice	..	..	Moraduccio	..	..	..	..	0	8,050	212
Santerno	62	178	Imola	..	..	..	..	0	21,190	258
"				..	..	..	..	0	28,200	388
SICILIAN RIVERS										
S. Leonardo	c. 32	..	Ponte S. Giuseppe Termini Imerese	..	..	..	..	0	6,000	71
"			Villagrazia	..	..	..	..	0	9,900	141
Oreto	c. 14	..	Montevago	..	..	..	..	0	4,550	71
Belice	c. 47	..	L. di Piana de' Greci	..	..	..	..	4	50,000	77
Belice destro	..	..	Palazzo Adriano	..	..	..	..	0	5,650	14
Verdura	c. 30	..	Junction of Gallo d'Oro	..	..	..	..	0	1,865	35
Platani	c. 60	..	Marianopoli Station	..	..	..	..	0	10,230	212
Belici	..	..	Capodarso	..	..	..	..	0	2,940	71
Salso or Imera meridionale	c. 80	818		..	..	..	..	0	10,400	141
Simeto	71	707	Ponte di Maccarone Motta Station	..	..	..	..	0	13,800	318
"				..	..	..	..	35	38,200	635

<sup>1</sup> Combined to form the Fiumi Uniti.



# APPENDIX VII

## CLIMATIC STATISTICS

TABLE I. *Frequency of Wind Direction (%)*

	N.	NE.	E.	SE.	S.	SW.	W.	NW.	Calm	Mean velocity (m.p.h.)
ISTRIA										
Trieste. 85 ft. 1883-1910										
January . . .	1	33	22	11	2	3	5	3	20	13.0
February . . .	1	31	21	12	1	4	5	5	20	10.7
March . . .	1	27	18	14	3	5	8	6	18	9.4
April . . .	2	21	19	13	2	6	10	10	17	7.2
May . . .	2	19	16	14	2	10	10	10	17	6.5
June . . .	2	16	18	13	3	9	11	10	18	5.8
July . . .	2	18	18	11	2	8	13	9	19	6.3
August . . .	2	21	21	11	1	5	13	9	17	6.9
September . . .	1	23	24	15	2	5	9	7	14	7.8
October . . .	1	26	23	18	2	6	6	5	13	8.9
November . . .	1	32	23	15	2	4	4	3	16	9.6
December . . .	1	31	24	16	2	4	3	3	16	11.2
NORTHERN PLAIN, <i>West</i>										
Milan. 482 ft. 1891-1900										
January . . .	10	12	10	10	4	16	22	16	—	2.9
February . . .	7	10	11	16	5	14	22	15	—	3.8
March . . .	9	10	13	24	5	14	16	9	—	4.3
April . . .	8	9	15	27	7	14	13	7	—	4.7
May . . .	7	10	11	23	8	21	11	9	—	4.5
June . . .	5	8	11	23	8	23	15	7	—	4.5
July . . .	4	8	14	25	10	19	12	8	—	4.3
August . . .	7	10	16	27	7	15	10	8	—	4.0
September . . .	5	10	16	29	8	12	11	9	—	3.6
October . . .	7	14	15	23	6	13	14	8	—	3.4
November . . .	8	13	14	15	5	13	21	11	—	2.7
December . . .	9	11	8	10	3	18	26	15	—	3.1
NORTHERN PLAIN, <i>East</i>										
Venice. 82 ft. 40-41 years										
January . . .	26	25	5	2	4	8	8	15	7	6
February . . .	21	24	9	9	9	8	5	9	6	6
March . . .	14	23	13	19	12	7	2	5	5	7
April . . .	10	19	16	26	14	6	2	5	2	8
May . . .	9	16	14	27	18	8	1	4	3	6
June . . .	8	12	12	31	19	8	3	5	2	7
July . . .	10	14	13	32	16	6	3	4	2	7
August . . .	13	19	12	26	16	4	2	5	3	7
September . . .	19	21	12	19	13	5	2	5	4	7
October . . .	24	23	9	11	12	8	2	6	5	7
November . . .	28	25	4	4	6	9	7	12	5	7
December . . .	32	20	4	2	3	10	7	17	5	6



TABLE I. *Frequency of Wind Direction (%) (cont.)*

	N.	NE.	E.	SE.	S.	SW.	W.	NW.	Calm	Mean velocity (m.p.h.)
<b>THE WEST OF THE PENINSULA</b>										
<i>Riviera</i>										
S. Remo. 7 ft. 1891-1900										
January . .	17	20	9	6	11	15	8	14	—	—
February . .	20	15	8	4	9	14	12	18	—	—
March . .	14	15	11	5	9	18	10	18	—	—
April . .	15	14	13	11	7	19	10	11	—	—
May . .	12	16	8	13	12	21	9	9	—	—
June . .	10	6	17	13	11	26	10	7	—	—
July . .	12	7	17	13	5	26	14	6	—	—
August . .	13	7	7	11	6	26	17	13	—	—
September . .	15	6	11	9	4	27	15	13	—	—
October . .	23	11	13	5	2	20	16	10	—	—
November . .	23	16	16	5	3	17	10	10	—	—
December . .	25	14	12	3	6	19	9	12	—	—
<i>Pre-Apennines</i>										
Leghorn. 79 ft. 1891-1900										
January . .	5	54	18	3	5	5	8	2	—	—
February . .	5	34	14	3	9	11	17	7	—	—
March . .	3	28	12	3	11	15	20	8	—	—
April . .	5	22	9	3	11	14	25	11	—	—
May . .	5	19	6	3	8	15	27	17	—	—
June . .	5	11	3	2	11	17	37	14	—	—
July . .	6	12	4	1	9	17	36	15	—	—
August . .	6	17	3	1	8	14	36	15	—	—
September . .	4	23	6	2	9	16	30	10	—	—
October . .	4	32	11	4	12	13	16	8	—	—
November . .	3	55	17	3	7	6	6	3	—	—
December . .	5	60	15	3	4	4	7	2	—	—
Rome. 208 ft. 1862-1910										
January . .	57	8	6	5	15	4	4	1	—	5.1
February . .	44	5	4	3	19	13	9	3	—	4.7
March . .	33	5	5	4	19	18	14	2	—	5.8
April . .	28	4	3	3	18	21	20	3	—	4.9
May . .	24	4	3	3	17	25	20	4	—	5.1
June . .	19	5	2	3	14	33	19	4	—	5.1
July . .	15	6	1	3	15	38	17	5	—	5.4
August . .	25	7	1	2	13	28	21	3	—	5.1
September . .	26	9	2	3	16	24	16	2	—	4.7
October . .	36	6	4	3	20	15	13	3	—	4.7
November . .	49	8	4	4	16	9	6	4	—	5
December . .	61	7	6	4	13	4	3	2	—	5.4



TABLE 1. *Frequency of Wind Direction (%) (cont.)*

	N.	NE.	E.	SE.	S.	SW.	W.	NW.	Calm	Mean velocity (m.p.h.)
<i>Calabria</i>										
Tropea. 169 ft. 1891-1900										
January . . .	4	6	11	19	14	23	13	10	—	—
February . . .	5	9	8	6	14	18	17	13	—	—
March . . .	7	11	9	11	10	19	18	15	—	—
April . . .	7	15	9	7	7	18	23	14	—	—
May . . .	9	17	9	4	4	18	24	15	—	—
June . . .	10	16	11	5	2	17	20	19	—	—
July . . .	11	14	7	5	4	17	25	17	—	—
August . . .	9	16	3	3	4	15	25	25	—	—
September . . .	7	19	10	7	5	16	19	17	—	—
October . . .	3	10	19	15	13	19	14	7	—	—
November . . .	2	9	16	24	18	14	11	6	—	—
December . . .	5	7	9	17	20	20	14	8	—	—
<i>THE EAST OF THE PENINSULA</i>										
<i>Adriatic Coastland</i>										
Pesaro. 45 ft. 1879-1898										
January . . .	16	10	3	2	3	13	21	32	—	—
February . . .	17	14	4	6	5	11	15	28	—	—
March . . .	14	18	11	10	7	16	12	12	—	—
April . . .	11	15	18	16	8	14	7	11	—	—
May . . .	13	14	18	15	7	14	8	11	—	—
June . . .	10	14	20	13	6	16	11	10	—	—
July . . .	11	16	20	15	6	14	8	10	—	—
August . . .	12	15	19	15	6	14	9	10	—	—
September . . .	10	15	15	13	6	17	12	12	—	—
October . . .	9	11	9	11	10	21	15	14	—	—
November . . .	13	9	4	5	6	15	19	29	—	—
December . . .	17	8	2	2	4	12	20	35	—	—
Fermo. 909 ft. 1886-1898										
January . . .	9	3	7	11	10	11	25	23	1	—
February . . .	11	8	7	14	10	7	19	23	1	—
March . . .	10	6	13	19	11	9	12	19	1	—
April . . .	11	7	19	18	10	7	13	14	1	—
May . . .	15	9	15	20	9	6	10	15	1	—
June . . .	13	10	18	18	12	6	9	13	1	—
July . . .	13	9	18	18	9	6	10	15	2	—
August . . .	14	12	15	19	8	7	10	15	—	—
September . . .	11	11	13	16	9	9	14	17	—	—
October . . .	8	6	14	16	14	10	16	16	—	—
November . . .	7	3	11	16	11	9	23	20	—	—
December . . .	6	4	5	13	10	13	26	23	—	—



TABLE I. *Frequency of Wind Direction (%) (cont.)*

	N.	NE.	E.	SE.	S.	SW.	W.	NW.	Calm	Mean velocity (m.p.h.)
<i>Apulian Region</i>										
Vieste. 164 ft. 1891-1900										
January . . .	7	3	10	16	7	4	19	<b>29</b>	5	—
February . . .	9	7	3	14	6	5	18	<b>30</b>	8	—
March . . .	8	4	6	20	7	6	14	<b>28</b>	7	—
April . . .	7	3	5	21	7	3	16	<b>28</b>	10	—
May . . .	6	1	5	21	5	4	16	<b>33</b>	9	—
June . . .	6	3	3	18	6	2	14	<b>36</b>	12	—
July . . .	6	2	3	12	2	2	17	<b>45</b>	11	—
August . . .	9	1	2	14	5	3	16	<b>39</b>	11	—
September . . .	9	4	4	15	4	4	13	<b>33</b>	14	—
October . . .	7	1	5	<b>26</b>	7	7	16	22	9	—
November . . .	9	3	6	19	6	5	18	<b>27</b>	7	—
December . . .	8	5	4	17	6	5	<b>25</b>	<b>25</b>	5	—
Bari. 93 ft. 1884-1909										
January . . .	9	3	6	9	12	15	<b>27</b>	18	1	—
February . . .	10	4	7	8	11	17	<b>24</b>	18	1	—
March . . .	9	6	8	12	14	15	15	<b>20</b>	1	—
April . . .	9	9	13	12	14	12	12	<b>18</b>	1	—
May . . .	9	11	13	9	11	11	10	<b>24</b>	2	—
June . . .	12	12	13	6	7	9	11	<b>28</b>	2	—
July . . .	14	11	13	4	4	8	11	<b>33</b>	2	—
August . . .	9	13	10	7	5	10	10	<b>36</b>	—	—
September . . .	10	12	11	10	6	15	12	<b>24</b>	—	—
October . . .	7	6	9	12	16	<b>17</b>	15	16	2	—
November . . .	8	4	7	11	14	17	<b>21</b>	17	1	—
December . . .	6	4	6	11	13	18	<b>23</b>	18	1	—
Lecce. 236 ft. 1880-1898										
January . . .	17	9	3	13	13	8	9	<b>19</b>	9	6.9
February . . .	18	8	4	12	10	9	8	<b>22</b>	9	6.5
March . . .	14	8	4	15	15	11	9	<b>16</b>	8	8.1
April . . .	13	8	6	13	<b>15</b>	13	9	<b>15</b>	8	8.3
May . . .	16	8	4	11	13	11	9	<b>19</b>	9	6.0
June . . .	<b>19</b>	11	4	8	9	10	9	18	12	5.8
July . . .	<b>25</b>	13	4	4	5	8	7	24	10	5.8
August . . .	<b>25</b>	12	5	5	7	8	7	21	10	5.8
September . . .	<b>20</b>	10	3	10	10	10	6	19	12	5.6
October . . .	14	7	4	15	<b>16</b>	14	6	14	10	6.7
November . . .	16	8	4	13	14	8	6	<b>17</b>	14	6.0
December . . .	16	8	4	15	12	8	9	<b>19</b>	9	7.2



TABLE I. *Frequency of Wind Direction (%) (cont.)*

	N.	NE.	E.	SE.	S.	SW.	W.	NW.	Calm	Mean velocity (m.p.h.)
<b>APENNINES</b>										
Aquila. 2,408 ft. 1891-1900										
January . . .	0	2	<b>29</b>	7	0	3	26	18	15	—
February . . .	1	2	23	7	1	2	<b>31</b>	22	11	—
March . . .	1	1	22	6	1	3	<b>35</b>	23	8	—
April . . .	1	1	28	8	0	3	<b>29</b>	20	10	—
May . . .	1	1	28	4	0	4	<b>32</b>	22	8	—
June . . .	1	1	18	5	0	5	<b>37</b>	24	9	—
July . . .	2	2	17	5	0	4	<b>35</b>	26	9	—
August . . .	1	0	24	9	0	4	<b>31</b>	21	10	—
September . . .	1	1	20	8	0	4	<b>32</b>	22	12	—
October . . .	0	0	22	7	0	5	<b>27</b>	23	16	—
November . . .	2	1	<b>28</b>	8	0	2	21	19	19	—
December . . .	1	3	<b>31</b>	5	0	3	28	18	11	—
<b>Potenza. 2,710 ft. 1891-1900</b>										
January . . .	3	3	1	1	7	<b>31</b>	18	15	21	—
February . . .	5	4	1	2	6	<b>31</b>	15	22	14	—
March . . .	6	3	2	2	6	<b>39</b>	14	18	10	—
April . . .	5	5	2	3	4	<b>37</b>	17	17	10	—
May . . .	5	4	2	2	4	<b>40</b>	17	16	10	—
June . . .	5	2	1	1	7	<b>41</b>	16	17	10	—
July . . .	7	2	0	0	1	<b>33</b>	19	25	13	—
August . . .	7	4	1	0	2	<b>29</b>	18	26	13	—
September . . .	9	4	0	0	2	<b>31</b>	17	18	19	—
October . . .	9	3	1	1	5	<b>36</b>	10	14	21	—
November . . .	11	9	1	2	6	<b>29</b>	8	14	20	—
December . . .	10	3	1	1	4	<b>29</b>	14	18	20	—
<b>SICILY</b>										
Palermo. 234 ft. 1880-1920										
January . . .	6	5	3	4	20	<b>33</b>	10	9	10	6.3
February . . .	7	9	5	2	13	<b>26</b>	8	11	19	6.5
March . . .	6	11	6	4	16	<b>18</b>	10	10	<b>19</b>	7.2
April . . .	4	<b>15</b>	9	3	9	11	11	11	<b>27</b>	6.7
May . . .	6	<b>19</b>	15	2	2	10	9	11	<b>26</b>	6.3
June . . .	5	<b>27</b>	16	2	4	4	5	9	<b>28</b>	5.4
July . . .	5	<b>25</b>	14	3	3	5	5	11	<b>28</b>	6.0
August . . .	6	<b>26</b>	14	5	5	7	5	9	<b>25</b>	5.6
September . . .	4	<b>24</b>	8	4	8	10	6	9	<b>27</b>	5.4
October . . .	5	14	8	4	12	<b>23</b>	7	9	19	5.8
November . . .	6	10	8	4	18	<b>29</b>	6	6	13	6.3
December . . .	6	5	4	5	21	<b>28</b>	13	9	9	6.3



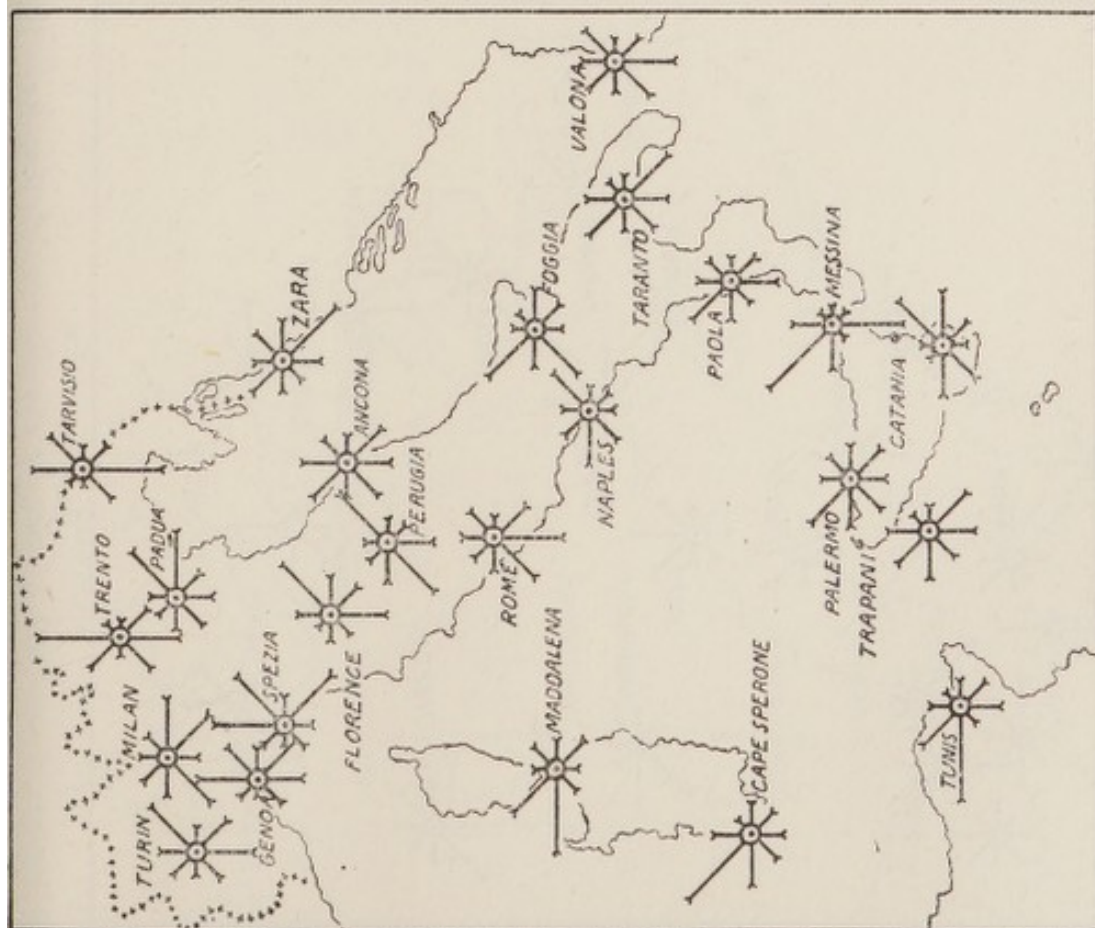
TABLE I. *Frequency of Wind Direction (%) (cont.)*

	N.	NE.	E.	SE.	S.	SW.	W.	NW.	Calm	Mean velocity (m.p.h.)
<b>SICILY (continued)</b>										
<b>Agrigento. 953 ft. 1891-1900</b>										
January . . .	18	9	9	9	11	7	15	11	11	—
February . . .	23	9	4	9	11	6	10	13	15	—
March . . .	15	9	7	9	10	11	10	11	18	—
April . . .	14	7	3	6	8	11	18	11	22	—
May . . .	13	6	5	6	11	13	16	7	23	—
June . . .	11	4	3	7	15	13	13	4	30	—
July . . .	10	7	5	2	14	12	12	5	33	—
August . . .	10	8	3	4	15	17	9	6	28	—
September . . .	9	6	3	4	13	14	10	4	37	—
October . . .	13	12	6	14	11	9	10	5	20	—
November . . .	19	11	7	8	13	10	6	8	18	—
December . . .	20	15	6	7	6	7	13	11	15	—
<b>Syracuse. 77 ft. 1881-1920</b>										
January . . .	4	15	6	4	1	22	38	7	3	—
February . . .	5	24	4	4	2	17	27	8	9	—
March . . .	4	20	8	11	3	20	22	5	4	—
April . . .	5	23	7	10	3	15	25	6	6	—
May . . .	7	28	7	11	5	13	15	9	7	—
June . . .	7	27	8	11	3	18	14	6	8	—
July . . .	7	33	6	8	4	22	8	6	6	—
August . . .	5	30	5	15	3	16	11	5	10	—
September . . .	6	21	5	11	3	20	18	7	9	—
October . . .	4	20	5	10	4	20	20	8	9	—
November . . .	4	21	7	8	4	14	28	6	8	—
December . . .	3	20	4	3	2	19	30	12	7	—
<b>SARDINIA</b>										
<b>Cagliari. 246 ft. 1892-1920</b>										
January . . .	18	4	7	8	4	3	7	31	18	..
February . . .	12	3	6	7	5	3	8	32	24	..
March . . .	13	2	6	13	8	3	7	28	20	..
April . . .	10	2	4	13	9	3	9	29	21	..
May . . .	11	1	3	11	14	5	8	26	21	..
June . . .	13	1	3	11	19	5	7	24	17	..
July . . .	12	8	2	12	20	3	4	30	9	..
August . . .	7	1	3	16	19	3	4	29	18	..
September . . .	8	1	4	19	12	3	5	27	21	..
October . . .	13	3	7	15	11	3	6	23	19	..
November . . .	14	3	8	11	7	3	8	23	23	..
December . . .	20	4	5	7	5	3	8	30	18	..

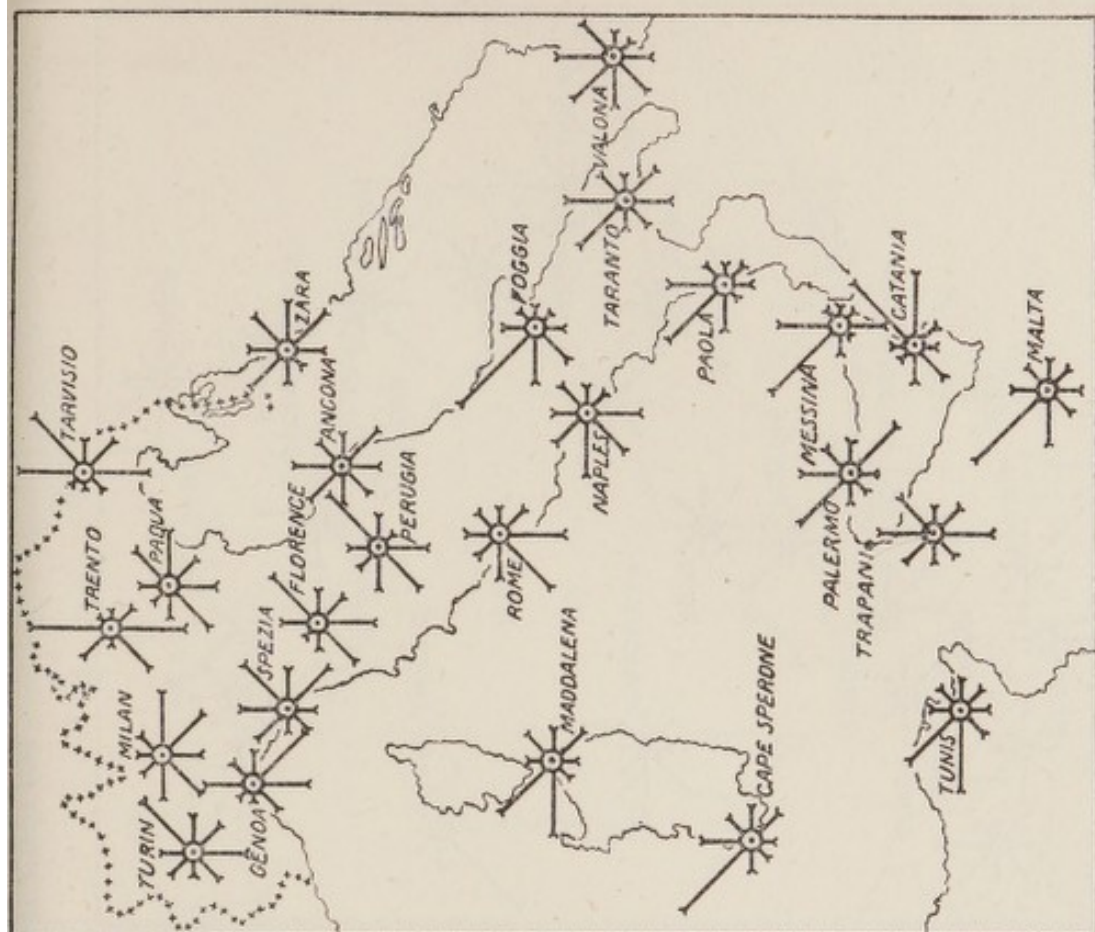
Authorities: (1) *Weather in the Mediterranean*, vol. ii.

(2) ALT, E. *Klimakunde von Mittel und Südeuropa*. Berlin, 1932.





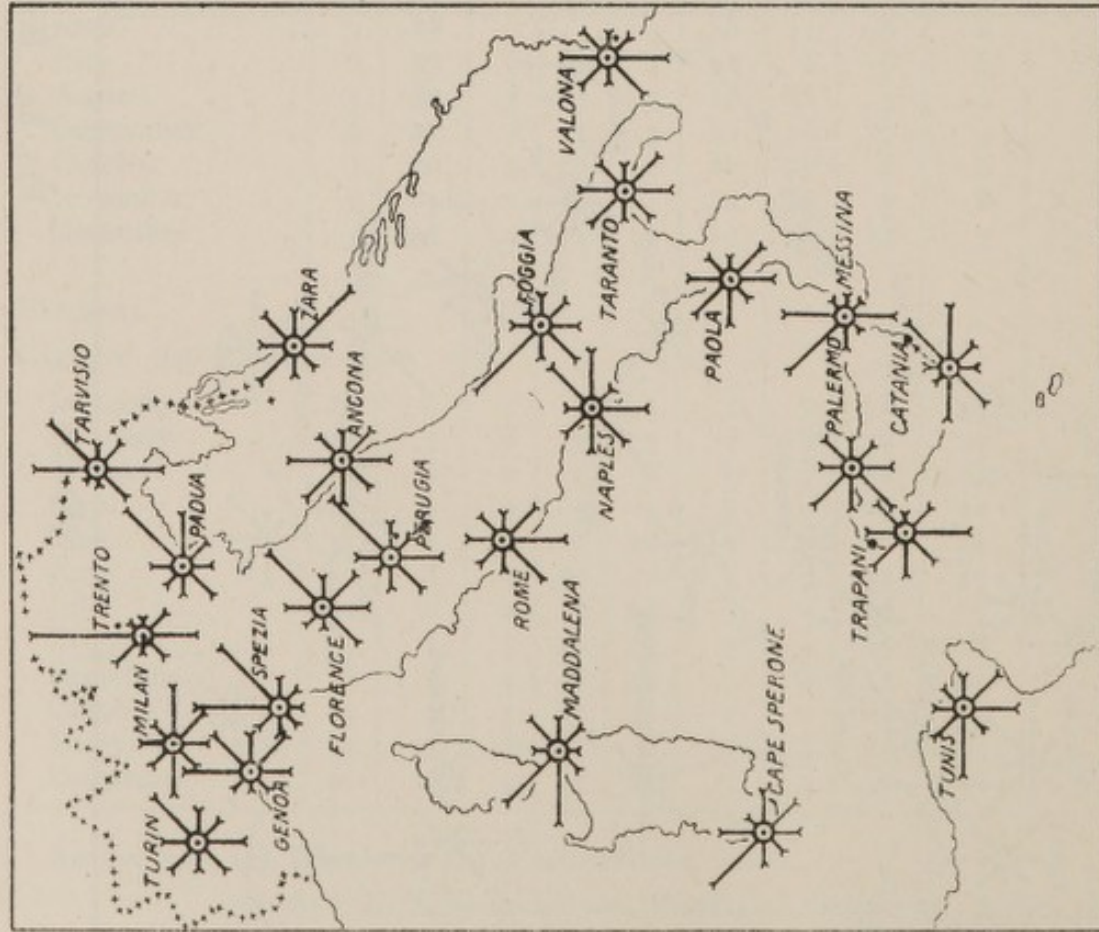
Spring



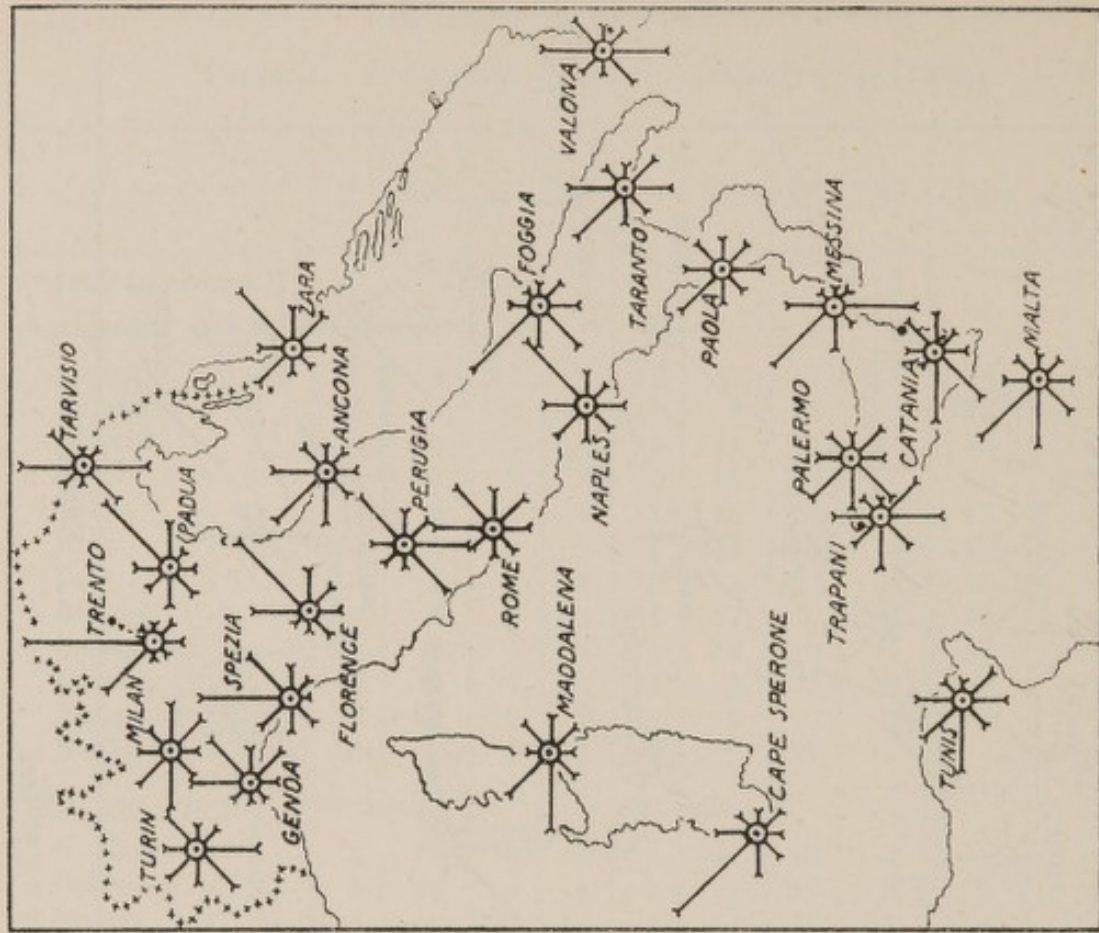
Summer

FIG. 84. Winds at 1,650 feet





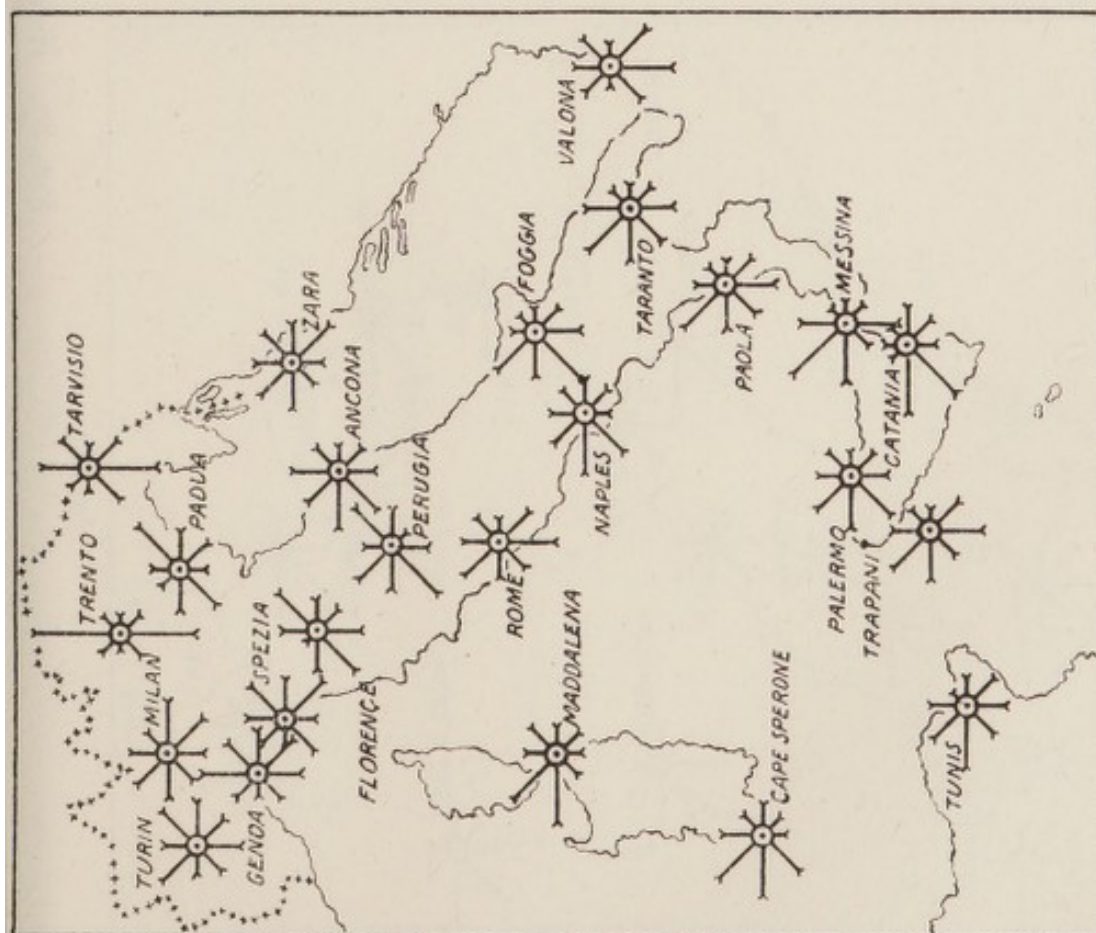
Autumn



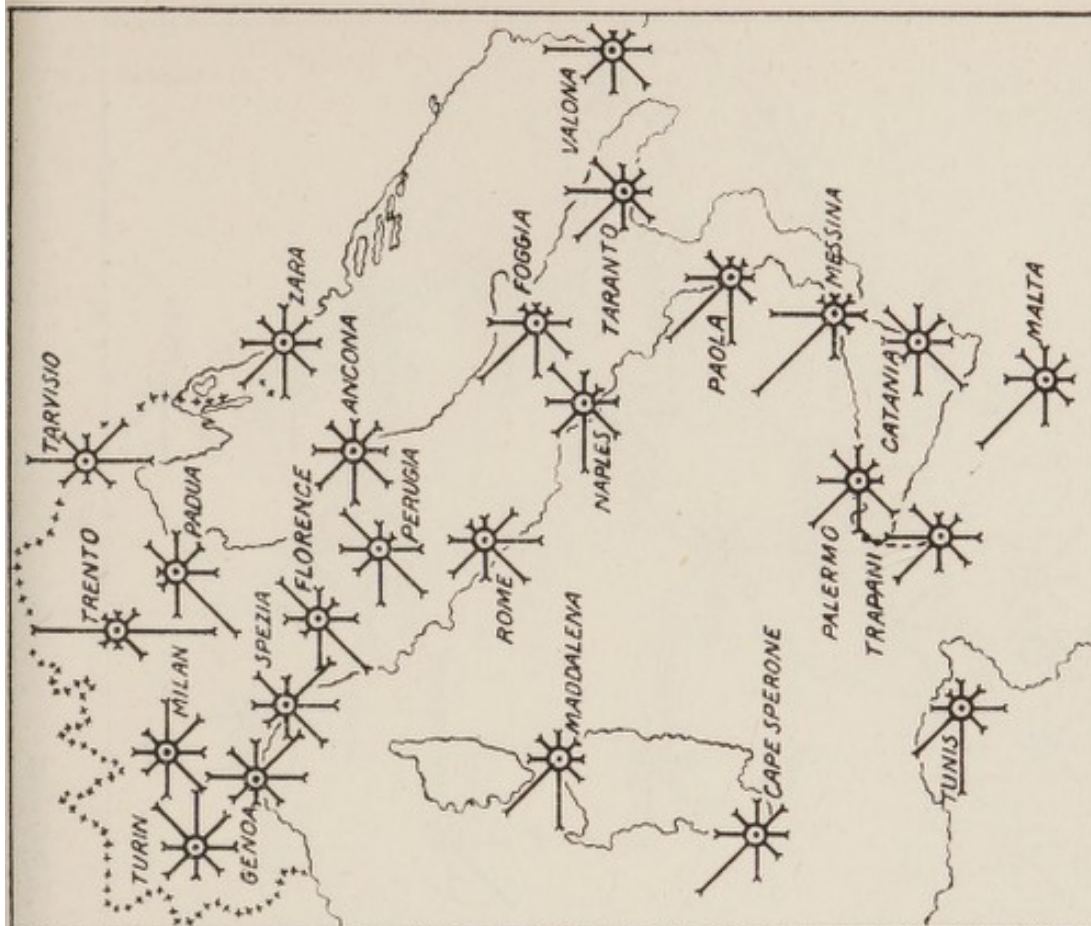
Winter

FIG. 85. Winds at 1,650 feet





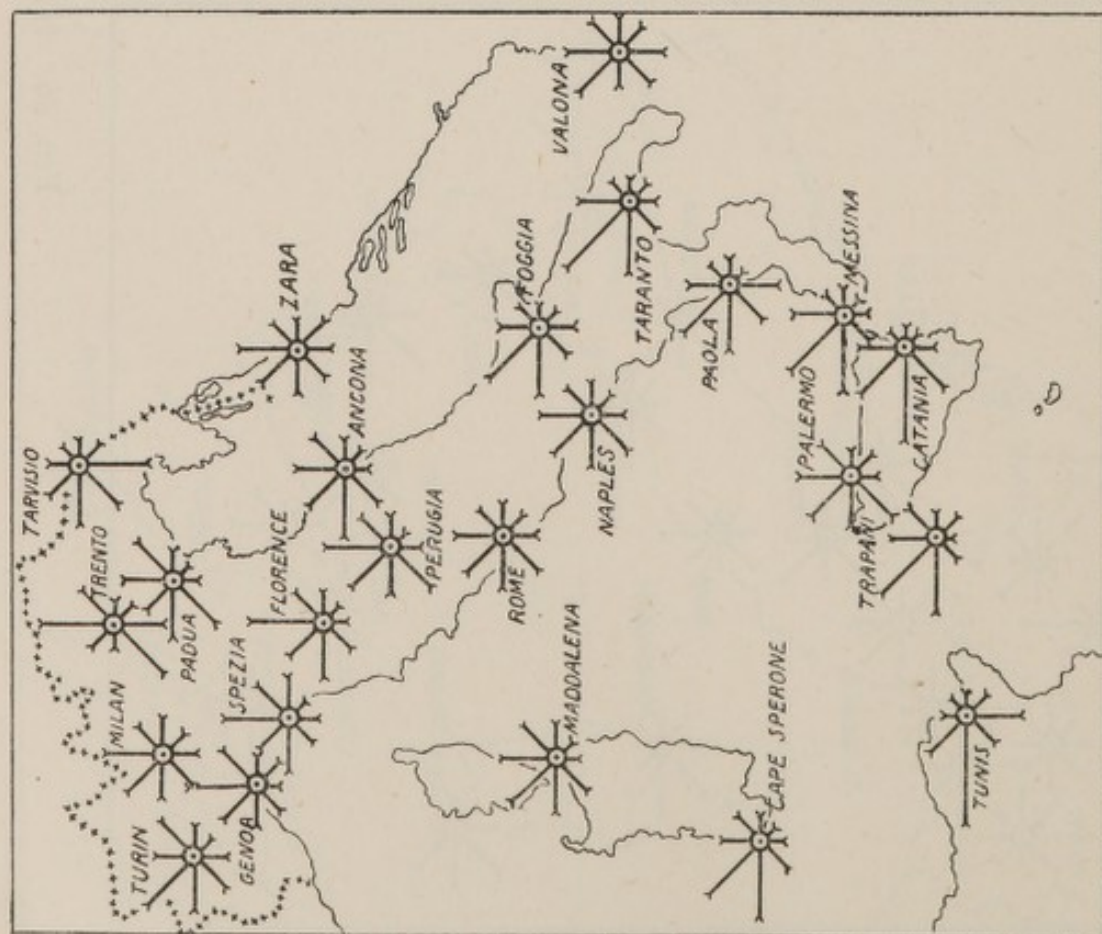
Spring



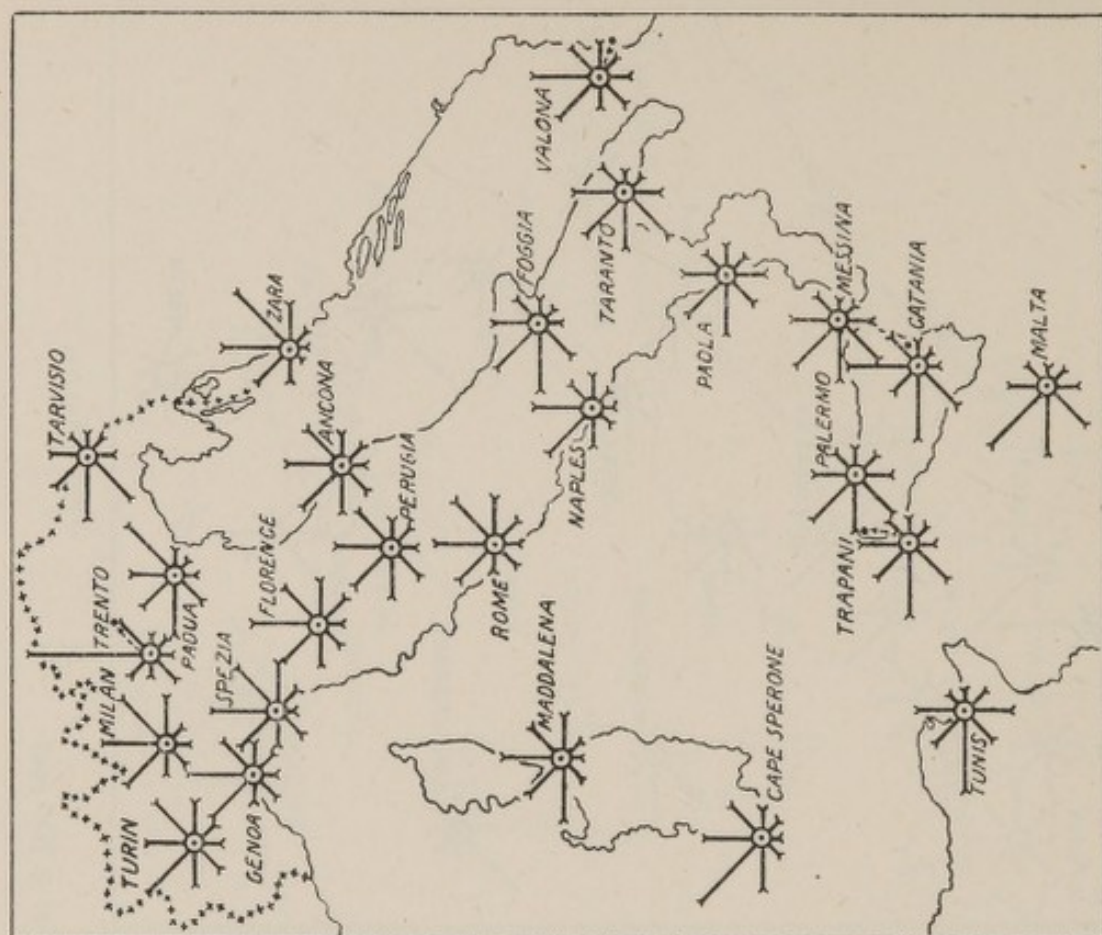
Summer

FIG. 86. Winds at 3,300 feet





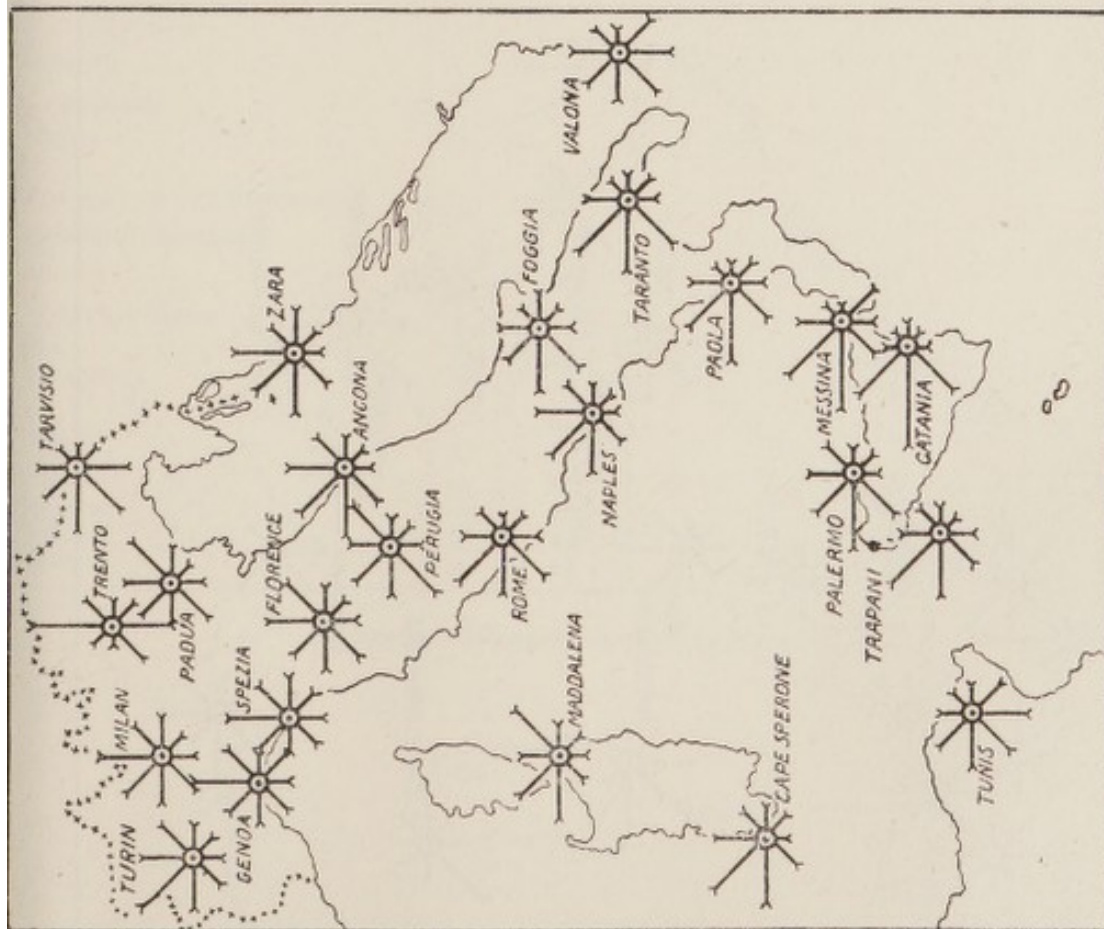
Autumn



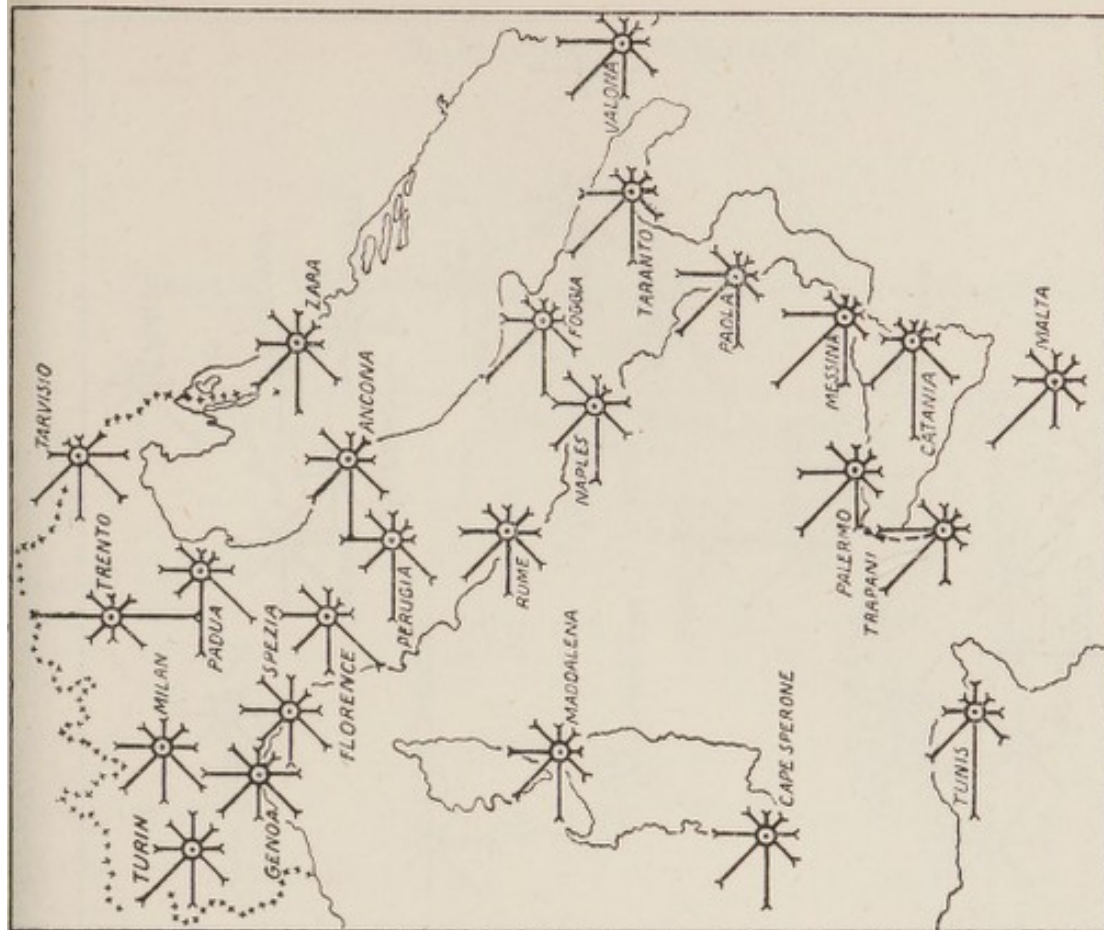
Winter

FIG. 87. Winds at 3,300 feet





Spring



Summer

FIG. 88. Winds at 6,600 feet



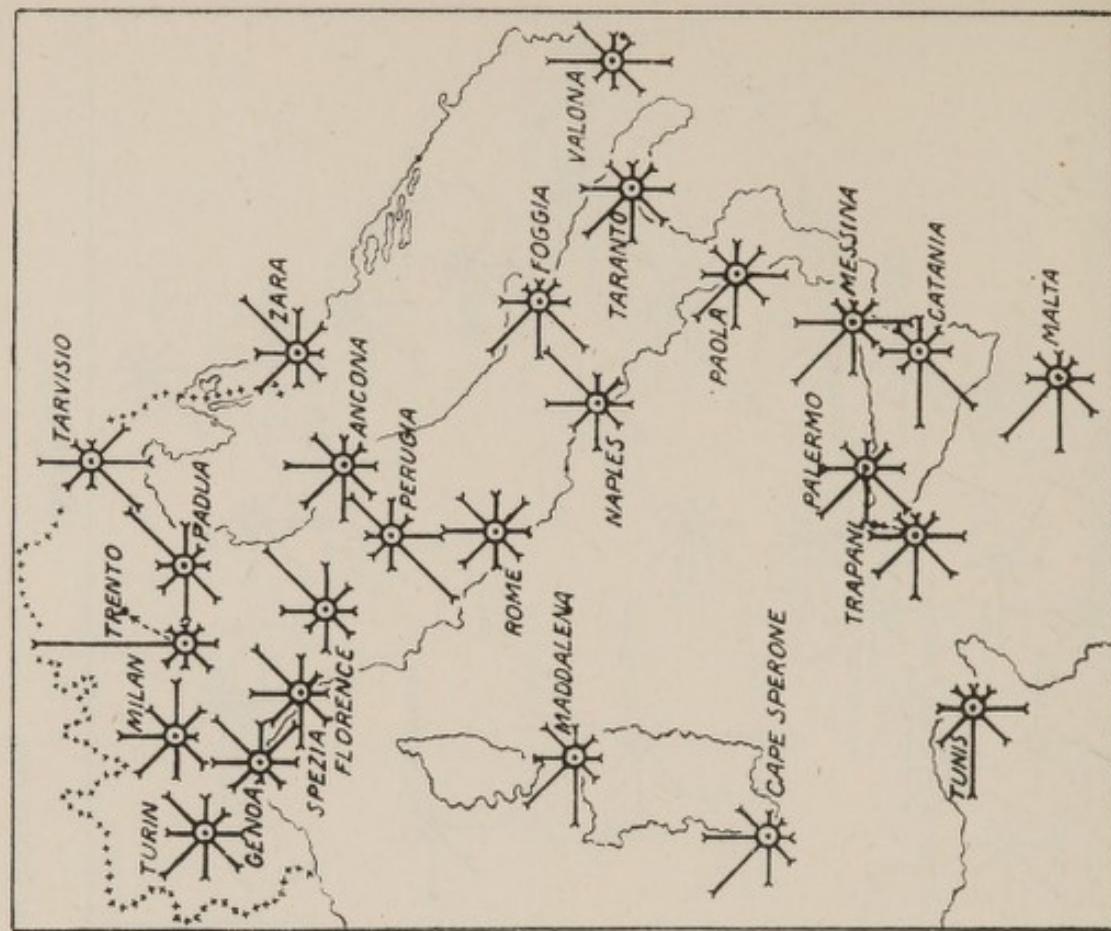
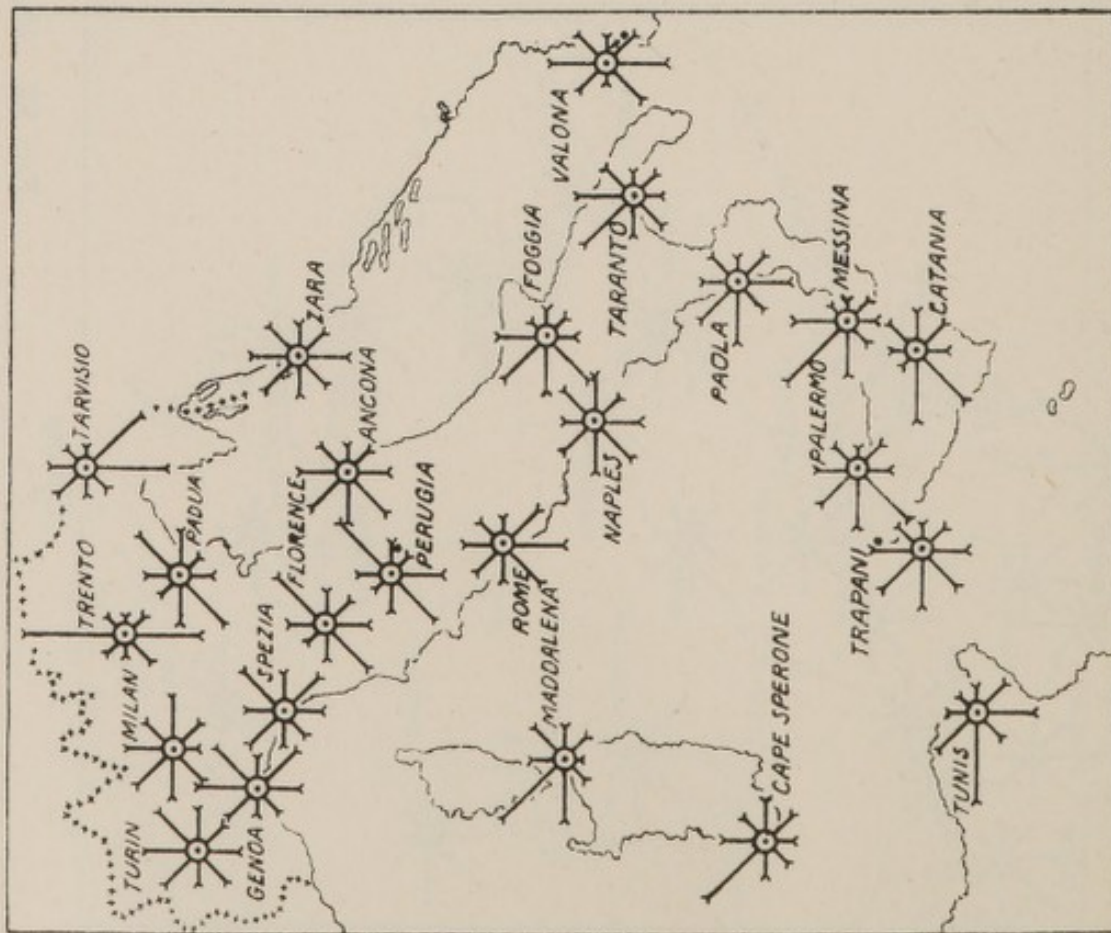


Fig. 80. Winds at 6600 feet



TABLE 2. *Mean Number of Days with Moderate and Rough Sea*  
1929-1933

	Winter			Spring			Summer			Autumn			Year
	Moderate	Rough	Total	Moderate	Rough	Total	Moderate	Rough	Total	Moderate	Rough	Total	Total
ISTRIA													
Trieste . . . . .	14	15	29	16	8	24	10	4	14	14	9	23	90
Pola . . . . .	26	9	35	30	4	34	17	2	19	29	3	32	120
Fiume . . . . .	20	2	22	14	1	15	6	0.4	6.4	15	2	17	60
NORTHERN PLAIN													
<i>East</i>													
Venice (1927-32) . . . . .	11	9	20	12	5	17	8	2	10	12	5	17	64
THE WEST OF THE PENINSULA													
<i>Riviera</i>													
Genoa . . . . .	40	10	50	35	12	47	26	8	34	30	9	39	170
Spezia . . . . .	57	7	64	45	7	52	29	4	33	43	10	53	203
<i>Pre-Apennines</i>													
Leghorn . . . . .	18	9	27	17	12	29	17	8	25	21	12	33	114
<i>Campania</i>													
Naples . . . . .	12	4	16	14	5	19	5	0.7	5.7	13	5	18	59
THE EAST OF THE PENINSULA													
<i>Adriatic Coastland</i>													
Ancona . . . . .	34	11	45	16		22	12	5	17	22	5	27	111
<i>Apulian Region</i>													
Bari. . . . .	16	9	25	13	4	17	14	4	18	13	6	19	79
Taranto . . . . .	27	8	35	23	10	33	22	3	25	19	5	24	117
SICILY													
Ustica . . . . .	52	14	66	52	11	63	39	6	45	44	18	62	236
Palermo . . . . .	13	7	20	13	4	17	6	0.3	6.3	11	3	14	57
Trapani . . . . .	32	11	43	38	7	45	29	1	30	35	7	42	160
Catania . . . . .	35	14	49	33	2	35	15	0.4	15.4	26	5	31	130

Authority: *Weather in the Mediterranean.*







TABLE 3. *Temperature (°F.) (cont.)*

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Mantua (151 ft.)													
Mean monthly	34.2	39.4	46.9	55.6	63.5	71.6	76.5	74.8	67.8	56.8	45.3	36.9	55.8
Mean daily max.	39	45	54	63	70	79	85	83	75	64	51	42	—
" " min.	30	33	40	48	56	64	68	67	61	52	42	33	—
Piacenza (236 ft.)													
Mean monthly	31.3	36.9	45.7	54.5	62.2	69.8	74.7	73.2	66.2	55.4	43.5	34.7	54.0
Mean daily max.	39	44	54	63	70	78	84	82	75	62	50	41	—
" " min.	28	31	39	46	53	61	65	64	58	50	40	31	—
Turin (906 ft.)													
Mean monthly	32.5	37.4	45.5	53.6	61.0	68.7	73.6	71.6	64.9	54.0	42.8	35.1	53.4
Mean daily max.	38	43	53	61	67	76	81	79	72	60	48	40	—
" " min.	29	32	40	47	54	62	66	65	59	50	40	32	—
Mean annual max.	—	—	—	—	—	—	90	—	—	—	—	—	—
" " min.	17	—	—	—	—	—	—	—	—	—	—	—	—
Alessandria (322 ft.)													
Mean monthly	31.1	36.5	45.1	54.5	61.9	69.6	74.5	73.2	66.0	55.0	43.0	34.7	53.8
Cuneo (1,821 ft.)													
Mean monthly	34.5	38.1	44.2	51.4	58.6	66.6	71.8	70.0	63.0	52.5	42.3	36.5	52.5
Mean daily max.	42	46	53	60	68	76	82	80	72	60	49	44	—
" " min.	29	32	38	45	50	58	63	62	57	47	38	32	—
East													
Udine (381 ft.)													
Mean monthly	37.2	40.3	46.2	54.7	61.9	69.1	73.8	72.1	65.8	56.1	45.9	39.2	55.4
Mean daily max.	43	47	54	63	70	78	83	81	74	63	53	45	—
" " min.	31	34	39	46	52	60	64	63	58	50	41	34	—
Vicenza (177 ft.)													
Mean monthly	34.9	39.0	45.9	54.3	61.9	69.6	74.3	72.7	66.2	55.6	45.0	37.4	54.7
Mean daily max.	41	46	53	62	69	78	83	81	74	63	52	44	—
" " min.	30	33	40	47	53	61	65	64	58	50	41	33	—
Venice (69 ft.)													
Mean monthly	36.7	40.3	46.2	54.9	63.0	70.2	75.4	73.8	67.1	57.4	46.4	39.2	55.9
Mean daily max.	41	46	52	61	69	77	83	81	74	64	52	44	—
" " min.	32	35	42	49	56	64	69	67	61	53	43	35	—
Absolute max.	56	62	73	77	86	91	97	95	89	77	69	61	—
" " min.	14	20	24	36	42	50	54	50	38	28	23	18	—
Bologna (279 ft.)													
Mean monthly	35.2	39.9	47.1	55.2	63.1	71.2	76.8	75.2	68.7	57.7	46.2	37.9	56.1
Mean daily max.	39	44	54	62	69	78	83	82	75	64	51	42	—
" " min.	31	34	41	48	55	63	68	67	61	52	43	34	—
Mean annual max.	—	—	—	—	—	—	95	—	—	—	—	—	—
" " min.	19	—	—	—	—	—	—	—	—	—	—	—	—
THE WEST OF THE PENINSULA													
Riviera													
Genoa (177 ft.)													
Mean monthly	45.5	47.7	51.8	57.2	63.1	70.0	75.4	75.4	70.3	62.1	53.2	47.5	59.9
Mean daily max.	49	52	56	62	67	75	81	81	75	66	58	52	—
" " min.	42	43	47	53	58	65	70	70	66	58	50	44	—
Absolute max.	65	70	75	78	87	91	95	95	93	80	75	68	—
" " min.	17	25	29	38	42	51	58	57	51	38	32	23	—



TABLE 3. *Temperature (°F.) (cont.)*

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
<i>Pre-Apennines</i>													
Florence (240 ft.)													
Mean monthly	40.5	43.5	48.9	56.1	63.1	70.7	76.3	74.8	68.7	58.8	49.1	42.6	57.7
Mean daily max.	47	51	57	65	72	81	87	86	78	67	56	48	—
" " min.	36	37	42	47	53	60	65	65	60	53	44	38	—
Mean annual max.	—	—	—	—	—	—	97	—	—	—	—	—	—
" " min.	30	—	—	—	—	—	—	—	—	—	—	—	—
Leghorn (79 ft.)													
Mean monthly	44.8	47.1	51.1	57.0	63.5	70.9	75.9	75.4	70.2	61.5	52.9	46.8	59.7
Mean daily max.	51	54	58	64	69	78	83	83	78	68	59	53	—
" " min.	39	40	44	50	55	62	67	67	62	55	48	41	—
Absolute max.	66	68	79	84	91	94	98	97	92	83	73	71	—
" min.	20	22	27	32	41	46	52	51	41	34	30	22	—
Siena (1,145 ft.)													
Mean monthly	40.3	42.8	46.9	53.6	60.8	68.4	74.3	73.4	67.3	57.4	48.6	42.4	56.3
Mean daily max.	46	49	55	62	68	77	83	82	76	65	55	48	—
" " min.	35	36	40	46	52	59	65	64	59	52	44	38	—
Rome (167 ft.)													
Mean monthly	44.1	46.6	50.7	56.8	63.9	71.2	76.6	75.7	70.2	61.3	52.3	46.2	59.7
Mean daily max.	52	54	59	66	72	80	87	86	80	70	61	54	—
" " min.	38	40	44	49	54	61	66	65	62	55	47	41	—
Absolute max.	65	68	74	83	90	97	108	99	93	90	76	70	—
" min.	19	17	25	27	38	48	52	52	43	32	26	21	—
<i>Campania</i>													
Naples (489 ft.)													
Mean monthly	46.8	48.2	51.3	56.8	63.5	70.2	75.6	75.2	70.3	62.4	54.9	49.1	60.4
Mean daily max.	51	53	57	63	69	76	82	82	77	69	61	54	—
" " min.	43	44	47	52	57	64	69	69	65	59	52	46	—
Absolute max.	65	65	73	79	91	93	99	99	93	88	73	68	—
" min.	24	24	27	38	42	50	55	53	48	38	31	28	—
<i>THE EAST OF THE PENINSULA</i>													
<i>Adriatic Coastland</i>													
Urbino (1,483 ft.)													
Mean monthly	36.5	39.4	44.4	51.4	58.8	66.9	73.2	72.0	65.1	55.2	45.9	39.4	54.0
Mean daily max.	41	44	51	58	65	74	80	79	72	61	50	43	—
" " min.	32	34	38	44	51	58	64	63	58	50	42	35	—
Ancona (302 ft.)													
Mean monthly	41.9	45.0	49.6	56.8	64.6	72.7	78.1	76.8	70.9	61.7	52.2	45.0	59.7
Mean daily max.	47	50	55	63	70	79	84	83	76	67	58	50	—
" " min.	38	40	45	51	58	66	71	70	65	58	49	41	—
Absolute max.	64	68	75	77	89	99	100	102	94	81	79	66	—
" min.	24	24	28	35	43	48	47	50	47	36	33	21	—
Chieti (1,119 ft.)													
Mean monthly	39.4	41.2	45.3	51.4	59.5	67.3	73.2	72.0	65.7	57.0	47.8	42.3	55.2
<i>Apulian Region</i>													
Pelagosa (302 ft.)													
Mean monthly	48.4	48.4	51.3	55.6	61.9	69.8	74.8	74.1	69.4	63.1	55.8	51.4	60.3
Mean annual max.	—	—	—	—	—	—	85	—	—	—	—	—	—
" " min.	34	—	—	—	—	—	—	—	—	—	—	—	—
Foggia (285 ft.)													
Mean monthly	43.3	45.7	50.0	56.7	64.4	72.7	79.0	78.3	73.4	62.6	52.3	45.9	60.4
Mean daily max.	50	54	60	65	73	82	88	87	81	71	61	53	—
" " min.	38	39	43	47	54	62	69	70	64	56	47	41	—



TABLE 3. *Temperature (°F.) (cont.)*

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
<b>Bari (92 ft.)</b>													
Mean monthly	46.4	47.8	51.3	56.5	63.3	70.2	75.4	75.2	70.5	63.5	54.9	48.6	60.3
Mean daily max.	52	54	58	62	69	76	81	81	77	70	62	55	—
" " min.	40	41	45	49	55	63	68	67	62	57	49	44	—
Absolute max.	66	72	79	82	91	101	103	107	101	93	77	70	—
" min.	23	24	29	34	40	49	57	53	45	37	32	21	—
<b>Brindisi (10 ft.)</b>													
Mean monthly	48	48	53	58	65	73	78	77	72	65	57	51	62
Absolute max.	64	68	79	81	95	100	101	102	99	90	87	72	—
" min.	27	21	32	37	40	52	55	50	46	39	32	32	—
<b>Gallipoli (92 ft.)</b>													
Mean monthly	50.2	51.3	53.8	58.6	64.6	72.0	77.2	77.5	73.4	66.7	58.5	52.7	63.1
Mean daily max.	56	57	62	65	71	78	84	84	80	74	66	59	—
" " min.	44	45	47	51	57	64	69	70	66	60	53	47	—
Absolute max.	66	66	68	75	87	91	95	97	91	88	84	68	—
" min.	32	31	34	37	41	52	58	63	55	45	39	32	—
<b>APENNINES</b>													
<b>Perugia (1,706 ft.)</b>													
Mean monthly	39.0	41.4	45.7	52.3	59.7	67.8	73.6	72.7	66.7	56.7	47.5	41.2	55.4
Mean daily max.	44	47	54	62	69	77	83	82	75	64	53	46	—
" " min.	35	36	40	46	51	59	65	64	59	51	44	37	—
<b>Aquila (2,408 ft.)</b>													
Mean monthly	34.3	37.2	43.0	49.8	57.6	65.1	70.5	69.6	63.3	53.8	43.9	37.8	52.2
Mean daily max.	40	45	53	60	66	74	81	80	73	63	51	44	—
" " min.	29	31	36	42	47	54	59	58	54	47	39	33	—
<b>Agnone (2,644 ft.)</b>													
Mean monthly	36.7	38.3	42.4	48.4	55.9	63.1	69.1	68.5	63.0	54.9	45.1	39.0	52.0
Mean daily max.	43	46	51	57	64	72	79	78	73	62	53	45	—
" " min.	32	33	37	42	48	55	61	60	56	49	41	35	—
<b>Potenza (2,710 ft.)</b>													
Mean monthly	37.0	39.0	42.6	48.7	56.5	63.0	68.9	68.5	63.1	54.7	45.5	39.2	52.2
Mean daily max.	42	45	50	56	63	71	78	77	72	62	52	45	—
" " min.	32	33	37	41	47	54	59	58	55	49	41	35	—
<b>SICILY</b>													
<b>Messina (197 ft.)</b>													
Mean monthly	52.9	53.4	55.9	59.9	66.0	72.9	78.4	79.3	75.4	68.5	61.0	55.6	64.9
Mean daily max.	57	58	61	65	72	79	85	86	82	74	66	60	—
" " min.	49	49	51	55	60	67	73	74	71	65	58	52	—
Absolute max.	69	75	74	77	87	93	100	98	95	85	78	69	—
" min.	33	33	36	45	49	59	63	63	61	48	44	35	—
<b>Palermo (233 ft.)</b>													
Mean monthly	50.5	51.8	54.7	58.8	64.6	71.1	76.3	76.8	73.2	67.1	59.2	53.4	63.1
Mean daily max.	61	62	65	69	74	82	88	88	85	78	70	63	—
" " min.	42	43	44	48	53	59	64	64	62	57	51	45	—
Absolute max.	82	82	98	95	104	108	113	114	108	105	89	79	—
" min.	30	29	31	34	39	50	54	54	51	43	38	30	—
<b>Caltanissetta (1,870 ft.)</b>													
Mean monthly	43.3	44.8	48.7	54.0	61.9	70.3	76.1	75.7	70.3	61.7	52.9	46.2	58.8
Mean daily max.	49	51	58	65	73	81	86	85	80	72	63	52	—
" " min.	37	38	42	47	53	61	66	67	63	56	48	40	—



TABLE 3. *Temperature (°F.) (cont.)*

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Syracuse (75 ft.)													
Mean monthly	51.3	51.8	54.5	58.3	64.4	72.1	77.9	78.6	74.1	67.5	59.5	54.0	63.7
Mean daily max.	57	58	62	66	73	81	87	87	82	75	66	60	—
" " min.	46	46	48	52	57	64	71	71	68	62	55	49	—
Absolute max.	73	69	78	80	90	97	104	105	102	91	82	70	—
" min.	34	32	38	42	47	52	55	63	56	46	41	34	—
SARDINIA													
Sassari (735 ft.)													
Mean monthly	47.3	48.9	51.6	56.3	62.4	70.0	75.6	75.6	70.7	62.8	55.6	49.8	60.6
Mean daily max.	53	54	58	63	69	77	83	82	78	69	62	55	—
" " min.	42	42	45	49	53	61	67	66	63	56	50	44	—
Mean annual max.	—	—	—	—	—	—	99	—	—	—	—	—	—
" " min.	32	—	—	—	—	—	—	—	—	—	—	—	—
Cagliari (246 ft.)													
Mean monthly	48.9	50.4	53.6	57.6	63.7	70.9	76.6	76.3	72.1	64.9	57.4	51.1	61.9
Mean daily max.	55	57	60	65	71	80	87	85	81	73	64	57	—
" " min.	43	44	47	50	54	61	66	67	64	58	52	45	—
Absolute max.	71	69	77	78	87	93	99	99	97	86	77	69	—
" min.	28	30	31	41	41	49	54	58	54	45	38	33	—

Note. Monthly means and mean annual extremes for 1866-1906, except Colle Isarco and Bolzano (1851-1910), Trieste and Pola (1870-1914), Lussinpiccolo (1881-1914), Pelagosa (1895-1910), Brindisi (24 years), and Alessandria (?). Daily extremes period unknown. Absolute extremes for various periods, all exceeding 24 years except Cagliari (11 years). See footnote on page 418.

Authorities: (1) *Weather in the Mediterranean*.

(2) ALT, E., op. cit.

(3) CRESTANI, G. *Climatologia*. Turin, 1931.

(4) Kendrew, W. G. *Climates of the Continents*. Oxford, 1937.



TABLE 4. *Number of Days with Frost*

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
ALPS													
Sondrio . . .	26	20	6	1	—	—	—	—	—	—	10	22	85
Domodossola . .	24	19	9	2	—	—	—	—	—	1	12	21	88
ISTRIA													
Lussinpiccolo . .	1	0	—	—	—	—	—	—	—	—	—	—	1
NORTHERN PLAIN													
<i>West</i>													
Mantua . . .	22	14	3	—	—	—	—	—	—	—	5	14	58
Turin . . .	26	17	4	—	—	—	—	—	—	—	7	19	73
Milan . . .	18	10	2	—	—	—	—	—	—	—	3	12	45
Piacenza . . .	23	17	5	—	—	—	—	—	—	—	7	16	68
Cuneo . . .	19	15	5	1	—	—	—	—	—	—	6	14	60
<i>East</i>													
Udine . . .	14	8	2	—	—	—	—	—	—	—	4	7	35
Vicenza . . .	16	10	2	—	—	—	—	—	—	—	4	10	42
Venice . . .	13	7	1	—	—	—	—	—	—	—	2	6	29
Bologna . . .	13	7	1	—	—	—	—	—	—	—	2	4	27
THE WEST OF THE PENINSULA													
<i>Riviera</i>													
Genoa . . .	2	1	—	—	—	—	—	—	—	—	—	—	3
<i>Pre-Apennines</i>													
Florence . . .	9	6	1	—	—	—	—	—	—	—	2	6	24
Leghorn . . .	3	2	—	—	—	—	—	—	—	—	1	1	7
Siena . . .	7	6	1	—	—	—	—	—	—	—	1	2	17
Rome . . .	4	3	—	—	—	—	—	—	—	—	1	2	10
<i>Campania</i>													
Naples . . .	1	1	—	—	—	—	—	—	—	—	—	—	2
THE EAST OF THE PENINSULA													
<i>Adriatic Coastland</i>													
Ancona . . .	8	6	2	—	—	—	—	—	—	—	1	3	20
<i>Apulian Region</i>													
Foggia . . .	5	6	2	—	—	—	—	—	—	—	1	2	16
Bari . . .	1	1	—	—	—	—	—	—	—	—	—	—	2
APENNINES													
Agnone . . .	5	6	2	—	—	—	—	—	—	—	1	2	16
Potenza . . .	13	11	6	1	—	—	—	—	—	—	2	6	39
SICILY													
Messina . . .	—	—	—	—	—	—	—	—	—	—	—	—	0
Palermo . . .	—	—	—	—	—	—	—	—	—	—	—	—	0
Caltanissetta . .	2	2	—	—	—	—	—	—	—	—	—	1	5
SARDINIA													
Sassari . . .	1	1	—	—	—	—	—	—	—	—	—	—	2
Cagliari . . .	1	—	—	—	—	—	—	—	—	—	—	—	1

Authority: ALT, E., op. cit.



TABLE 5. *Relative Humidity (%)*

	<i>Jan.</i>	<i>July</i>	<i>Year</i>
ALPS			
Colle Isarco . . . . .	82	71	77
Bolzano . . . . .	82	66	72
Belluno . . . . .	78	65	71
ISTRIA			
Trieste . . . . .	69	62	66
Pola . . . . .	75	69	74
Lussinpiccolo . . . . .	73	66	71
NORTHERN PLAIN			
<i>West</i>			
Turin . . . . .	82	58	69
Milan . . . . .	85	55	69
<i>East</i>			
Udine . . . . .	67	60	65
Vicenza . . . . .	80	60	71
Bologna . . . . .	72	50	63
THE WEST OF THE PENINSULA			
<i>Riviera</i>			
Genoa . . . . .	59	63	62
<i>Pre-Apennines</i>			
Florence . . . . .	75	50	64
Leghorn . . . . .	68	61	66
Siena . . . . .	77	53	67
Rome . . . . .	72	53	65
<i>Campania</i>			
Naples . . . . .	71	63	69
THE EAST OF THE PENINSULA			
<i>Adriatic Coastland</i>			
Urbino . . . . .	84	56	71
Ancona . . . . .	79	57	69
<i>Apulian Region</i>			
Pelagosa . . . . .	74	73	75
APENNINES			
Aquila . . . . .	79	45	62
Potenza . . . . .	79	48	65
SICILY			
Messina . . . . .	69	59	65
Palermo . . . . .	75	63	69
Caltanissetta . . . . .	77	46	65
Syracuse . . . . .	69	62	68
SARDINIA			
Sassari . . . . .	71	51	63

Authority: ALT, E., op. cit.



TABLE 6. *Precipitation (inches)*

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
<b>ALPS</b>													
Colle Isarco . . .	1.2	0.7	1.4	2.0	2.8	3.4	5.2	3.7	3.5	4.1	1.7	1.3	31.6
Auronzo . . .	1.5	3.0	2.8	3.1	5.2	4.6	4.6	4.7	5.2	5.5	3.8	3.2	48.1
Bolzano . . .	1.0	1.0	1.7	2.2	2.8	3.2	3.8	3.6	2.8	3.1	2.1	1.3	29.1
Sondrio . . .	1.7	1.7	2.6	2.5	3.9	2.8	3.1	3.3	3.3	4.1	3.1	1.9	34.4
Belluno . . .	1.9	2.2	3.7	4.1	5.5	5.2	4.5	4.1	4.8	4.8	3.9	2.8	48.2
Domodossola . . .	3.0	3.0	3.7	5.4	6.4	4.8	3.5	4.5	5.2	7.0	4.8	3.1	55.3
<b>ISTRIA</b>													
Trieste . . .	2.2	2.3	2.8	2.9	3.7	4.1	3.7	3.7	4.0	4.7	3.6	3.4	41.8
Pola . . .	2.0	2.2	2.6	2.8	2.5	2.6	2.6	2.2	3.5	4.6	3.5	3.6	35.0
Lussinpiccolo . . .	2.8	3.5	3.0	3.1	2.8	2.3	1.9	1.7	4.3	5.0	5.2	5.0	40.8
<b>NORTHERN PLAIN</b>													
<i>West</i>													
Mantua . . .	1.4	1.5	1.7	2.3	3.0	2.6	1.9	1.7	2.3	3.2	2.5	1.8	26.3
Turin . . .	2.2	1.6	2.3	4.4	4.8	4.2	2.3	2.6	2.8	3.6	2.6	1.6	35.5
Milan . . .	2.6	2.7	3.0	4.0	4.6	3.4	2.8	2.8	3.7	4.8	4.2	3.0	42.2
Piacenza . . .	1.9	2.1	2.7	2.9	3.0	2.7	1.5	1.9	3.3	4.0	3.9	2.8	33.0
Cuneo . . .	2.5	2.0	3.2	5.2	5.6	4.3	2.2	1.8	3.1	5.0	3.6	2.6	41.8
<i>East</i>													
Udine . . .	2.6	3.1	4.6	5.4	5.9	6.9	4.8	4.9	6.5	7.0	4.8	3.7	61.1
Vicenza . . .	2.8	3.1	4.2	4.7	5.5	4.7	3.0	3.5	4.9	5.7	4.4	3.4	50.3
Venice . . .	1.4	1.7	2.1	2.2	2.8	2.9	1.9	2.0	2.6	2.7	2.2	1.6	26.3
Bologna . . .	2.1	1.6	2.4	3.1	2.9	2.4	1.7	1.7	2.5	4.4	3.1	1.9	30.3
Padua . . .	2.1	1.9	2.4	3.0	3.4	3.4	2.5	2.6	3.0	3.8	3.3	2.5	33.9
<b>THE WEST OF THE PENINSULA</b>													
<i>Riviera</i>													
Genoa . . .	4.1	4.4	4.5	4.4	3.5	3.5	2.0	1.9	4.9	6.8	7.4	4.6	52.8
<i>Pre-Apenines</i>													
Florence . . .	1.9	2.1	2.7	2.9	3.0	2.7	1.5	1.9	3.3	4.0	3.9	2.8	33.0
Leghorn . . .	2.7	2.7	2.8	2.9	2.4	1.9	1.0	1.7	3.4	5.6	4.6	3.6	35.8
Siena . . .	1.9	1.7	2.5	2.5	3.0	2.8	1.3	1.4	2.6	4.0	3.6	2.5	30.4
Rome . . .	3.5	2.9	3.0	3.1	2.3	1.8	0.8	1.0	3.0	5.2	4.5	4.0	35.5
<i>Campania</i>													
Naples . . .	3.5	2.8	2.6	3.1	2.2	1.4	0.5	0.8	2.9	4.8	4.1	4.4	33.6
<b>THE EAST OF THE PENINSULA</b>													
<i>Adriatic Coastland</i>													
Urbino . . .	4.4	2.1	2.8	3.9	4.1	3.3	1.9	1.9	2.6	5.3	3.7	3.0	39.6
Ancona . . .	2.6	1.6	1.8	2.2	1.9	2.0	1.1	1.2	2.3	3.9	2.4	1.9	25.4
Chieti . . .	4.6	3.3	2.6	3.3	3.4	2.9	1.7	2.0	2.8	4.3	4.7	3.3	39.5
<i>Apulian Region</i>													
Pelagosa . . .	1.8	1.4	1.7	1.4	1.5	0.9	0.3	0.6	1.0	2.0	1.9	1.8	16.2
Foggia . . .	1.9	1.3	1.3	1.7	1.7	1.2	0.6	1.2	1.4	2.1	2.2	1.7	18.6
Bari . . .	2.6	2.2	1.6	1.9	1.9	1.0	0.7	1.2	2.0	2.6	2.7	2.7	23.2
Gallipoli . . .	2.6	2.0	1.3	1.8	0.9	0.6	0.2	0.4	2.0	2.7	3.2	2.8	20.8
Brindisi . . .	3.6	2.5	2.2	2.3	1.6	0.9	0.5	1.1	2.1	3.3	3.2	3.7	27.2
<b>APENNINES</b>													
Perugia . . .	2.0	2.1	3.2	3.6	3.1	3.4	1.4	1.9	2.8	5.2	4.3	2.7	36.4
Aquila . . .	2.2	2.0	2.2	2.6	2.4	2.1	1.2	1.5	2.2	3.3	3.1	2.2	27.3
Agnone . . .	3.0	2.9	2.6	3.1	2.9	3.1	2.5	1.8	2.5	3.9	4.0	3.3	35.7
Potenza . . .	2.8	2.1	2.1	2.5	2.0	1.5	0.9	1.1	1.9	2.9	3.0	2.8	25.9



TABLE 6. *Precipitation (inches) (cont.)*

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
SICILY													
Messina . . .	3.7	3.3	2.8	2.7	1.4	0.9	0.6	0.8	1.8	4.2	4.5	4.3	31.4
Palermo . . .	3.9	3.3	2.8	2.6	1.3	0.6	0.3	0.6	1.5	3.9	3.9	4.5	29.5
Caltanissetta . .	4.0	3.1	2.1	1.8	1.5	0.4	0.2	0.6	1.1	2.5	2.9	3.8	24.1
Syracuse . . .	3.6	2.8	1.6	1.5	0.8	0.2	0.3	0.3	1.9	3.5	4.3	4.0	25.1
SARDINIA													
Sassari . . .	2.4	1.9	2.0	2.2	1.7	1.1	0.2	0.6	1.5	3.4	3.9	2.8	24.1
Cagliari . . .	1.7	1.4	2.0	1.6	1.0	0.9	0.1	0.2	1.1	2.0	4.0	2.7	19.1

*Note.* Means for 1880-1905, except Colle Isarco and Bolzano (1884-1900), Trieste, Pola, and Lussinpiccolo (1890-1914), Pelagosa (1894-1907), Padua and Brindisi (?).

Authorities: (1) ALT, E., op. cit. (2) KENDREW, W. G., op. cit.

TABLE 7. *Number of Rain-days\**

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
ALPS													
Colle Isarco . .	7	6	9	10	13	13	13	10	9	11	8	7	116
Auronzo . . .	5	5	7	9	13	14	12	11	9	11	8	6	110
Bolzano . . .	5	5	7	8	12	11	10	10	7	11	8	5	98
Sondrio . . .	6	6	8	8	12	11	10	9	8	10	8	5	100
Belluno . . .	5	6	9	13	15	16	12	11	10	11	8	7	124
Domodossola . .	7	7	8	11	13	13	10	10	10	11	8	7	114
ISTRIA													
Trieste . . .	9	10	11	11	13	12	10	9	10	12	10	10	125
Pola . . .	9	8	10	11	10	9	8	6	9	12	11	12	116
Lussinpiccolo . .	9	8	9	9	9	7	5	5	7	10	10	11	99
NORTHERN PLAIN													
<i>West</i>													
Mantua . . .	7	7	9	10	12	10	7	6	8	11	10	9	106
Turin . . .	7	6	8	13	14	13	10	8	9	10	9	7	115
Milan . . .	9	8	10	12	13	11	8	8	8	12	11	10	121
Piacenza . . .	8	7	8	10	10	9	6	5	7	10	10	9	99
Cuneo . . .	7	7	9	13	15	13	8	7	9	10	9	6	112
<i>East</i>													
Udine . . .	7	7	11	12	15	14	11	10	10	13	10	9	129
Vicenza . . .	7	7	10	12	14	12	9	8	9	12	10	9	120
Venice . . .	6	6	9	10	11	10	7	6	7	10	9	8	98
Bologna . . .	8	8	10	11	12	9	5	6	8	12	11	10	108
THE WEST OF THE PENINSULA													
<i>Riviera</i>													
Genoa . . .	10	10	11	12	12	9	6	6	9	13	12	11	119
<i>Pre-Apennines</i>													
Florence . . .	9	10	11	12	12	10	5	5	8	13	12	12	117
Leghorn . . .	10	10	11	10	9	6	3	4	7	13	12	12	106
Siena . . .	8	7	9	10	10	8	4	4	7	11	10	9	98
Rome . . .	11	10	11	12	9	6	2	3	6	12	12	12	106
<i>Campania</i>													
Naples . . .	12	12	12	13	9	6	3	4	8	13	13	14	116

\* The definition of a rain-day is not known, but is probably one with 0.1 mm. or more.



TABLE 7. *Number of Rain-days (cont.)*

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
THE EAST OF THE PENINSULA													
<i>Adriatic Coastland</i>													
Urbino . . .	8	6	7	10	10	8	4	6	7	10	8	8	92
Ancona . . .	9	8	9	9	9	8	5	5	7	11	10	9	99
Chieti . . .	11	10	9	10	9	8	5	5	6	9	11	10	101
<i>Apulian Region</i>													
Foggia . . .	8	7	8	9	7	6	2	4	5	8	8	8	79
Bari . . .	12	12	10	11	8	5	3	4	6	10	11	13	104
Gallipoli . . .	8	6	6	6	4	2	1	1	4	6	7	8	59
APENNINES													
Perugia . . .	11	10	12	13	13	11	6	5	9	13	12	11	126
Aquila . . .	9	10	10	14	12	10	6	6	8	12	10	10	116
Agnone . . .	9	10	10	11	10	9	6	6	7	10	11	11	107
Potenza . . .	9	10	10	12	10	8	4	5	7	11	10	12	106
SICILY													
Messina . . .	15	14	13	11	7	5	3	3	7	13	13	16	118
Palermo . . .	15	14	12	11	7	4	2	2	6	12	13	15	113
Caltanissetta . . .	10	11	8	8	5	2	1	2	4	8	9	11	80
Syracuse . . .	11	10	8	6	5	2	1	2	5	9	10	12	79
SARDINIA													
Sassari . . .	12	11	11	11	8	5	1	2	6	12	14	14	107
Cagliari . . .	9	10	11	10	7	5	1	1	4	8	11	12	89

Authority: ALT, E., op. cit.

TABLE 8. *Number of Days with Snowfall*

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
ALPS													
Sondrio . . .	..	..	..	..	..	..	..	..	..	..	..	..	6.0
Colle Isarco . . .	6.5	5.3	6.2	3.2	1.2	0.1	—	—	0.1	1.9	3.3	6.4	34.2
Bolzano . . .	2.9	2.5	1.3	0.1	—	—	—	—	—	0.2	0.9	3.0	10.9
Belluno . . .	2.1	2.0	1.1	0.1	—	—	—	—	—	0.1	0.7	2.3	8.4
ISTRIA													
Trieste . . .	1.9	1.2	1.1	0.2	—	—	—	—	—	0.1	0.7	1.2	6.4
Pola . . .	1.6	1.2	0.7	0.2	—	—	—	—	—	—	0.4	0.9	5.0
Lussinpiccolo . . .	1.0	0.3	0.4	—	—	—	—	—	—	—	0.1	0.3	2.1
NORTHERN PLAIN													
<i>West</i>													
Turin . . .	2.5	2.4	1.4	—	—	—	—	—	—	—	0.9	2.6	9.8
Piacenza . . .	..	..	..	..	..	..	..	..	..	..	..	..	9.5
Milan . . .	2.7	2.3	1.0	—	—	—	—	—	—	—	1.0	2.1	9.1
Cuneo . . .	..	..	..	..	..	..	..	..	..	..	..	..	13.0
<i>East</i>													
Udine . . .	1.4	0.9	1.1	0.2	—	—	—	—	—	—	0.1	0.6	4.3
Vicenza . . .	1.4	0.8	0.8	—	—	—	—	—	—	—	0.4	0.5	3.9
Venice . . .	0.6	0.4	0.4	0.1	—	—	—	—	—	—	0.3	0.2	2.0
Bologna . . .	3.1	2.3	1.2	0.1	—	—	—	—	—	—	0.6	1.3	8.6



TABLE 8. *Number of Days with Snowfall (cont.)*

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
<b>THE WEST OF THE PENINSULA</b>													
<i>Riviera</i>													
Genoa . . .	0.3	0.6	0.3	—	—	—	—	—	—	—	0.1	0.4	1.7
<i>Pre-Apennines</i>													
Florence . .	0.8	0.8	0.4	—	—	—	—	—	—	—	—	0.3	2.3
Leghorn . .	0.9	0.9	0.7	—	—	—	—	—	—	—	0.1	0.3	2.9
Siena . . .	1.0	1.1	0.6	—	—	—	—	—	—	—	0.1	0.4	3.2
Rome . . .	0.8	0.4	0.3	—	—	—	—	—	—	—	—	0.1	1.6
<i>Campania</i>													
Naples . . .	0.4	0.4	0.2	—	—	—	—	—	—	—	—	0.1	1.1
<b>THE EAST OF THE PENINSULA</b>													
<i>Adriatic Coastland</i>													
Urbino . . .	3.6	2.4	1.1	0.1	—	—	—	—	—	—	0.2	1.3	8.7
Ancona . . .	1.5	1.1	0.5	—	—	—	—	—	—	0.1	0.1	0.8	4.1
Chieti . . .	..	..	..	..	..	..	..	..	..	..	..	..	10.9
<i>Apulian Region</i>													
Foggia . . .	1.4	0.5	0.3	—	—	—	—	—	—	—	0.1	0.5	2.8
Bari . . .	..	..	..	..	..	..	..	..	..	..	..	..	2.2
<i>Apennines</i>													
Perugia . . .	..	..	..	..	..	..	..	..	..	..	..	..	6.2
Aquila . . .	4.1	3.8	3.5	3.9	—	—	—	—	—	0.4	1.4	2.9	17.0
Potenza . . .	3.9	3.3	2.5	0.9	—	—	—	—	—	0.1	0.6	2.3	13.6
<b>SICILY</b>													
Palermo . . .	0.3	0.3	0.1	—	—	—	—	—	—	—	—	0.1	0.8
Caltanissetta .	0.6	0.3	0.1	0.1	—	—	—	—	—	—	—	0.1	1.2
Syracuse . . .	—	0.1	—	—	—	—	—	—	—	—	—	—	0.1
<b>SARDINIA</b>													
Sassari . . .	0.9	0.6	0.4	—	—	—	—	—	—	—	0.1	0.2	2.2
Cagliari . . .	—	—	—	—	—	—	—	—	—	—	—	—	0.0

Stations showing annual totals only are not strictly comparable with the others, since they refer to a different series of years (unknown).

Authorities: (1) ALT, E., op. cit.

(2) FERRARA, G. 'Sulla distribuzione geografica della neve', *Meteorologia pratica*, No. 2, 1923, pp. 63-8.



TABLE 9. *Mean Number of Days with Visibility less than  $\frac{1}{2}$  mile and 2 nautical miles in each season at 7, 13, and 18 hours\**

1929-1933

	Nautical miles	Winter			Spring			Summer			Autumn		
		7	13	18	7	13	18	7	13	18	7	13	18
THE WEST OF THE PENINSULA													
<i>Riviera</i>													
Genoa . . . . .	0- $\frac{1}{2}$	2	2	1	5	5	5	3	3	3	3	4	3
	$\frac{1}{2}$ -2	3	7	4	6	7	10	5	6	5	4	3	5
<i>Pre-Apennines</i>													
Leghorn . . . . .	0- $\frac{1}{2}$	3	2	5	1	0	0	0	0	0	2	0	3
	$\frac{1}{2}$ -2	13	6	14	11	2	4	5	0	1	7	3	10
<i>Campania</i>													
Naples . . . . .	0- $\frac{1}{2}$	4	1	0	1	0	0	0	0	0	3	0	1
	$\frac{1}{2}$ -2	28	13	15	33	11	10	19	2	1	20	7	6
THE EAST OF THE PENINSULA													
<i>Adriatic coastland</i>													
Ancona . . . . .	0- $\frac{1}{2}$	11	10	7	4	3	3	0	0	0	3	0	0
	$\frac{1}{2}$ -2	15	17	14	9	6	7	2	1	1	8	4	3
<i>Apulian Region</i>													
Taranto . . . . .	0- $\frac{1}{2}$	1	0	0	1	0	0	0	0	0	2	0	0
	$\frac{1}{2}$ -2	6	3	6	8	5	6	1	0	0	4	2	4
SICILY													
Messina . . . . .	0- $\frac{1}{2}$	1	1	1	1	0	0	1	0	0	0	1	1
	$\frac{1}{2}$ -2	4	2	3	5	3	2	3	0	1	6	4	5
Palermo . . . . .	0- $\frac{1}{2}$	0	0	0	0	0	0	0	0	0	0	0	0
	$\frac{1}{2}$ -2	9	5	9	17	3	6	10	0	0	13	3	6

\* In interpreting this table it should be remembered that according to present international usage a fog is defined as visibility less than 1 km. (1,100 yds.) and a mist as visibility from 1-2 km. (2,200 yds.). A nautical mile is usually taken as 2,027 yards.

Authority: *Weather in the Mediterranean.*



TABLE 10. *Number of Days with Fog (not defined)*

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
ISTRIA													
Pola . . .	13	8	7	5	3	1	1	3	4	7	7	10	69
Lussinpiccolo . .	0.4	0.8	0.8	0.4	0.1	0.1	0.1	0.1	0.4	0.4	0.2	0.3	4
Fiume . . .	2	2	2	2	1	1	1	1	1	2	2	1	18
THE NORTHERN PLAIN													
Venice (mist or fog) . . .	9	9	5	1	1	—	—	—	1	2	4	8	39
THE WEST OF THE PENINSULA													
Pre-Apennines													
Rome . . .	1.6	1.5	1.9	1.7	1.5	1.3	1.8	2.1	1.7	1.6	1.5	1.8	20
THE EAST OF THE PENINSULA													
Apulian Region													
Pelagosa . . .	2	3	2	2	3	2	2	2	3	3	1	2	26
Brindisi . . .	0.3	0.2	0.3	0.1	0.2	0.1	—	—	0.1	0.3	0.3	0.2	2
SICILY													
Syracuse . . .	—	1	1	1	1	—	—	—	—	—	1	1	6

Authority: *Weather in the Mediterranean.*TABLE 11. *Number of Days with Fog (not defined) per season*  
1894-1923

	Winter		Spring		Summer		Autumn		Year	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Lower Adriatic and Ionian*.	2	1.2	2	0.8	1.2	0.5	1.4	0.7	7	3
Chieti . . . . .	12	24	9	19	4	11	11	28	36	82
Lecce . . . . .	12	11	4	4	4	2	8	9	27	26
S. Maria di Leuca . . .	2	1.5	3	2.5	2.5	1.5	2	2	10	8

\* Vieste, Bari, Brindisi, Taranto.

Authority: *Weather in the Mediterranean.*



TABLE 12. *Duration of Sunshine in Hours and as Percentage of the Possible*

		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
<b>ISTRIA</b>														
Trieste	hours	94	137	155	170	228	256	315	294	212	140	108	96	2205
	%	33	47	42	42	49	55	66	67	57	41	38	36	49
<b>NORTHERN PLAIN</b>														
Turin	hours	56	97	161	151	158	186	215	220	158	101	52	63	1618
	%	25	35	39	39	37	37	45	50	44	29	18	19	..
<b>THE WEST OF THE PENINSULA</b>														
Rome	hours	114	135	158	176	225	279	348	311	219	162	131	107	2362
	%	38	45	42	44	50	62	76	73	59	47	44	37	53
<b>THE EAST OF THE PENINSULA</b>														
Lecce	hours	111	129	164	186	249	312	351	317	228	167	142	109	2468
	%	38	42	45	47	54	70	77	74	62	48	47	37	56
<b>SICILY</b>														
Messina	hours	114	121	180	192	244	298	336	287	213	151	122	102	2358
	%	37	40	49	49	56	68	75	68	58	44	40	35	52

Authority: ALT, E., op. cit.

TABLE 13. *Cloud Amount (tenths)*

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
<b>ALPS</b>													
Domodossola .	4.0	4.0	5.0	5.4	5.7	5.4	4.3	4.4	4.8	5.5	5.0	4.4	4.8
Sondrio .	3.4	3.7	4.4	4.7	5.0	4.2	3.6	3.6	4.1	4.8	4.6	3.8	4.2
Bolzano .	3.6	3.5	4.4	5.2	5.4	5.1	4.1	3.9	4.3	4.9	4.4	3.7	4.4
Colle Isarco .	3.7	3.7	4.1	4.3	4.4	4.0	3.5	3.4	3.5	4.1	3.7	3.8	3.8
Belluno .	5.0	5.5	6.2	6.7	7.2	7.0	6.1	5.5	5.8	6.2	5.8	5.4	6.0
Auronzo .	3.7	4.3	4.7	5.3	6.0	5.7	4.9	4.2	4.1	4.7	4.4	4.1	4.7
<b>ISTRIA</b>													
Trieste .	5.9	5.4	5.5	5.8	5.6	5.2	3.9	3.7	4.2	5.7	6.0	5.9	5.2
Pola .	5.1	4.9	4.8	4.7	4.4	4.0	3.0	2.7	3.7	5.1	5.2	5.6	4.4
Lussinpiccolo .	4.7	4.7	4.5	4.3	3.6	3.2	2.0	2.2	3.2	4.7	4.8	5.3	3.9
<b>NORTHERN PLAIN</b>													
<i>West</i>													
Milan .	6.4	5.5	5.6	5.8	5.8	5.2	4.3	4.4	4.9	6.3	7.1	6.6	5.7
Mantua .	5.5	4.2	4.2	3.5	4.0	3.3	2.2	2.1	3.3	4.5	5.6	5.8	4.0
Piacenza .	6.0	4.9	4.8	4.9	5.0	4.1	3.0	2.8	3.9	5.7	6.6	6.3	4.8
Turin .	4.8	4.2	4.8	5.1	5.4	5.1	4.0	3.8	4.5	5.7	5.9	5.2	4.9
Cuneo .	3.9	3.6	4.7	5.1	5.2	4.5	4.0	4.1	4.9	5.6	5.0	4.1	4.6
<i>East</i>													
Udine .	5.1	5.3	5.9	6.2	6.2	5.7	4.6	4.1	4.6	5.6	5.3	5.6	5.3
Vicenza .	4.9	4.7	5.0	5.0	5.0	4.5	3.4	3.2	3.8	5.1	5.3	5.3	4.6
Venice .	6.2	5.9	6.2	5.9	5.9	5.4	4.7	4.1	5.0	6.3	6.5	6.7	5.7
Bologna .	5.7	4.8	5.0	4.9	4.7	4.0	3.0	2.6	3.7	5.2	6.1	6.1	4.6



TABLE 13. *Cloud Amount (tenths) (cont.)*

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
THE WEST OF THE PENINSULA													
<i>Riviera</i>													
Genoa . . .	5.4	5.0	5.5	5.7	5.8	5.3	4.0	3.8	4.4	5.7	5.5	5.3	5.1
<i>Pre-Apennines</i>													
Florence . .	5.5	5.3	5.6	5.5	5.2	4.3	2.9	2.5	3.6	5.3	5.5	6.0	4.8
Leghorn . .	5.5	5.3	5.6	5.3	5.2	4.5	3.1	2.9	4.1	5.2	5.5	5.9	4.8
Siena . . .	5.2	5.1	5.3	5.1	4.7	3.6	2.3	2.2	3.4	4.7	5.1	5.7	4.4
Rome . . .	5.5	5.6	5.5	5.6	5.3	4.1	2.3	2.2	3.8	5.2	5.3	5.8	4.7
<i>Campania</i>													
Naples . . .	4.8	5.0	5.0	4.9	4.2	3.2	1.9	1.6	2.8	4.3	4.9	5.2	4.0
THE EAST OF THE PENINSULA													
<i>Adriatic coast-land</i>													
Urbino . . .	6.2	5.8	5.8	5.6	5.4	4.1	3.0	3.0	4.3	6.1	6.8	6.7	5.2
Ancona . . .	7.6	6.9	6.3	6.0	5.9	5.1	3.9	3.7	5.0	6.5	7.4	7.5	6.0
Chieti . . .	5.0	5.1	4.6	4.7	4.4	4.0	2.6	2.4	3.6	4.6	5.6	5.5	4.3
<i>Apulian Region</i>													
Pelagosa . .	6.0	5.9	5.4	5.0	4.5	3.8	2.5	2.2	3.2	5.1	5.6	5.8	4.6
Foggia . . .	6.2	6.3	5.4	5.6	4.8	4.2	2.6	2.9	3.3	5.6	6.2	6.7	4.9
Bari . . .	6.0	5.8	5.3	4.9	4.2	3.8	1.7	2.0	3.2	4.8	5.8	6.1	4.5
Gallipoli . .	5.1	5.2	4.7	4.7	3.9	2.8	1.4	1.4	3.0	4.5	4.9	5.8	3.9
APENNINES													
Perugia . . .	5.9	5.7	6.0	5.9	5.6	4.8	3.4	3.1	4.2	5.5	5.8	6.2	5.2
Aquila . . .	5.8	5.4	5.5	5.6	5.4	4.5	2.9	2.6	3.8	5.4	5.9	6.3	4.9
Agnone . . .	5.6	5.3	4.8	5.4	4.8	4.2	2.8	2.7	3.6	5.4	5.9	6.1	4.7
Potenza . . .	7.0	6.5	6.4	6.4	5.8	4.8	3.0	3.0	4.2	5.8	6.6	7.2	5.6
SICILY													
Messina . .	6.1	6.0	5.4	5.2	4.3	3.0	2.8	2.1	3.4	4.9	5.6	6.4	4.6
Palermo . .	6.2	6.3	5.5	5.3	4.6	3.2	1.5	1.6	3.4	5.2	5.6	6.5	4.6
Caltanissetta .	5.6	5.6	4.5	4.0	2.8	1.6	0.6	0.8	2.5	3.5	5.3	6.2	3.6
Syracuse . .	6.0	6.0	5.6	5.6	4.9	3.4	1.8	2.2	4.2	5.7	6.0	6.4	4.8
SARDINIA													
Sassari . . .	6.2	6.0	6.1	5.6	5.3	4.2	2.6	2.6	4.3	5.7	5.9	6.5	5.1
Cagliari . .	5.3	5.5	5.3	4.9	4.1	2.7	1.3	1.0	3.3	4.7	5.3	5.5	4.1

Authority: ALT, E., op. cit.



TABLE 14. *Number of Days with Thunder*

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
<b>ALPS</b>													
Colle Isarco . . .	0	0	0	0	1	2	4	3	1	1	0	0	12
Bolzano . . .	0	0	0	0	2	3	6	4	2	0	0	0	17
Sondrio . . .	0	0	0	0	1	4	4	3	1	0	0	0	13
Domodossola . . .	0	0	0	0	3	4	5	5	0	0	1	0	18
<b>ISTRIA</b>													
Trieste . . .	0	0	1	1	3	5	6	5	4	2	1	0	27
Pola . . .	1	1	2	2	5	6	9	6	6	4	2	1	44
Lussinpiccolo . . .	1	1	1	1	1	3	3	3	4	3	1	1	21
<b>NORTHERN PLAIN</b>													
<i>West</i>													
Mantua . . .	0	0	0	2	4	4	3	3	2	1	0	0	19
Turin . . .	0	0	0	2	3	4	5	2	2	1	0	0	19
Milan . . .	0	0	1	3	5	6	5	4	2	1	0	0	29
Piacenza . . .	0	0	0	1	3	4	3	3	1	0	0	0	15
Cuneo . . .	0	0	0	2	4	6	5	3	2	1	0	0	23
<i>East</i>													
Vicenza . . .	0	0	1	2	3	4	4	3	2	1	0	0	20
Venice . . .	0	0	0	2	2	2	3	3	1	1	0	0	14
Bologna . . .	0	0	1	2	4	5	3	3	2	1	0	0	21
<b>THE WEST OF THE PENINSULA</b>													
<i>Pre-Apennines</i>													
Florence . . .	0	0	1	1	1	3	1	1	2	1	0	0	11
Siena . . .	0	0	1	1	2	2	1	1	1	1	0	0	10
Rome . . .	0	1	2	2	1	2	1	0	2	1	2	0	14
<i>Campania</i>													
Naples . . .	0	0	1	1	1	2	1	1	1	1	1	1	11
<b>THE EAST OF THE PENINSULA</b>													
<i>Apulian Region</i>													
Foggia . . .	0	0	0	1	0	1	1	2	1	0	1	0	7
Bari . . .	0	0	0	1	1	2	1	1	2	1	1	1	11
<i>Apennines</i>													
Agnone . . .	0	0	1	2	3	5	4	4	3	2	2	1	27
Potenza . . .	0	0	0	1	2	2	2	2	3	0	1	0	13
<b>SICILY</b>													
Messina . . .	0	0	0	1	0	1	0	0	1	1	0	0	4
Palermo . . .	1	1	1	1	1	1	1	1	1	2	1	1	13
<b>SARDINIA</b>													
Sassari . . .	0	0	1	0	1	0	0	0	1	1	0	0	4
Cagliari . . .	0	0	0	1	1	1	0	0	0	1	1	0	5

Authority: ALT, E., op. cit.



TABLE 15. *Number of Days with Hail*

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
ALPS													
Belluno . . .	0.0	0.0	0.1	0.3	0.7	0.3	0.5	0.5	0.2	0.3	0.0	0.0	2.9
ISTRIA													
Trieste . . .	0.3	0.2	0.4	0.4	0.1	0.5	1.0	0.4	0.3	0.1	0.6	0.1	4.4
Pola . . .	0.2	0.4	0.5	0.3	0.3	0.0	0.3	0.1	0.1	0.1	0.5	0.6	3.4
Lussinpiccolo .	0.2	0.5	0.1	0.2	0.1	0.0	0.1	0.1	0.1	0.1	0.4	0.3	2.2
NORTHERN PLAIN													
<i>West</i>													
Turin . . .	0.0	0.0	0.1	0.3	0.1	0.7	0.6	0.4	0.1	0.1	0.0	0.0	2.4
Milan . . .	0.0	0.0	0.2	0.3	0.5	0.5	0.5	0.5	0.3	0.1	0.0	0.0	2.9
<i>East</i>													
Udine . . .	0.0	0.0	0.2	0.6	1.0	0.6	0.4	0.4	0.4	0.2	0.1	0.0	3.9
Vicenza . . .	0.0	0.0	0.1	0.3	0.5	0.7	0.4	0.4	0.1	0.2	0.0	0.1	2.8
Venice . . .	0.0	0.0	0.1	0.3	0.4	0.3	0.3	0.3	0.2	0.1	0.0	0.0	2.0
Bologna . . .	0.0	0.0	0.1	0.5	0.6	0.4	0.3	0.1	0.2	0.1	0.0	0.0	2.3
THE WEST OF THE PENINSULA													
<i>Riviera</i>													
Genoa . . .	0.1	0.2	0.6	0.4	0.7	0.2	0.3	0.2	0.3	0.2	0.2	0.1	3.5
<i>Pre-Apennines</i>													
Florence . . .	0.3	0.3	0.6	0.7	0.4	0.4	0.4	0.1	0.3	0.2	0.3	0.2	4.2
Leghorn . . .	0.4	0.7	0.9	0.7	0.2	0.3	0.0	0.1	0.2	0.4	0.5	0.8	5.2
Siena . . .	0.2	0.4	0.4	0.7	0.4	0.3	0.2	0.3	0.2	0.3	0.1	0.2	3.7
Rome . . .	1.0	0.7	1.2	0.8	0.4	0.1	0.2	0.1	0.1	0.3	0.2	1.3	6.4
<i>Campania</i>													
Naples . . .	0.4	0.9	0.5	0.7	0.4	0.1	0.0	0.1	0.1	0.2	0.4	0.5	4.3
THE EAST OF THE PENINSULA													
<i>Adriatic coast- land</i>													
Urbino . . .	0.0	0.1	0.1	0.4	0.4	0.2	0.2	0.1	0.2	0.0	0.2	0.1	2.0
Ancona . . .	0.2	0.1	0.1	0.4	0.3	0.3	0.3	0.3	0.2	0.3	0.2	0.0	2.7
<i>Apulian Region</i>													
Foggia . . .	0.1	0.2	0.3	0.2	0.1	0.2	0.2	0.0	0.1	0.1	0.0	0.0	1.5
APENNINES													
Aquila . . .	0.0	0.2	0.2	0.5	0.5	0.5	0.4	0.3	0.1	0.0	0.1	0.0	2.8
Potenza . . .	0.1	0.3	0.4	0.5	0.7	0.3	0.1	0.1	0.1	0.0	0.0	0.1	2.7
SICILY													
Palermo . . .	1.6	1.0	1.4	0.9	0.2	0.0	0.1	0.1	0.1	0.2	0.5	1.2	7.3
Caltanissetta .	0.0	0.3	0.1	0.3	0.4	0.2	0.1	0.1	0.1	0.0	0.1	0.2	1.9
Syracuse . . .	0.9	0.4	0.5	0.2	0.1	0.0	0.1	0.1	0.1	0.2	0.3	0.5	3.4
SARDINIA													
Sassari . . .	0.6	0.6	1.4	0.6	0.3	0.1	0.0	0.2	0.2	0.2	0.4	0.6	5.2

Authority: ALT, E., op. cit.



# APPENDIX IV

## CONVERSION TABLES

### METRIC AND BRITISH UNITS

All metallic standards are subject to molecular change. Tables differ according to the date of the comparison on which they rest. These are based on the 1896 comparison between Yard and Metre, which gives:

$$1 \text{ metre} = 39.370113 \text{ inches.}$$

Tables 1 to 6 give the ratios between units of the same sort.

Space, and printing, deny the use of many decimal figures. Therefore such a figure as 0.00000032 is given as  $3.2 \times 10^{-7}$  (which means that the first significant figure is the seventh after the decimal point: 0.0001925 becomes  $1.925 \times 10^{-4}$ , and 0.0000734 is  $7.34 \times 10^{-5}$ ).

Tables 7 to 20 give ratios *in extenso* between single units.

These deal with conversions from metric into the equivalent British units.

Figures referring to metric units are given in italics; metric units (1 to 9) are given at the top of each table, reading horizontally from left to right; metric tens read vertically from top to bottom on extreme right and left of the table.

Thus in Table 8, if 87 centimetres are to be converted to inches, the 8 is read on the left or right edge, and, following the horizontal line until the 7 unit column is reached, the answer 34.252 is read.

### LIST OF TABLES

1. Units of Length
2. Units of Area
3. Units of Volume
4. Units of Weight
5. Units of Pressure
6. Yields per Area
7. Metres to Feet
8. Centimetres to Inches
9. Kilometres to Statute Miles
10. Square Metres to Square Feet
11. Hectares to Acres
12. Square Kilometres to Square Miles
13. Cubic Metres to Cubic Feet
14. Kilogrammes to Pounds
15. Litres to Gallons
16. Metric Tons to Tons
17. Quintals per Hectare to Tons per Acre
18. Numbers per Square Kilometre to Numbers per Square Mile
19. Degrees Centigrade to Degrees Fahrenheit
20. Millibars, Millimetres of Mercury, and Inches of Mercury



TABLE 1. UNITS OF LENGTH

Nautical mile	Statute mile	Kilometre	Metre	Yard	Foot	Inch	Centimetre
1	1.152	1.853	1853	2027	6080	72,960	185,300
$8.684 \times 10^{-1}$	$1$	$1.60934$	$1609.34$	$1760$	$5280$	$63,360$	$160,934$
$5.396 \times 10^{-1}$	$6.21372 \times 10^{-1}$	$1$	$1000$	$1093.61$	$3280.84$	$39,370.1$	$100,000$
$5.396 \times 10^{-4}$	$6.21372 \times 10^{-4}$	$1.0 \times 10^{-3}$	$1$	$1.09361$	$3.28084$	$39.3701$	$100$
$4.934 \times 10^{-4}$	$5.68182 \times 10^{-4}$	$9.14399 \times 10^{-4}$	$9.14399 \times 10^{-1}$	$1$	$3$	$36$	$91.4399$
$1.645 \times 10^{-4}$	$1.89394 \times 10^{-4}$	$3.048 \times 10^{-4}$	$3.048 \times 10^{-1}$	$3.33333 \times 10^{-1}$	$1$	$12$	$30.48(00)$
$1.371 \times 10^{-5}$	$1.57828 \times 10^{-5}$	$2.54 \times 10^{-5}$	$2.54 \times 10^{-2}$	$2.77778 \times 10^{-2}$	$8.33333 \times 10^{-2}$	$1$	$2.54(000)$
$5.396 \times 10^{-6}$	$6.21372 \times 10^{-6}$	$1.0 \times 10^{-5}$	$1.0 \times 10^{-2}$	$1.09361 \times 10^{-2}$	$3.28084 \times 10^{-2}$	$3.93701 \times 10^{-1}$	$1$

† This is the customary British practice, and not the international nautical mile, of 1852 metres, which Great Britain has not adopted.

Rough rules: 1 millimetre = 0.04 inch.

1 metre =  $\frac{1}{3}$  feet.

1 kilometre =  $\frac{1}{2}$  of a mile.

TABLE 2. UNITS OF AREA

Square mile	Square kilometre	Hectare	Acre	Square metre	Square yard	Square foot
1	2.58998	258.998	640	$258,998 \times 10$	$30,976 \times 10^2$	$278,784 \times 10^2$
$3.86103 \times 10^{-1}$	$1$	100	247.106	1,000,000	$119,599 \times 10$	$107,639 \times 10^2$
$3.86103 \times 10^{-3}$	$1.0 \times 10^{-2}$	$1$	2.47106	10,000	11,959.9	107,639
$1.5625 \times 10^{-3}$	$4.04685 \times 10^{-3}$	$4.04685 \times 10^{-1}$	$1$	4046.85	4840	43,560
$3.86103 \times 10^{-7}$	$1.0 \times 10^{-6}$	$1.0 \times 10^{-4}$	$2.47106 \times 10^{-4}$	$1$	1.19599	10.7639
$3.22831 \times 10^{-7}$	$8.36126 \times 10^{-7}$	$8.36126 \times 10^{-5}$	$2.06612 \times 10^{-4}$	$8.36126 \times 10^{-1}$	$1$	9
$3.58701 \times 10^{-8}$	$9.29029 \times 10^{-8}$	$9.29029 \times 10^{-6}$	$2.29568 \times 10^{-5}$	$9.29029 \times 10^{-2}$	$1.11111 \times 10^{-1}$	$1$

Rough rules: 1 square kilometre =  $\frac{3}{8}$  square mile.

1 hectare =  $2\frac{1}{2}$  acres.



TABLE 3. UNITS OF VOLUME

Kilolitre	Cubic metre	Cubic yard	Bushel	Cubic foot	Imp. gall.	Litre	Pint
1	1.000027	1.30799	27.4969	35.3157	219.976	1000	1759.80
$9.99973 \times 10^{-1}$	1	$1.30795$	27.4962	$35.3148$	219.970	999.973	1759.75
$7.64532 \times 10^{-1}$	$7.64553 \times 10^{-1}$	1	21.0223	27	168.178	764.532	1345.43
$3.63677 \times 10^{-2}$	$3.63687 \times 10^{-2}$	$4.75685 \times 10^{-2}$	1	1.28435	8	36.3677	64
$2.83160 \times 10^{-2}$	$2.83167 \times 10^{-2}$	$3.70370 \times 10^{-2}$	$7.78602 \times 10^{-1}$	1	6.22882	28.3160	49.8306
$4.54596 \times 10^{-3}$	$4.54608 \times 10^{-3}$	$5.94607 \times 10^{-3}$	$1.25 \times 10^{-1}$	$1.60544 \times 10^{-1}$	1	4.54596	8
$1.0 \times 10^{-3}$	$1.000027 \times 10^{-3}$	$1.30799 \times 10^{-3}$	$2.74969 \times 10^{-2}$	$3.53157 \times 10^{-2}$	$2.19976 \times 10^{-1}$	1	1.75980
$5.68245 \times 10^{-4}$	$5.68260 \times 10^{-4}$	$7.43258 \times 10^{-4}$	$1.5625 \times 10^{-2}$	$2.00680 \times 10^{-2}$	$1.25 \times 10^{-1}$	$5.68245 \times 10^{-1}$	1

TABLE 4. UNITS OF WEIGHT

† Ton	Millier or metric ton	Quintal	Kilogramme	lb.
1	1.01605	10.1605	1016.05	2240
$9.84207 \times 10^{-1}$	1	10	1000	2204.62
$9.84207 \times 10^{-2}$	$1.0 \times 10^{-1}$	1	100	220.462
$9.84207 \times 10^{-4}$	$1.0 \times 10^{-3}$	$1.0 \times 10^{-2}$	1	2.20462
$4.46429 \times 10^{-4}$	$4.53592 \times 10^{-4}$	$4.53592 \times 10^{-3}$	$4.53592 \times 10^{-1}$	1

† The ton of 2240 lb. is sometimes called the "Long Ton" to distinguish it from the "Short Ton" of 2000 lb.

Rough rule: To turn metric into British tons deduct  $1\frac{1}{2}$  per cent.



TABLE 5. UNITS OF PRESSURE

Atmosphere normal 760 mm. Hg at 0° C. ( $g = 980.665$ cm. per sec. per sec.)	Bar ( $= 10^6$ dynes per sq. cm.)	lb. per sq. inch ( $g = 980.665$ cm. per sec. per sec.)	Inches of mercury at 32° F. ( $g = 980.665$ cm. per sec. per sec.)	Millibars (1,000 dynes per sq. cm.)
1	1.01325	14.6959	29.9213	1013.25
$9.86923 \times 10^{-1}$	1	14.5037	29.5300	1000
$6.80461 \times 10^{-2}$	$6.89477 \times 10^{-2}$	1	2.03603	68.9477
$3.34210 \times 10^{-2}$	$3.38639 \times 10^{-2}$	$4.91153 \times 10^{-1}$	1	33.8639
$9.86923 \times 10^{-4}$	$1.0 \times 10^{-3}$	$1.45037 \times 10^{-2}$	$2.95300 \times 10^{-2}$	1

TABLE 6. YIELD PER AREA

Ton per acre	Metric ton per hectare	Quintal per hectare
1	2.51071	25.1071
$3.98294 \times 10^{-1}$	1	10
$3.98294 \times 10^{-2}$	$1.0 \times 10^{-1}$	1



	0	1	2	3	4	5	6	7	8	9	
1	..	3.3	6.6	9.8	13.1	16.4	19.7	23.0	26.3	29.5	1
2	32.8	36.1	39.4	42.7	45.9	49.2	52.5	55.8	59.1	62.3	2
3	65.6	68.9	72.2	75.5	78.7	82.0	85.3	88.6	91.9	95.1	3
4	98.4	101.7	105.0	108.3	111.6	114.8	118.1	121.4	124.7	128.0	4
5	131.2	134.5	137.8	141.1	144.4	147.6	150.9	154.2	157.5	160.8	5
6	164.0	167.3	170.6	173.9	177.2	180.5	183.7	187.0	190.3	193.6	6
7	196.9	200.1	203.4	206.7	210.0	213.3	216.5	219.8	223.1	226.4	7
8	229.7	232.9	236.2	239.5	242.8	246.1	249.3	252.6	255.9	259.2	8
9	262.5	265.8	269.0	272.3	275.6	278.9	282.2	285.4	288.7	292.0	9
10	295.3	298.6	301.8	305.1	308.4	311.7	315.0	318.2	321.5	324.8	10
11	328.1	331.4	334.6	337.9	341.2	344.5	347.8	351.0	354.3	357.6	11
12	360.9	364.2	367.5	370.7	374.0	377.3	380.6	383.9	387.1	390.4	12
13	393.7	397.0	400.3	403.5	406.8	410.1	413.4	416.7	419.9	423.2	13
14	426.5	429.8	433.1	436.4	439.6	442.9	446.2	449.5	452.8	456.0	14
15	459.3	462.6	465.9	469.2	472.4	475.7	479.0	482.3	485.6	488.8	15
16	492.1	495.4	498.7	502.0	505.2	508.5	511.8	515.1	518.4	521.7	16
17	524.9	528.2	531.5	534.8	538.1	541.3	544.6	547.9	551.2	554.5	17
18	557.7	561.0	564.3	567.6	570.9	574.1	577.4	580.7	584.0	587.3	18
19	590.6	593.8	597.1	600.4	603.7	607.0	610.2	613.5	616.8	620.1	19
20	623.4	626.6	629.9	633.2	636.5	639.8	643.0	646.3	649.6	652.9	20
21	656.2	659.4	662.7	666.0	669.3	672.6	675.9	679.1	682.4	685.7	21
22	689.0	692.3	695.5	698.8	702.1	705.4	708.7	711.9	715.2	718.5	22
23	721.8	725.1	728.3	731.6	734.9	738.2	741.5	744.8	748.0	751.3	23
24	754.6	757.9	761.2	764.4	767.7	771.0	774.3	777.6	780.8	784.1	24
25	787.4	790.7	794.0	797.2	800.5	803.8	807.1	810.4	813.7	816.9	25
26	820.2	823.5	826.8	830.1	833.3	836.6	839.9	843.2	846.5	849.7	26
27	853.0	856.3	859.6	862.9	866.1	869.4	872.7	876.0	879.3	882.5	27
28	885.8	889.1	892.4	895.7	899.0	902.2	905.5	908.8	912.1	915.4	28
29	918.6	921.9	925.2	928.5	931.8	935.0	938.3	941.6	944.9	948.2	29
30	951.4	954.7	958.0	961.3	964.6	967.8	971.1	974.4	977.7	981.0	30
31	984.3	987.5	990.8	994.1	997.4	1000.7	1003.9	1007.2	1010.5	1013.8	31
32	1017.1	1020.3	1023.6	1026.9	1030.2	1033.5	1036.7	1040.0	1043.3	1046.6	32
	1049.9	1053.1	1056.4	1059.7	1063.0	1066.3	1069.6	1072.8	1076.1	1079.4	



	0	1	2	3	4	5	6	7	8	9	
33	1082.7	1086.0	1089.2	1092.5	1095.8	1099.1	1102.4	1105.6	1108.9	1112.2	33
34	1115.5	1118.8	1122.0	1125.3	1128.6	1131.9	1135.2	1138.5	1141.7	1145.0	34
35	1148.3	1151.6	1154.9	1158.1	1161.4	1164.7	1168.0	1171.3	1174.5	1177.8	35
36	1181.1	1184.4	1187.7	1190.9	1194.2	1197.5	1200.8	1204.1	1207.3	1210.6	36
37	1213.9	1217.2	1220.5	1223.8	1227.0	1230.3	1233.6	1236.9	1240.2	1243.4	37
38	1246.7	1250.0	1253.3	1256.6	1259.8	1263.1	1266.4	1269.7	1273.0	1276.2	38
39	1279.5	1282.8	1286.1	1289.4	1292.7	1295.9	1299.2	1302.5	1305.8	1309.1	39
40	1312.3	1315.6	1318.9	1322.2	1325.5	1328.7	1332.0	1335.3	1338.6	1341.9	40
41	1345.1	1348.4	1351.7	1355.0	1358.3	1361.5	1364.8	1368.1	1371.4	1374.7	41
42	1378.0	1381.2	1384.5	1387.8	1391.1	1394.4	1397.6	1400.9	1404.2	1407.5	42
43	1410.8	1414.0	1417.3	1420.6	1423.9	1427.2	1430.4	1433.7	1437.0	1440.3	43
44	1443.6	1446.9	1450.1	1453.4	1456.7	1460.0	1463.3	1466.5	1469.8	1473.1	44
45	1476.4	1479.7	1482.9	1486.2	1489.5	1492.8	1496.1	1499.3	1502.6	1505.9	45
46	1509.2	1512.5	1515.7	1519.0	1522.3	1525.6	1528.9	1532.2	1535.4	1538.7	46
47	1542.0	1545.3	1548.6	1551.8	1555.1	1558.4	1561.7	1565.0	1568.2	1571.5	47
48	1574.8	1578.1	1581.4	1584.6	1587.9	1591.2	1594.5	1597.8	1601.0	1604.3	48
49	1607.6	1610.9	1614.2	1617.5	1620.7	1624.0	1627.3	1630.6	1633.9	1637.1	49
50	1640.4	1643.7	1647.0	1650.3	1653.6	1656.8	1660.1	1663.4	1666.7	1669.9	50
51	1673.2	1676.5	1679.8	1683.1	1686.4	1689.6	1692.9	1696.2	1699.5	1702.8	51
52	1706.0	1709.3	1712.6	1715.9	1719.2	1722.4	1725.7	1729.0	1732.3	1735.6	52
53	1738.8	1742.1	1745.4	1748.7	1752.0	1755.2	1758.5	1761.8	1765.1	1768.4	53
54	1771.7	1774.9	1778.2	1781.5	1784.8	1788.1	1791.3	1794.6	1797.9	1801.2	54
55	1804.5	1807.8	1811.0	1814.3	1817.6	1820.9	1824.1	1827.4	1830.7	1834.0	55
56	1837.3	1840.6	1843.8	1847.1	1850.4	1853.7	1857.0	1860.2	1863.5	1866.8	56
57	1870.1	1873.4	1876.6	1879.9	1883.2	1886.5	1889.8	1893.0	1896.3	1899.6	57
58	1902.9	1906.2	1909.4	1912.7	1916.0	1919.3	1922.6	1925.9	1929.1	1932.4	58
59	1935.7	1939.0	1942.3	1945.5	1948.8	1952.1	1955.4	1958.7	1961.9	1965.2	59
60	1968.5	1971.8	1975.1	1978.3	1981.6	1984.9	1988.2	1991.5	1994.8	1998.0	60
61	2001.3	2004.6	2007.9	2011.1	2014.4	2017.7	2021.0	2024.3	2027.6	2030.8	61
62	2034.1	2037.4	2040.7	2044.0	2047.2	2050.5	2053.8	2057.1	2060.4	2063.6	62
63	2066.9	2070.2	2073.5	2076.8	2080.1	2083.3	2086.6	2089.9	2093.2	2096.5	63
64	2099.7	2103.0	2106.3	2109.6	2112.9	2116.1	2119.4	2122.7	2126.0	2129.3	64
65	2132.5	2135.8	2139.1	2142.4	2145.7	2149.0	2152.3	2155.5	2158.8	2162.1	65
66	2165.4	2168.6	2171.9	2175.2	2178.5	2181.8	2185.1	2188.3	2191.6	2194.9	66











1 square metre = 10.76391 square feet

[illegible]

TABLE 11. HECTARES TO ACRES

1 hectare = 2.47106 acres

[illegible]



TABLE 12. SQUARE KILOMETRES TO SQUARE MILES

1 square kilometre = 0.386103 square miles

	0	1	2	3	4	5	6	7	8	9	
..	..	0.386	0.772	1.158	1.544	1.931	2.317	2.703	3.089	3.475	..
1	3.861	4.247	4.633	5.019	5.405	5.792	6.178	6.564	6.950	7.336	1
2	7.722	8.108	8.494	8.880	9.266	9.653	10.039	10.425	10.811	11.197	2
3	11.583	11.969	12.355	12.741	13.128	13.514	13.900	14.286	14.672	15.058	3
4	15.444	15.830	16.216	16.602	16.989	17.375	17.761	18.147	18.533	18.919	4
5	19.305	19.691	20.077	20.463	20.850	21.236	21.622	22.008	22.394	22.780	5
6	23.166	23.552	23.938	24.324	24.711	25.097	25.483	25.869	26.255	26.641	6
7	27.027	27.413	27.799	28.186	28.572	28.958	29.344	29.730	30.116	30.502	7
8	30.888	31.274	31.660	32.047	32.433	32.819	33.205	33.591	33.977	34.363	8
9	34.749	35.135	35.521	35.908	36.294	36.680	37.066	37.452	37.838	38.224	9
10	38.610										10

TABLE 13. CUBIC METRES TO CUBIC FEET

1 cubic metre = 35.3148 cubic feet

	0	1	2	3	4	5	6	7	8	9	
..	..	35.315	70.630	105.944	141.260	176.574	211.889	247.204	282.518	317.833	..
1	353.148	388.463	423.778	459.092	494.407	529.722	565.037	600.352	635.666	670.981	1
2	706.296	741.611	776.926	812.240	847.555	882.870	918.185	953.500	988.814	1024.129	2
3	1059.444	1094.759	1130.074	1165.388	1200.703	1236.018	1271.333	1306.648	1341.962	1377.277	3
4	1412.592	1447.907	1483.222	1518.536	1553.851	1589.166	1624.481	1659.796	1695.110	1730.425	4
5	1765.740	1801.055	1836.370	1871.684	1906.999	1942.314	1977.629	2012.944	2048.258	2083.573	5
6	2118.888	2154.203	2189.518	2224.832	2260.147	2295.462	2330.777	2366.092	2401.406	2436.721	6
7	2472.036	2507.351	2542.666	2577.980	2613.295	2648.610	2683.925	2719.240	2754.554	2789.869	7
8	2825.184	2860.499	2895.814	2931.128	2966.443	3001.758	3037.073	3072.388	3107.702	3143.017	8
9	3178.332	3213.647	3248.962	3284.276	3319.591	3354.906	3390.221	3425.536	3460.850	3496.165	9



TABLE 14. KILOGRAMMES TO POUNDS

1 kilogramme = 2.20462 pounds

[illegible]

TABLE 15. LITRES TO GALLONS

1 litre = 0.219976 gallons

[illegible]







TABLE 18. NUMBERS PER SQUARE KILOMETRE TO NUMBERS PER SQUARE MILE  
(or Square Miles to Square Kilometres)

1 square mile = 2.58998 square kilometres

[illegible]







TABLE 20. PRESSURE: EQUIVALENTS OF MILLIBARS, MILLIMETRES OF MERCURY, AND INCHES OF MERCURY AT 32° F. IN LATITUDE 45°

Mercury in.	Milli- bars	Mercury mm.	Mercury in.	Milli- bars	Mercury mm.	Mercury in.	Milli- bars	Mercury mm.	Mercury in.	Milli- bars	Mercury mm.	Mercury in.	Milli- bars	Mercury mm.
27.02	915	686.3	27.82	942	706.6	28.62	969	726.8	29.41	996	747.1	30.21	1,023	767.3
27.05	916	687.1	27.85	943	707.3	28.65	970	727.6	29.44	997	747.8	30.24	1,024	768.1
27.08	917	687.8	27.88	944	708.1	28.67	971	728.3	29.47	998	748.6	30.27	1,025	768.8
27.11	918	688.6	27.91	945	708.8	28.70	972	729.1	29.50	999	749.3	30.30	1,026	769.6
27.14	919	689.3	27.94	946	709.6	28.73	973	729.8	29.53	1,000	750.1	30.33	1,027	770.3
27.17	920	690.1	27.97	947	710.3	28.76	974	730.6	29.56	1,001	750.8	30.36	1,028	771.1
27.20	921	690.8	28.00	948	711.1	28.79	975	731.3	29.59	1,002	751.6	30.39	1,029	771.8
27.23	922	691.6	28.03	949	711.8	28.82	976	732.1	29.62	1,003	752.3	30.42	1,030	772.6
27.26	923	692.3	28.05	950	712.6	28.85	977	732.8	29.65	1,004	753.1	30.45	1,031	773.3
27.29	924	693.1	28.08	951	713.3	28.88	978	733.6	29.68	1,005	753.8	30.48	1,032	774.1
27.32	925	693.8	28.11	952	714.1	28.91	979	734.3	29.71	1,006	754.6	30.51	1,033	774.8
27.35	926	694.6	28.14	953	714.8	28.94	980	735.1	29.74	1,007	755.3	30.53	1,034	775.6
27.38	927	695.3	28.17	954	715.6	28.97	981	735.8	29.77	1,008	756.1	30.56	1,035	776.3
27.41	928	696.1	28.20	955	716.3	29.00	982	736.6	29.80	1,009	756.8	30.59	1,036	777.1
27.44	929	696.8	28.23	956	717.1	29.03	983	737.3	29.83	1,010	757.6	30.62	1,037	777.8
27.46	930	697.6	28.26	957	717.8	29.06	984	738.1	29.86	1,011	758.3	30.65	1,038	778.6
27.49	931	698.3	28.29	958	718.6	29.09	985	738.8	29.89	1,012	759.1	30.68	1,039	779.3
27.52	932	699.1	28.32	959	719.3	29.12	986	739.6	29.92	1,013	759.8	30.71	1,040	780.1
27.55	933	699.8	28.35	960	720.1	29.15	987	740.3	29.94	1,014	760.6	30.74	1,041	780.8
27.58	934	700.6	28.38	961	720.8	29.18	988	741.1	29.97	1,015	761.3	30.77	1,042	781.6
27.61	935	701.3	28.41	962	721.6	29.21	989	741.8	30.00	1,016	762.1	30.80	1,043	782.3
27.64	936	702.1	28.44	963	722.3	29.24	990	742.6	30.03	1,017	762.8	30.83	1,044	783.1
27.67	937	702.8	28.47	964	723.1	29.26	991	743.3	30.06	1,018	763.6	30.86	1,045	783.8
27.70	938	703.6	28.50	965	723.8	29.29	992	744.1	30.09	1,019	764.3	30.89	1,046	784.6
27.73	939	704.3	28.53	966	724.6	29.32	993	744.8	30.12	1,020	765.1	30.92	1,047	785.3
27.76	940	705.1	28.56	967	725.3	29.35	994	745.6	30.15	1,021	765.8	30.95	1,048	786.1
27.79	941	705.8	28.59	968	726.1	29.38	995	746.3	30.18	1,022	766.6	30.98	1,049	786.8



## APPENDIX IX

### BIBLIOGRAPHY, MAPS, AND AUTHORSHIP

#### BIBLIOGRAPHY

No Admiralty Handbook on Italy was published during the War of 1914-1918, and there is no complete, up-to-date account of Italy in English although there are many books of travel and guide books. The following list contains the most important books and articles which give further information and have been most useful in the preparation of this book.

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#### GUIDE BOOKS

There are innumerable guide and travel books, among which the publications of the Consociazione Turistica Italiana (formerly Touring Club Italiano) are particularly useful. These include (1) *The Guida d'Italia*, completed in 17 volumes in 1929, subsequently revised and expanded to 24 volumes in 1938. The introductions to these volumes are valuable regional monographs; the original editions are in some ways more useful than the later. (2) *The Annuario Generale* is invaluable as a gazetteer. (3) *Attraverso Italia* gives a good pictorial guide to the art and scenery of the country; by 1938 eight volumes had been published covering Piedmont, Lombardy (2), Sicily, Tuscany (2), Campania and Apulia, Lucania and Calabria.

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## MAPS

The whole of Italy, including the newly acquired territories and the islands, are mapped by the official Istituto Geografico Militare. The smaller-scale official maps are supplemented by many unofficial maps, some of which are of great value.

## INTERNATIONAL MAPS

- 1/1,000,000 (G.S.G.S. 2758). Italy is covered by 8 sheets: L 32 Milan, L 33 Trieste, K 32 Florence, K 33 Rome, K 34 Sofia, J 32 Tunis, J 33 Palermo, and J 34 Athens.  
 1/250,000 (G.S.G.S. 3982). Italy is covered by 35 sheets.

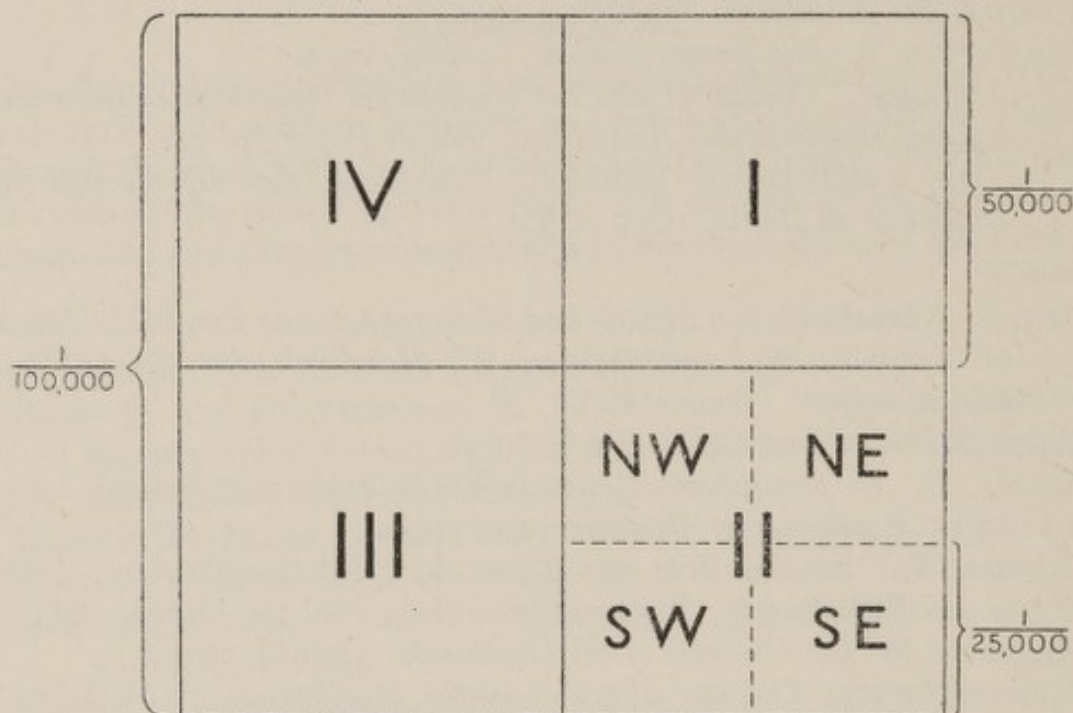
## OFFICIAL MAPS

- 1/100,000 (G.S.G.S. 4164). 300 sheets, each covering 20' of latitude and of longitude. The older editions are in black with hachures and



50-metre contours. The newer editions are in four colours with hill-shading instead of hachures. Sometimes the black edition gives a clearer impression of relief.

Based on the sheet lines and numbers of the 1/100,000 are the larger-scale series:



1/50,000 (G.S.G.S. 4229). All black. Contours mainly at 10-metre intervals, but on some sheets at either 25 metres or 50 metres with 10-metre contours interpolated here and there.

1/25,000 (G.S.G.S. 4228). As 1/50,000. Series not complete.

#### UNOFFICIAL MAPS

Among the most useful are those of the Touring Club Italiano.

1/500,000 (1937). 12 sheets. 7 colours. Motoring map with road classification, distances, and state road numbers. Hill-shading and two layers, but no contours. Useful.

1/250,000. 62 sheets. 7 colours. Motoring map with road classification, distances, and gradients. Heavy hachures, hill-shading, and contours at 50-metre intervals. This has been superseded by the

1/200,000. 30 sheets. 6 colours. Motoring map with road classification, distances, numbers, and gradients. Pale hachures and hill-shading. No contours. The best road map, although a few roads are shown as open to traffic before completion.

*Carta delle zone turistiche*. Coloured reproductions and improvements of official 1/50,000 and 1/25,000 maps of a few special areas such as the Naples district, the Riviera, and many mountain groups in the Alps.



Other useful road maps are:

*Carta dello stato delle strade.* 1/1,000,000. Published twice a year by the Reale Automobile Club d'Italia. Road map only, showing the state of road surfaces and roads normally closed by snow.

*Carta d'Italia speciale per Automobilisti, Ciclisti e Turisti.* 1/250,000. Published in 35 sheets by Istituto Italiano d'Arte Grafiche. Each sheet has a gazetteer attached.

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#### AUTHORSHIP

This volume has been written and prepared at the Oxford sub-centre by:

D. F. W. Baden-Powell, B.Sc., M.A.

J. E. M. Campbell, M.A.

H. Fifoot

C. B. Gibb, B.A.

C. F. W. R. Gullick, B.Litt., M.A.

J. O. Harries, B.A.

R. E. Head, B.A.

A. F. Martin, M.A.

E. Montgomery, M.A.

A. N. Sherwin-White, M.A.

W. B. Turrill, D.Sc.

The maps have been prepared by the drawing staff under the direction of K. W. Hartland.



# INDEX

C. = cape; F. = Fiume, river; I. = Isola -e, island -s; L. = Lago, lake; M., Mi. = Monte -i, mountain -s; P. = point; R. = Rio, stream; Staz. = stazione, station; T. = Torrente, torrent

- Abatemarco, F., 102.  
 Abbazia, 154, 155, 157, 247, 248, 434.  
 Abetone pass, 303, 307, 310.  
 Abruzzi, 22, 26, 29, 31, 313, 322, 325-6, 446, 447, 467, 482, 483, 485, 489, 493, 501.  
 —, National Park, 324, 467.  
 Abtei, *see* Badia.  
 Abyssinia, 1.  
 Acate (Dirillo), F., 165, 393, 399, 400, 401, 402.  
 Acciaroli, 99, 102.  
 Acero pass, 324.  
 Acerone di Avella, 333.  
 Aci Castello, 185.  
 — Trezza, 179, 185.  
 Acireale, 179.  
 Acqua dei Corsari, 170.  
 — Palomba, 182, 183.  
 — Salata, M. dell', 309.  
 Acquappesa, Marina di, 105.  
 Acquasanta, 169.  
 Acquaviva, 247.  
 — delle Fonti, 377.  
 Acque Paola, 278.  
 Adamello, M., 24, 27, 28, 52, 205, 210, 211, 214, 215, 221.  
 Adda, F., 20, 44, 47, 50, 52, 192, 205, 208, 209, 214, 215, 218, 219-20, 221, 252, 253, 255, 262, 433, 505.  
 Adelsberg, *see* Postumia.  
 Aderci, P., 136.  
 Adige, F., 20, 44, 45, 46, 47, 52, 141, 145, 191, 192, 205, 211, 213, 215, 216, 221-4, 225, 226, 227, 228, 230, 232, 262, 263, 265, 433, 505.  
 Administrative divisions, 12, 13.  
 Adriano (Aderno), 180.  
 Adriatic coast, 30, 31, 34, 43, 46, 136-49, 254, 311, 374, 375, 377, 380, 426, 427, 430, 450, 460, 468, 493.  
 — Coastland region, 21, 22, 310, 314, 385-9; agriculture, 388; climate, 411, 427, 428, 430, 515, 525, 528, 531-3, 535-8, 540, 542; coast, 136-41; communications, 137-9, 389; physical features, 386; population, 140, 388; ports, 141; vegetation, 140.  
 — Sea, 3, 27, 29, 44, 55, 365, 406, 407, 409, 414, 415, 417, 437, 481.  
 Afforestation, 444.  
 African Sea, 3, 56, 401.  
 Agaro, M., 231.  
 Agaves, 440.  
 Agerola, 298.  
 Agnano, L., 42.  
 Agnel, L., 497.  
 Agnone, 432, 494, 529, 531, 533, 535, 540, 541.  
 — (Montecorice), 99, 103.  
 — (Sicily), 176, 179, 180, 183, 185, 402.  
 Agordo, 233.  
 Agrabona, M., 400.  
 Agri, F., 46, 122, 329, 330, 337-8, 339, 341, 342, 368, 489, 510.  
 Agrigento, 30, 163, 167, 391, 399, 400, 518.  
 Agro, F. d', 177.  
 Agropoli, 93, 96, 97, 102, 103.  
 Aiello, 109.  
 Aiguille de Bionassay, 202.  
 Aiguillette, M., 196.  
 Ailano, 293.  
 Ala, 222.  
 —, P. (Troia, P.), 75, 82, 85.  
 Alagna, 203.  
 Alano, 236.  
 Alassio, 60, 65.  
 Alban hills, 32, 40, 81, 267, 268, 269, 277, 278, 279, 280-1.  
 Albania, 1.  
 Albano, 281.  
 —, L., 42, 279, 281, 501.  
 —, M., 270, 271, 273, 277, 280.  
 — di Lucania, 341.  
 Albegna (Albinia), F., 77, 276.  
 —, Staz. di, 83.  
 Albenga, 60, 64, 65.  
 Alberese, Plate 98.  
 Alberobello, 377, 379.  
 Albisola, 63, 64.  
 —, C., 63.  
 — Marina, 65.  
 Alburno, M., 332, 336.  
 Alcamo, 175, 395, 396.  
 Alcantara, F., 178, 398, 403.  
 Alento, F., 99, 102, 103, 335, 489.  
 Alessandria, 45, 256, 257, 259, 305, 418, 426, 527.  
 Alesso, L., *see* Caldonazzo, L.  
 Ali, C., 177.  
 Alice, P., 120, 122, 126, 347, 363.  
 Alife, 293.  
 Aliga, P., 165, 166.  
 Alimini, 128, 131.  
 Alimuri, 91, 94.



- Allaro, F., 114, 357.  
 Allée Blanche glacier, 202.  
 Alleghe, L., 43.  
 Alluvial plains, 34.  
 Alma, M. d', 75.  
 Alpage district, 230.  
 Alpe di Catenaia, 308.  
 — di S. Benedetto, 309.  
 — tre Potenze, 307.  
 Alps, 19, 20, 30, 32, 62, 187-241, 251, 262, 467, 468, 469, 478, 483, 485, 491, 493, 494, 495; climate, 406, 407, 408, 416, 418, 420, 421, 423, 424, 425, 426, 427, 428, 432-3, 526, 531, 532, 533, 534, 535, 539, 541, 542; communications, 191-2; geology, 25, 26, 27-8, 38; lakes, 41; population, 189, 191; rivers, 44, 45, 47; structure, 33, 37, 39, 187, 188; vegetation, 188, 189, 441, 445, 446, 447, 448, 449, 454, 455, 456.  
 —, Central region, 20, 52, 204-25, 467; communications, 191-2, 207, 209, 218, 219, 220, 221, 222, 225; population, 189, 191; vegetation, 188, 189.  
 —, Eastern region, 20, 52, 221, 225-41, 467, 468; climate, 421; communications, 191-2, 231, 232, 233, 235, 236, 239, 240, 241; population, 189, 191; vegetation, 188, 189.  
 —, Western region, 20, 52, 193-204, 466; communications, 191-2, 195, 197, 201; population, 189, 191; vegetation, 188, 189.  
 —, Aurine, 205, 216, 217, 218.  
 —, Belluno, 229, 232, 233, 235, 236.  
 —, Bergamasque, 209-10, 220, 221.  
 —, Bernina, 52, 214, 218, 219.  
 —, Brenner, 205, 216-17, 218, 224.  
 —, Brescian, 209, 210, 211, 212, 220, 260.  
 —, Carnic, 25, 28, 52, 188, 225, 235, 237-9, 484.  
 —, Cottian, 52, 193, 195-8, 258.  
 —, Dinaric, 28, 241.  
 —, Graian, 52, 194, 198-202.  
 —, Grosina, 205, 214-15, 219.  
 —, Istrian, 245, 249-50.  
 —, Judicarian, 204, 210, 211-13, 222.  
 —, Julian, 52, 188, 226, 238, 239-41, 409, 423, 467.  
 —, Ligurian, 64, 194, 434, 447, 448, 467.  
 —, Lombardy, 204, 206-11, 214, 222.  
 —, Maritime, 21, 26, 28, 39, 44, 52, 57, 59, 60, 62, 189, 194-5, 303, 305, 407, 408, 467, 468, 482, 483, 485.  
 —, Monginevro, 196-7.  
 —, Monviso, 196.  
 —, Orobie, 210, 215, 219, 221.  
 —, Pennine, 52, 193, 199, 202-4.  
 —, Piedmontese, 467.  
 Alps, Pusteria, 7, 218.  
 —, Rhaetian, 52, 204, 214-16.  
 —, Stubai, 216, 217.  
 —, Varo, 194.  
 —, Venetian, 42, 222, 226-30, 467, 485.  
 —, Venoste, 205, 216, 223.  
 Alseantino, L., *see* Martignano, L.  
 Alserio, L., 499.  
 Altamura, 371, 377, 379, 380.  
 Altipiano Zolfifero (Sulphur plateau), 399, 400.  
 Altissima, L', 216.  
 Alto, M., 263.  
 Altopascio, 273.  
 Alveo del Lago di Palo, 335.  
 Alvito, 327.  
 Amalfi, 92, 96, 97, 298, 493.  
 Amantea, 105, 106, 109, 347, 350.  
 Amaro, M., 326.  
 Amaseno, 289.  
 —, F., 289, 292.  
 Amato, F., 106, 353, 355.  
 Amatrice, 321, 326, 389.  
 Ambra, T., 282, 283.  
 Amendolea, F., 111.  
 Amiata, M., 30, 32, 267, 276.  
 Ampollino, F., 352.  
 Anapo, F., 180, 184, 390, 402.  
 Ancinale, F., 357.  
 Ancona, 23, 27, 137, 139, 141, 313, 320, 387, 388, 389, 415, 420, 424, 430, 480, 482, 483, 484, 525, 528, 531, 532, 533, 535-7, 540, 542.  
 —, province, 27.  
 Andalo, L., 213.  
 Andora, Marina di, 60.  
 Andrea, P., 155.  
 Andreis, 237.  
 Angeli, M. degli, 384.  
 Angitola, F., 106, 111, 355, 358, 359.  
 Angri, 299.  
 Aniene, F., 279, 312, 321, 322, 509.  
 Animal life, 467-70.  
 Anipro, P., 166.  
 Annone, 43, 207.  
 —, L., 499.  
 —, P., 94.  
 Ansiei, F., 235, 236.  
 Antelao, M., 234, 235.  
 Anthracite, 25.  
 Antignano, 74.  
 Anza, T., 203.  
 Anzio, 79, 81, 83, 84, 85, 279, 281.  
 Aosta, 44, 199, 201, 202.  
 Apennines, 19, 21, 22, 26, 27, 30, 31, 32, 33, 37, 38, 41, 52, 62, 137, 251, 265, 300-42, 366, 380, 386, 387, 389, 491, 493, 494, 495; climate, 407, 420, 423, 424, 426, 428, 435, 436, 437, 517, 529, 531, 532, 535, 536, 540, 541, 542; geology, 28-9; rivers, 45-6;



- vegetation, 440, 441, 442, 445, 446, 447, 448, 449, 454, 457.  
 Apennines, Central region, 22, 23, 26, 31, 45, 286, 300, 301, 302, 310-28, 381, 467, 468, 495; climate, 408; communications, 288, 312, 315, 322, 328; physical features, 310; rivers, 50; vegetation, 303, 313, 446.  
 —, Northern region, 22, 26, 29, 39, 57, 65, 270, 273, 300-10, 311, 385, 495; climate, 406, 408; communications, 304, 306, 310; geology, 302; structure, 301.  
 —, Southern or Campanian and Lucanian region, 22, 26, 31, 102, 119, 287, 288, 300, 328-42, 368, 370, 495; climate, 408; communications, 333; physical features, 329; vegetation, 331, 446.  
 —, Calabrian, 105, 108, 342.  
 —, Campanian, 22, 294, 298, 328-42.  
 —, Etruscan (Tuscano-Emilian), 304, 306-10, 446, 448.  
 —, Ligurian, 21, 304-6, 307, 468.  
 —, Lucanian, *see* Apennines, Southern.  
 —, Neapolitan, 332, 334, 340, 380.  
 —, Roman, 314-18, 325.  
 Appiano, 223.  
 Aprica pass, 205, 219, 220, 221.  
 Apricena, 382, 383.  
 Aprilia, 282.  
 Apuan Alps, 24, 25, 26, 29, 31, 74, 267, 268, 269-70, 271, 306, 485.  
 Apulia region, 23, 26, 29, 30, 33, 364-85, 467, 483, 485; climate, 423, 432, 437, 516, 525, 528, 529, 531, 532, 533, 535-42; coast, 127-35; communications, 129, 131, 133, 367, 385; lakes, 365; physical features, 365; population, 135, 367; ports, 135-6; rivers, 46; vegetation, 135, 366, 453; water-supply, 50, 334, 366.  
 Aquarone (Acqualadrona), 173.  
 Aquila, 311, 317, 323, 324, 420, 422, 426, 437, 482, 483, 517, 529, 532, 533, 535, 536, 540, 542.  
 — plateau, 312, 313, 318, 321, 322-5.  
 Aqueduct, Apulian, 50, 334, 366.  
 Aquilone, M., 384.  
 Arcevia, 316.  
 Archi, 109.  
 Arcidosso, 276.  
 Ardenza, 73, 85.  
 Ardore, Marina di, 119.  
 Arena, Rivo dell', 99.  
 Arenella, P., 176.  
 Arenzano, 64.  
 —, C., 64.  
 Arêtes, 38.  
 Arezzo, 282, 283, 284, 308, 482, 483.  
 Argegno, 208.  
 Argentario, M., 31, 73, 77, 82, 276.  
 Argentina, *see* Taggia, F.  
 Argento, T., 489.  
 Ariano Irpino, 330, 331, 340, 483.  
 Arma di Taggia, 60.  
 Armea, R., 59.  
 Armi, C., 111, 112, 116, 117, 119, 347.  
 Arno, F., 22, 31, 44, 45, 51, 74, 84, 267, 269, 270-1, 273, 274, 275, 282-5, 308, 435, 437, 470, 489, 508.  
 —, L., 499.  
 Arpino, 483.  
 Arrone, F., 278.  
 Arroscia, F., 60, 508.  
 Arsa, F., 153, 246, 247.  
 —, L. (Cepich See) basin, 244, 245, 264, 500.  
 Arsie, 236.  
 Arsiero, 227.  
 Arsino, F., 237.  
 Artemisio, M., 280.  
 Arvo, F., 352, 353, 510.  
 Arziglio, 59.  
 Ascoli Piceno, 387, 389.  
 Asiago, 227.  
 — plateau, *see* Sette Comuni.  
 Asinaro, F., 182.  
 Aso, F., 387, 511.  
 Asolo, 228, 263.  
 Asparano, P., 180.  
 Aspera, P., 64.  
 Aspio, F., 387.  
 Aspra, 170.  
 —, M. d', 169, 170, 396.  
 Aspromonte, 105, 108, 111, 112, 347, 356, 359-61, 398, 432, 489.  
 Assi, F., 115.  
 Assietta ridge, 196.  
 Assino, T., 315.  
 Assisi, 315, 318, 320.  
 Asti, 30, 45, 255, 256, 260, 305.  
 Astura, F., 81.  
 Atella, Fiumara d', 340.  
 Atena Lucana, 337.  
 Aterno, F., 46, 312, 314, 323, 324, 325, 326, 511.  
 Atrani, 92, 96.  
 Atri, 388.  
 Auer, *see* Ora.  
 Augusta, 183, 184, 185, 402.  
 —, gulf of, 176, 180, 183, 402.  
 Aulella, T., 269.  
 Auremiano, M., 248.  
 Aurino, F., 505.  
 Aurisina, 243, 247.  
 Auronzo, 425, 526, 533, 534, 539.  
 Aurunci, Mi., 87, 287, 288, 289, 290, 291.  
 Ausa, T., 489, 507.  
 Ausoni, Mi., 81, 87, 281, 282, 287, 288, 289, 290.  
 Avalanches, 493.



- Avella, M., 89.  
 —, Mi., 332-3.  
 Avellino, 298, 331, 333, 334, 483.  
 Aventino, F., 326, 489, 511.  
 Averno, F., 326, 489, 511.  
 Avigliano Lucana, 335.  
 Avisio, T., 222, 230, 231, 232, 234, 506.  
 Avola, Marina d', 182, 183, 185.  
 Azeglio, L. d', *see* Viverone, L. di.  
  
 Bacchiglione, F., 506.  
 Baccia, T., 239, 240, 241, 250.  
 Badia, 234.  
 Badlands, 36, 489-90.  
 Badolato, 117.  
 —, Staz. di, 115, 116.  
 Baffe, P., 68.  
 Baganzola, 51.  
 Bagheria, 395.  
 Bagnara, 105, 108, 109, 110, 112, 360.  
 Bagni, F., 106.  
 — di Lucca, Plate 115.  
 — di Pozzano, 91.  
 Bagnoli, 90, 96.  
 Bagnolo, 261.  
 Bagnone, F., 508.  
 Bagnoregio (*or* Bagnorea), 278.  
 Baia, 89, 90, 96.  
 —, gulf of, 89.  
 — di Capodistria, 149, 151.  
 — di Carini, 169.  
 — di Medolino, 153, 154, 155, 157.  
 — di Muggia, 149, 151.  
 — di Oliveri, 173, 174.  
 — di Patti, 173, 174.  
 — di Pirano, 149, 151.  
 — di Portopalo, 166.  
 — e Latina, 293.  
 Bainsizza, 249.  
 Baldo, M., 213, 222.  
 Balearic (Sardinian) Sea, 3.  
 Balestrate, 169, 170, 175.  
 Ballano, L., 500.  
 Ballino, 212.  
 Balza, 36, 387, 493.  
 Balzi Rossi, 6.  
 Baraggie, 254, 258.  
 Barati, C., 75.  
 Barbariga, 151.  
 Barberino di Mugello, 308.  
 Barcellona Pozzo di Gotto, 176.  
 Barcis, 226, 230, 237.  
 Barcovercillo, 115.  
 Bard, 199.  
 Bardonecchia, T., 197, 504.  
 Barene, 264.  
 Barga, 193, 270.  
 Bari, 129, 131, 134, 135, 366, 375, 377, 379, 437, 516, 525, 529, 531, 533, 535, 536, 538, 540, 541.  
 Barisciano, 325.  
 Barletta, 129, 131, 133, 134, 135, 136, 366, 370, 377, 381, 437.  
 Basento, F., 46, 332, 341, 342, 368, 370, 492, 493, 510.  
 Basentello, T., 369, 370.  
 Basilicata, *see* Lucania.  
 Basins, Pliocene, 36-7, 267, 270, 301, 311, 315.  
 Basodino, M., 204.  
 Bassano, 228.  
 Bastione di Malta, 112.  
 Battipaglia, 95, 299, 300.  
 Bauxite, 26.  
 Bazia, M., 108.  
 Beech woods, 446, 448.  
 Beigua, M., 62, 305.  
 Belbo, T., 489.  
 Belice, F., 161, 396, 512.  
 — Destro, F., 512.  
 Belici, F., 512.  
 Bella, I., 207.  
 Bellagio, 209.  
 Bellannova, 123.  
 Bellano, 208, 209.  
 Bellaria, 148.  
 Belledonne, 193.  
 Bellino, T., 196.  
 Bellinzona (Switzerland), 192, 207.  
 Bello, Piani del, 355.  
 Belluno, 191, 226, 230, 232, 235, 236, 482, 484, 526, 532, 533, 534, 535, 539, 542.  
 Belmonte, 109.  
 Belvedere, 109, 147.  
 — Marittimo, 105.  
 Benaco, L., *see* Garda, L.  
 Benevento, 298, 327, 328, 333-4, 435, 482, 483; gap, 22, 30, 310, 328, 329.  
 Benna, 254.  
 Bergamo, 41, 191, 192, 221, 255, 258, 260, 483.  
 Bergeggi, 62.  
 Berici, Mi., 21, 24, 26, 251, 263, 435.  
 Bernardo, P., 182.  
 Bernina pass, 192, 220.  
 Berta, C., 59, 60.  
 Bessanese, 198.  
 Bevagna, 320.  
 Bianca, C., 125.  
 —, P., 70.  
 —, P. (Sicily), 162.  
 Bianco, 119.  
 —, C., 161, 162.  
 —, M., *see* Mont Blanc.  
 —, T., 299, 337.  
 Bibbona Casale, Staz., 83.  
 —, Marina di, 82.  
 Biella, 193, 254.  
 Bientina, 273.  
 Biferno, F., 46, 136, 327, 328, 491, 510.  
 Biois, 234.



- Birds, 468-9.  
 Birgi, F., 396.  
 Bisagno, T., 508.  
 Bisceglie, 129, 131, 135, 136.  
 Biscubio, T., 511.  
 Biviere, *see* Lentini, L.  
 Bivona, 112.  
 —, plain of, 107.  
 Blanc, Mont, *see* Mont Blanc.  
 Blinden Horn, 204.  
 Bocca del Bianco, 143.  
 — del Falce, 143.  
 — di Primero, 145, 146.  
 — Piccolo, 92.  
 Bocchetta pass, 305, 306.  
 Bocco pass, 70.  
 Boeo (Marsala), C., 389.  
 Bogliasco, 67.  
 Boiano, 327.  
 Boite, T., 235, 236, 506.  
 Bologna, 255, 257, 303, 310, 430, 527, 531, 532, 533, 534, 535, 539, 541, 542.  
 Bolsena, L., 42, 278, 483, 501.  
 Bolzano, 45, 191, 204, 205, 213, 216, 217, 221, 222, 223, 224, 225, 226, 230, 231, 232, 234, 426, 433, 526, 532, 533, 534, 535, 539, 541.  
 Bonassola, 69, 70.  
 Bonico, P., 180.  
 Bonifati, C. (Cittadella del Capo), 105.  
 Bonifato, M., 395.  
 Bono, T., 511.  
 Bora, 243, 414-15, 417, 434, 436, 437.  
 Bordighera, 59.  
 Borghetto (S. Spirito), 61.  
 — (Tiber valley), 286.  
 Borgia, 355.  
 Borgio, 65.  
 Borgo, 230.  
 Borgo San Sepolcro (Sansepolcro), 315.  
 Borgocollefegato, 323.  
 Borgoforte, 266.  
 Bormida, F., 305.  
 Bormida di Spigno, F., 305, 507.  
 Bormio, 215, 219.  
 Borromeo, L., 207.  
 Bosco del Cansiglio, 229.  
 — della Ficuzza, 393, 396.  
 — di Caronia, 393.  
 — d'Umbra, 384.  
 — S. Domenica, 332, 341.  
 Boscolungo, 303.  
 Botte Donato, 352.  
 Bova Marina, 119.  
 — —, P., 182.  
 Bovalino, 362.  
 — Marina, 116, 117, 119, 362.  
 Bovino, 340, 380, 382.  
 Bozen, *see* Bolzano.  
 Bra, 257, 305.  
 Bracciano, L., 42, 278, 279, 472, 501.  
 Bracetto, P., 165.  
 Bradano, F., 46, 51, 122, 341, 368, 369, 370, 437, 510.  
 Brancalone Marina, 111, 116, 119.  
 Branco, P., 165.  
 Bratello pass, 305, 306.  
 Brembo, F., 505.  
 Brenner pass, 192, 216, 221, 224, 225.  
 Breno, 220.  
 Brenta, F., 45, 226, 227-8, 231, 265, 506.  
 Brenva glacier, 52, 53, 202.  
 Brescia, 191, 254, 256, 260, 482, 485.  
 Bressanone (Brixen), 205, 224, 426.  
 Briançonnais, 193, 194, 195, 197, 199, 201.  
 Brianza, 207, 208.  
 Briatico, 107, 109, 110, 111, 358.  
 Brienza, 337.  
 Brindisi, 128, 129, 131, 133, 135, 371, 374, 375, 377, 480, 482, 529, 533, 538.  
 — di Montagna, 492.  
 Brioni, I., 152.  
 Brisighella, 309.  
 Brixen, *see* Bressanone.  
 Brolo, 176.  
 Brucoli, 180, 183, 185.  
*Brughiere*, 254, 258.  
 Bruna, F., 75, 275.  
 Brunico (Bruneck), 225, 235.  
 Brushwoods, 454-6.  
 Bruzio, 109.  
 Bruzolo, 197.  
 Bruzzano, C., 111, 116, 361.  
 —, Fiumura di, 113.  
 Buie, 246.  
 Bulgheria, M., 98, 99, 102, 336.  
 Buonamico, F., 113, 119, 362.  
 Burano, F., 511.  
 Busento, F., 351.  
 Busin Inferiore, 497.  
*Buso*, 38.  
 Bussento, F., 101, 336.  
 But, T., 238, 239.  
 Cacafava, R., 101.  
 Caccia, M., 375.  
 Cadenabbia, 209.  
 Cadibona pass, 62, 64, 192, 195.  
 Cadini, 235.  
 Cadore, 52, 234, 235.  
 Cadria, M., 212.  
 Cagliari (Sardinia), 438, 439, 469, 518, 530, 531, 534, 535, 536, 540, 541.  
 Cagnano Varano, 385.  
 Caianello, 326.  
 Caiazzo, 291, 292.  
 Caina, T., 285.  
 Cairo, M., 327.  
 Calabernardo, 182, 183, 185.  
 Cala Bufuto, 157.



- Cala del Cefalo, 99.  
 — di Forno, 75, 77.  
 — di Mitigliano, 92.  
 — Galera, 77.  
 — Sciabica, 170.  
 Calabria region, 22, 23, 25, 29, 30, 35, 37, 45, 47, 342-64, 467, 468, 470, 489, 490, 492, 494; climate, 423, 428, 432, 437, 515; coasts, 103-21; communications, 109-10, 116, 122, 348, 351, 353, 357, 363, 364; earthquakes, 480, 481, 483, 484, 485, 487; population, 111-12, 117, 119, 126; ports, 112, 119, 127; vegetation, 110-11, 117, 127, 448.  
 Calabro Marina, 109.  
 Calaggio, F., 340.  
 Calanchi, 36, 99, 113, 302, 317, 330, 386, 397, 489.  
 Calatafimi, 396.  
 Calava, C., 173.  
 Caldanelle, T., 339.  
 Caldaro, 223.  
 —, L. (Kalterersee), 223, 499.  
 Calderone glacier, 52.  
 Caldonazzo, L., 228, 230, 500.  
 Caleiano, 370.  
 Calopinace, Fiumara, 360, 361.  
 Calore, F., 93, 292, 294, 299, 310, 327, 328, 329, 333, 334, 340, 510.  
 Calta Bellotta, 396.  
 Caltagirone, 399, 401, 402.  
 —, F., 401, 402.  
 Caltanissetta, 422, 431, 438, 480, 529, 531, 532, 534, 535, 536, 540, 542.  
 Calvi, M., 74, 309.  
 Calvo, M., 133, 153, 249, 384.  
 Camaldoli, 295, 303.  
 Cameri, 258.  
 Camerina, P., 165.  
 Camerino, 316, 317.  
 Camerota, Marina di, 99, 102, 103.  
 Cammarata, 393, 394, 396.  
 Camogli, 67, 71, 73.  
 Campagna di Roma, *see* Roman Campagna.  
 Campanella, P. (Cape of Minerva), 89, 91, 92, 298.  
 Campania, plain of, 85, 86, 91, 93, 94, 95, 96, 287, 288, 293-8, 332, 502.  
 — region, 22, 286-300, 467, 482, 483; climate, 525, 528, 531, 532, 533, 534, 536, 540, 541, 542; coast, 85-97; communications, 93-5, 288, 298, 299; lakes, 502; physical features, 287; population, 95-6; ports, 96-7; rivers, 45, 51; vegetation, 95, 288.  
 Campi d'Annibale, 281.  
 — di Reggio, 360.  
 — di S. Agata, 361.  
 — di Sclanu, 361.  
 Campi Flegrei, 32, 40, 42, 43, 89, 90, 95, 287, 294, 295, 296, 471, 472.  
 — Salentina, 373.  
 Campidano (Sardinia), 438.  
 Campiglione, 296.  
 Campione, 7.  
 Campo dei Fiori, M., 208.  
 — del Galdo, 339.  
 — di Fortuna, 81.  
 — di S. Maurizio, 254.  
 — Lomaso, 212.  
 — Tenese, 339.  
 Campobasso, 312, 328, 483.  
 Campodolcino, Plate 68.  
 Campofelice, 174.  
 Campolato, C., 180.  
 Campolongo pass, 235.  
 Campomaggiore, 493.  
 Campomarino, 137, 139, 140.  
 Camporosso (Saifnitz) pass, 239.  
 Camposauro, M., 333.  
 Canadian pond-weed, 440.  
 Canale, 264.  
 Canale del Ferro, 192, 226, 238, 239, 240.  
 — della Farasina, 153.  
 — dell' Arsa, 153, 157.  
 — di Castel Fusana, 85.  
 — di Fasana, 152.  
 — di Leme, 151, 152, 154.  
 — Fiumicino, 85.  
 — Maestro, 284.  
 — S. Odorico, 151.  
 — Volano (Po di Volano), 143.  
 Canals, *see under proper names*.  
 Canapine pass, 317.  
 Canavese, 254.  
 Canazei, Plate 78.  
 Cancelli, 294, 298.  
 Candela, 382.  
 Candelaro, T., 380, 381, 382, 383, 384, 385.  
 Candelo, 254.  
 Candia, L., 497.  
 Candigliano, F., 511.  
 Cane, P., 180, 402.  
 Canin, M., 240.  
 Canna, T., 121, 122, 126, 368.  
 Canneto canal, 85, 87, 93, 129.  
 Cannitello lighthouse, 108, 109, 111, 112.  
 Cannito, L., *see* L. Averno.  
 Canosa di Puglia, 370, 375.  
 Canterno, L., 42, 501.  
 Cantone, Marina del, 92.  
 Caorle, 149.  
 Capistrano, 356.  
 Capistrello, 43.  
 Capitello, 101.  
 Capitolo, 129.  
 Capobianco, 101.



- Capodarso, 51.  
 Capodistria, 149, 151, 155, 244.  
 Caporetto (Karfreit), 29, 240, 241.  
 Caposele, 50, 334, 335, 366, 484.  
 Capossele, 87.  
 Capraia, I., 32, 73.  
 Capraro, M., 328.  
 Caprazoppa, C., 60, 61, 62, 65.  
 Capri, I. di, 85, 91, 92.  
 Capriano, 261.  
 Caprino, 260.  
 Capua, 294, 298, 332.  
 Carabollaco, F., 161.  
 Caraffa, 355.  
 Carapelle, T., 340, 380, 381, 382.  
 Carbo, F., 396.  
 Carbone, T., 171.  
 Cardona, F., 122.  
 Cariati, 123, 126, 127, 363.  
 Carini, 175, 396.  
 Carnaro, *see* Quarnero.  
 Carnia, *see* Alps, Carnic.  
 Carob trees, 454.  
 Caronia, F. di, 397.  
 —, P., 171.  
 Caronie, Mi., *see* Nebrodi, Mi.  
 Carpano, L., 153.  
 Carpinelli, M., 382.  
 Carrara, 270.  
 —, Marina di, 82, 83, 85.  
 Carrito, 324.  
 Carrobbio, *see* Marobbia.  
 Carso (Istria), 37, 243, 244, 407, 423, 455.  
 — Tergestino, 245, 247, 248, 434.  
 Carsoli, 322.  
 Caruso pass, 324.  
 Casa Torraca, 99.  
 Casaglia pass, 308, 309.  
 Casalabate, 131.  
 Casale, M., 213.  
 — Monferrato, 44, 259.  
 Casalmaggiore, 266.  
 Casal Velino, 99.  
 Casamassima, 375, 379.  
 Casamicciola, 484.  
 Cascate della Marmore (Marble Falls), 320.  
 Casentino, 283, 303, 304, 308, 309, 467.  
 Caserta, 295.  
 Casino del Conte, 102.  
 Casoli, 326, 389.  
 Casotto, T., 195.  
 Cassano, 350.  
 —, Marina di, 97.  
 Cassibile, F., 182.  
 Castagneto, Marina di, 82.  
 Castasegna (Switzerland), 428.  
 Castel Campagnano, 292.  
 — del Piano, Plate 104.  
 — di Sangro, 324.  
 Castel di Tusa, 171.  
 — Gandolfo, 281.  
 — —, L., *see* Albano, L.  
 — Volturno, 294.  
 Castelvita, 336.  
 Casteldelfino, 196.  
 Castella, 174.  
 —, C., 116, 119.  
 Castellaccio, M., 309.  
 Castellammare del Golfo, 169, 170, 175, 176, 395.  
 — —, gulf of (Sicily), 168, 169, 170, 174, 175, 394, 395.  
 — di Stabia, 90, 94, 96, 97, 295, 299.  
 — di Velia, 102.  
 Castellaneta, 370, 371.  
 Castellano, T., 511.  
 Castelli Romani, 281.  
 Castello di Baia, 89, 97.  
 — di Falconara, 163.  
 — di Portiglione, 75, 82.  
 — Romito, 85.  
 — Villanuova, 131.  
 Castelnuovo, 270.  
 Castelpetroso pass (Pettoranello pass), 327.  
 Castelvetro, 163, 391, 395.  
 Castenedolo, 261.  
 Castiglion Fiorentino, 284.  
 Castiglioncello, 74, 85.  
 Castiglione del Lago, 286.  
 — della Pescaia, 75, 82, 84, 85.  
 Castignano, 489.  
 Casto, T., 291.  
 Castro, 292.  
 —, Marina di, 128.  
 Castrocucco, F. (F. Noce), 101, 103, 338.  
 Castrogiovanni, *see* Enna.  
 Castrovillari, 338, 339, 346, 349, 350, 351.  
 Castua, 247, 248.  
 Catania, 30, 176, 178, 179, 180, 184, 185, 391, 482, 483, 525.  
 —, gulf of, 176.  
 —, plain of, 23, 177, 178, 179, 184, 185, 390, 391, 401, 402-3, 404.  
 Catanzaro, 22, 27, 31, 116, 117, 119, 355, 480, 483.  
 — depression, 105, 347, 353-6, 361, 362, 364.  
 —, Marina di, 110, 115, 116, 117, 119.  
 Catena Costiera, 105, 106, 338, 346, 347-9, 350.  
 — Metallifera, 29, 74, 75, 274, 275, 276.  
 Catenanuova, 401.  
 Catinaccio (Rosengarten), 231, 234.  
 Catino, M., 217.  
 Catona, Fiumara, 108, 109, 360.  
 Catria, M., 316.  
 — — chain, 309, 311, 314, 315, 317.



- Cattolica, 137, 139, 140, 387, 389.  
 — Eraclea, 400.  
 Caudine Forks, 298, 333, 334.  
 Cava, 295, 298, 299.  
 — di Pozzolana, 89.  
 Cavalese, 231.  
 Cavallo, C., 128.  
 —, M., 230, 316.  
 Cavalluccio, P., 136, 137.  
 Cavazzo, L., 238, 500.  
 Cave, 402.  
 Cavedine, L., 213, 500.  
 Cavi (Cava di Lavagna), 69.  
 Cavone, F., 368.  
 Cavour canal, 256.  
 Cazzano (Cassano), Marina di, 91.  
 Ceccano, 290, 292.  
 Cecina, 74, 82, 83, 84, 275.  
 —, F., 74, 274, 489, 508.  
 Cedegolo, 221.  
 Cefalo, M., 87.  
 Cefalu, 171, 175, 176.  
 Celle Ligure, 63, 65.  
 Cellina, T., 229, 230, 237, 264.  
 Cenis, M. (Moncenisio), 44, 192, 195, 197.  
 Cenischia, T., 197.  
 Centa, F., 60, 61.  
 Cento Croci pass, 71, 306.  
 Cepich, L., *see* Arsa, L.  
 Ceppo, 261.  
 Cerbaie, 270, 273.  
 Cerda, 174.  
 Cereda pass, 233.  
 Ceresio, L., *see* Lugano, L.  
 Cerignola, 366, 380, 381, 382.  
 Cerknica (Yugoslavia), 8, 250.  
 Cerreto pass, 307.  
 Cerro pass, 320.  
 Cervaro, M., 336.  
 —, T., 310, 328, 334, 340, 380, 381, 383, 510.  
 Cervati, M., 336, 338.  
 Cervia, 143, 147, 148, 254.  
 Cervialto, M., 329, 334, 340, 366.  
 Cervino, M. (Matterhorn), 20, 28, 52, 201, 203.  
 Cervo, C., 60.  
 Cesano, F., 511.  
 Cesaro, 398.  
 Cesen, M., 229.  
 Cesenatico, 143.  
 Cesima, M., 291.  
 Cetara (Citara), 93.  
 Cetona, M., 276, 285.  
 Cetraro, 105, 109.  
 Cevedale, M., 20, 52, 215.  
 Chambeyron, M., 195, 196.  
 Cherso, I., 3, 153, 248, 500.  
 Chestnut woods, 446, 448-9.  
 Chiana, F., 284, 285, 317, 319, 508.  
 Chianale, T., 196.  
 Chiani, T., 282, 285, 286, 489, 509.  
 Chianti, 30, 273, 274, 275-6, 283, 284.  
 Chiappa, P., 67.  
 —, P. (Sicily), 165.  
 Chiappe, P., 69.  
 Chiaravalle Centrale, 116, 356, 357.  
 Chiascio (Chiaggio), F., 312, 315, 316, 318.  
 Chiatona, Staz. di, 122.  
 Chiavari, 69, 70, 71.  
 Chiavenna, 218, 491.  
 Chiecina, 489.  
 Chienti, F., 314, 317, 388, 489, 511.  
 Chieri, 258.  
 Chies d'Alpago, 230.  
 Chiese, F., 42, 211, 262, 505.  
 Chieti, 388, 528, 533, 535, 536, 538, 540.  
 Chieuti, Staz. di, 139.  
 Chieve, 261.  
 Chioggia, 147, 148.  
 Chisone, T., 196, 197, 198, 483, 504.  
 Chiusa (Klausen), Plate 73.  
 Chiusi, 283, 286.  
 —, L., 284, 285, 501.  
 Chivasso, 259, 260.  
 Ciane, F., 390.  
 Ciavola, M., 339.  
 Cicci plateau (Tschitschenboden), 245, 246, 247.  
 Cilento, 97, 99, 330, 332, 335-6, 338.  
 Ciliverghe, 261.  
 Cima Brenta, 212, 213.  
 — Ciarforon, 199.  
 — d'Asta, 28, 225, 226, 228, 230, 231, 232.  
 — di Castello, 214.  
 — di Collalunga, 6.  
 — di Lavaredo, 235.  
 — di Piazzzi, 214.  
 — Dieci, 234.  
 — Lobbie, 196.  
 — Monfalcone, 237.  
 — Orena, 231.  
 — Presanella, 215.  
 — Tombea, 211, 212.  
 — Tosa, 212.  
 — Vanscuro, 8.  
 — Vertana, 215.  
 Cimabanche pass, 235.  
 Cimini, Mi., 32, 79, 277, 278.  
 Cimino, L., *see* Vico, L.  
 —, M., 277.  
 Cimiti, C., 116.  
 Cimone, M., 31, 306, 307.  
 — chain, 272, 284, 311, 314.  
 Cimonega, 233.  
 Cingoli, 389.  
 Cinquefrondi, 110, 361.  
 Cinque Terre, 71.  
 Ciota, P., 162.



- Circeo, M., 31, 73, 81, 83, 266, 281.  
 — National Park, 81, 268, 467.  
 Cirschina (Kirchheim) pass, 8, 245, 250.  
 Cirella, 362.  
 —, P., 102.  
 Cirie, 254.  
 Ciro, 120, 127.  
 —, Marina di, 122.  
 Cirque, 38.  
 Cisa pass, 307.  
 Cismon, T., 230, 232, 236, 506.  
 — della Grappa, 228.  
 Cisterna di Roma, 279.  
 Citta di Castello, 315, 482, 483.  
 Cittadella del Capo, *see* Bonifati, C.  
 Cittanova, 151, 152, 155.  
 Civetta, M., 233.  
 Cividale, 240.  
 Civita, 339.  
 — Castellana, 278.  
 Civitavecchia, 79, 82, 83, 84, 85, 268, 277, 481.  
 Civitavella, M., 276, 277.  
 Clapier, M., 194.  
 Classe, 254.  
 Claut, 237.  
 Clauzetto, 226, 230.  
 Clays, 35-6.  
 Cles, 213.  
 Climate, 406-39; continental, 407, 411, 425, 426; influence on vegetation, 440; influence of relief on, 407; maritime influence on, 407, 433, 436, 437, 438; Mediterranean, 406, 411, 426, 430, 434, 435; statistics, 513-42.  
 Climiti, Mi., 402.  
 Cloud, 431, 433.  
 Clusone, 210.  
 Co, L., 497.  
 Coal, 25.  
 Coasts, 55-185; length of, 55.  
 Cocuzzo, M., 106, 348.  
 Codroipo, 264.  
 Cofano, M., 157, 394.  
 Cogne, 423, 433, 467.  
 Cogoletto, 64.  
 Col de Fréjus, 197.  
 — de Larche, *see* Maddalena pass.  
 — di Lana, 234.  
 — Nudo, 237.  
 — Visentin, 229.  
 Colfiorito pass, 316.  
 Colico, 209.  
 Colle della Croce, 324.  
 — della Guardia, 281.  
 — Isarco (Gosse), 422, 425, 426, 433, 526, 532-5, 539.  
 Colli Euganei, *see* Euganean hills.  
 — Laziali, *see* Alban hills.  
 Collina di Posilipo, 90.  
 Collio, 240.  
 Colonne, C., 112, 115, 116, 117, 119, 120.  
 Coltano, 271.  
 Coltura promiscua, 452.  
 — *specializzata*, 452.  
 Comabbio, L., 43, 499.  
 Comeglians, 239.  
 Comelico, 235, 237.  
 Communications, 20-1, 64, 70, 71, 82, 83, 93-5, 102, 103, 109, 110, 116, 122, 125, 129, 130, 133, 137, 139, 147, 151, 152, 154, 163, 166, 170, 174, 178, 179, 183, 191, 192, 195, 197, 201, 203, 207, 209, 218, 219, 220, 221, 222, 225, 231, 232, 233, 235, 236, 239, 241, 244-5, 246, 255-7, 260, 269, 278, 288, 298, 299, 304, 306, 310, 312, 315, 324, 328, 333, 348, 351, 353, 357, 363, 364, 367, 385, 389, 393, 398, 399, 401, 495.  
 Como, 192, 209, 254, 260.  
 —, L., 41, 43, 44, 205, 206, 207, 208, 209, 218, 221, 498.  
 Comunelli, T., 400.  
 Conca, C., 92.  
 —, T., 489.  
 — d'Oro, 169, 174, 394, 395.  
 Conegliano, 229, 263.  
 Conero, M., 30, 137, 139, 140, 386, 387, 389.  
 Conglomerates, 35-6.  
 Coniferous woods, 446.  
 Consolino (Busolino), M., 357.  
 Consuma pass, 308.  
 Contessa, M., 356.  
 —, Punta della, 128.  
 Contrasto pass, 398.  
 Conza pass, 335.  
 Copanello, C., 115.  
 Coppa, T., 489.  
 — d'Apolito, 384.  
 Copper, 276.  
 Corace, F., 115, 355, 362, 363.  
 Cordevole, T., 43, 232, 233, 234, 236.  
 Cori, 289.  
 Corica, C., 105, 106, 111.  
 Corigliano, 349, 352, 363.  
 Cork-oak woods, 450.  
 Corleone, Plate 144.  
 Cornacchia, M., 328.  
 Cornia, F., 75.  
 Corniglia, 70.  
 Cornigliano, 64.  
 Corno, F., 312, 321, 507.  
 — di Campo, 215.  
 — di Renon, 217.  
 — Grande, 310, 326.  
 Cornuda, 228.  
 Correnti, I., 2, 165.  
 Corrie, 38.  
 Corsica, 27, 29.  
 Cortale, 355.



- Cortellazzo, 145.  
 Cortina d'Ampezzo, 225, 231, 232, 233, 235, 491.  
 Cortona, 284.  
 Corvara, Plate 80.  
 Corvo, 333.  
 —, C., 70.  
 —, M., 326.  
 —, P., 165.  
 Cosa e Ansedonia, 77, 82.  
 —, T., 292, 293.  
 Coscile, F., 121, 339, 349, 350, 351.  
 Cosenza, 110, 116, 348, 350, 351, 483.  
 Cosola, 60.  
 Costa Squadro, 329, 335.  
 Costalunga pass, 232.  
 Cotrone, *see* Crotone.  
 Cotronei, 353.  
 Courmayeur, 201.  
 Cozzo, C., 107.  
 — Pellegrino, 338, 346.  
 Crati, F., 23, 46, 121, 329, 343, 346, 347, 348, 349-50, 351, 352, 364, 510.  
 Crema, 261.  
 Cremona, 256, 260, 261, 266, 483.  
 Cresta, 38.  
 Cridola, M., 237.  
 Crispiano, 371, 373.  
 Crispiniano, M., 340.  
 Crispo, M., 493.  
 Crissolo, 196.  
 Cristallo, M., 9, 235.  
 Crocco, M., 356.  
 Croce, M., 85.  
 —, M., pass, 239.  
 —, P., 87.  
 — del Calvario, M., 99.  
 — di Comelico, M., pass, 235.  
 — di Serra, M., 319.  
 — di Termini, M., 271.  
 Crocetta pass, 348, 349.  
 Cropani, 363.  
 —, Staz. di, 116.  
 Crotone, 116, 120, 122, 123, 126, 127, 363, 483.  
 —, promontory, 23, 112, 362, 363.  
 Crozzon di Lares, 215.  
 Crystalline rocks, 37.  
 Cucco, M., 308.  
 Cumae, 89, 93.  
 Cuneo, 191, 195, 259, 305, 420, 527, 531, 533, 534, 535, 539, 541.  
 Cupola di Paola, 339.  
 Cupra Marittima (Marano), 137.  
 Curinga, 356, 357.  
 Curone, T., 489.  
 Cusio, L., *see* Orta, L.  
 Cusna, M., 31, 306, 307.  
 — chain, 270, 273.  
 Cyclops, I., 179.  
 Cyrenaica, 1.  
 Dantoli, P., 152.  
 Darfo, 220.  
 Daunia, Mi. della, 133, 327, 328, 382.  
 Degano, T., 238.  
 Deiva, Marina, 69, 70.  
 Dejection-cones, 34, 35, 39, 217, 219, 220, 223, 224, 228, 238, 252, 259, 262, 264, 348, 359.  
 Deltas, *see* Lagoon-delta zone.  
 Dent Blanche, 194, 199, 200.  
 Dervio, 209.  
 Devero, L., *see* Co, L.  
 Diamante, 97, 102, 103, 105, 109, 110, 111.  
 Diano Marina, 60, 65.  
 Diavolo pass, 324.  
 Dicaearchia, 90.  
 Dicomano, 308.  
 Dirillo, *see* Acate, F.  
 Disgrazia, M., 214.  
 Dittaino, F., 401, 403.  
 Divaccia, 247.  
 Diveria, T., 203.  
 Divieto, 174, 176, 178.  
 Dobbiaco, 192, 218, 225, 235, 236.  
 — pass, 20, 192, 218, 225.  
 Dodecanese Islands, 1.  
 Dogna, 240.  
 Dolce, 222.  
 Dolent, M., 202.  
 Dolina, or doline, 38, 227, 244, 263, 366, 380.  
 Dolomites, 20, 26, 28, 39, 52, 225, 232-5, 447.  
 Domestic animals, 469-70.  
 Domodossola, 203, 204, 425, 526, 531, 533, 534, 539, 541.  
 Donna, M. della, 384.  
 Donnalucata, 165, 166, 168.  
 Dora Baltea, F., 44, 47, 50, 52, 189, 191, 193, 199, 202, 251, 258, 259, 433, 504.  
 — Riparia, F., 44, 191, 193, 196, 197, 198, 251, 258, 433, 504.  
 Dosso Alto, 211.  
 — d'Abramo, 213.  
 Draga valley, 246.  
 Dragogna, T., 151.  
 Drava, F., 225.  
 Drought, 435, 437, 438, 439.  
 Druogno, 204.  
 Dugenta, 294.  
 Duglia, F., 352.  
 Duino, 50, 146, 151, 154, 155, 243, 247.  
 Dunes, *see* Sand-dunes.  
 Duran pass, 233.  
 Earthquakes, 32, 111, 330, 331, 336, 478-88; causes of, 478-9; distribution of, 485; frequency, 481; list of, 482-5.  
 Eboli, 93, 299.



- Edolo, 205, 219, 221.  
 Egadi, I., 3, 390, 394.  
 Eggental, *see* Valle d'Ega.  
 Elba, I., 1, 3, 27, 29, 73.  
 Eleutero, F., *see* Ficarazzi, F.  
 Elio, M. d', 133, 385.  
 Ellero, T., 195.  
 Elsa, F., 275, 489.  
 Emilia, 26, 257, 265-6, 485, 489, 500.  
 Emilius, M., 199.  
 Endine, L., 210, 499.  
 Enna (Castrogiovanni), 399, 401.  
 Enza, T., 45, 507.  
 Eolie, I., *see* Lipari, I.  
 Epitaffo, P., 89, 90, 97.  
 Equa, Marina di, 97.  
 Era, F., 489, 508.  
 Erba, 207.  
 Erei, Mi., 393, 401, 402.  
 Erice (S. Giuliano), 158, 159, 393, 395.  
 Eridio, L., *see* Idro, L.  
 Eritrea, 1.  
 Ermetta, M., 62.  
 Ernici, Mi., 292, 293, 321, 322, 327.  
 Erpelle (Herpelje), 247, 248.  
 Erto e Casso, 237.  
 Eruptions, *see* Volcanic eruptions.  
 Esaro, F., 349, 350, 510.  
 Esino, F., 22, 310, 312, 317, 386, 388, 389, 511.  
 Esse, T., 284.  
 Etiache pass, 197.  
 Etna, M., 31, 32, 40, 176, 178, 179, 180, 184, 390, 391, 393, 401, 403-5, 421, 424, 448, 454, 471, 473, 474-7, 483, 484, 485.  
 Etsch river, *see* Adige, F.  
 Euganean hills, 21, 26, 251, 254, 263, 435.  
 Fabriano, 316, 483.  
 Fabrizia, 357.  
 Fabro, 286.  
 Fadalto, 229.  
 Faenza, 309.  
 Faete, M., 281.  
 Faeto, M., 347.  
 Fagagna, 262.  
 Fagnano Alto, 324, 325.  
 — Castello, 348.  
 Faiano, 299.  
 Falconera, 139.  
 — Marittima, 140.  
 Falerna, 353.  
 — Staz. di, 109.  
 Falterona, M., 309.  
 — chain, 307, 311, 314, 316, 318.  
 Falvaterra, 292.  
 Falzarego pass, 235.  
 Fano, 137, 139, 140, 301, 387, 483.  
 Faro S. Cataldo, 129.  
 Fasana, 155, 157.  
 Fasano, 377, 379.  
 Fata Morgana, 430.  
 Fate, M. delle, 290.  
 Favalto, M., 315.  
 Favazzina, 108.  
 Fedaia pass, 234.  
 Fella, F., 238, 239, 240.  
 Feltre, 228, 231, 235, 236.  
 Femina Morta, F., 161.  
 Femminamorta, M., 353.  
 Fermo, 388, 515.  
 Ferrara, 147, 148, 256, 266.  
 —, T., 491.  
 Ferret pass, 198, 201, 202.  
 Ferreto, 252, 258.  
 Ferro, F., 121.  
 Ferru, M. (Sardinia), 40.  
 Fersina, T., 222, 228.  
 Feto, C., 158.  
 Fianona, 155, 248.  
 Fiastrone, T., 511.  
 Fibreno, F., 327.  
 Ficarazzi, F. (Eleutero), 170, 396.  
 Fiesole, 273.  
 Fiessi, 155.  
 Figline, 283.  
 Filadelfia, 359.  
 Finale, 62.  
 Fioio, F., 322.  
 Fiora, F., 79, 276, 277, 509.  
 Firenzuola, 308, 309.  
 Fisch, L., 497.  
 Fiumara, 47, 104, 113, 343, 346, 361, 398.  
 Fiumara, F., *see* Recina, F.  
 Fiume, 151, 154, 155, 157, 243, 245, 247, 248, 249, 415, 417, 434, 525, 538.  
 —, gulf of, 149, 153, 154, 155.  
 Fiumefreddo (Calabria), 105, 109.  
 — di Sicilia, 174, 179.  
 Fiumenica, P., 120, 126.  
 Fiumicino, 82, 83.  
 Fiuzzo, 101.  
 Fivizzano, 484.  
 Flavia, 170, 174.  
 Fleimstal, *see* Val di Fiemme.  
 Flora, 440, 441.  
 Florence, 45, 82, 267, 269, 270, 271, 273-4, 275, 282, 304, 310, 420, 435, 436, 482, 484, 528, 531, 532, 533, 534, 536, 540, 541, 542.  
 Floresta pass, 398, 399.  
 Foce, R. la, 43.  
 — Aloisa, 131.  
 — del Brenta, 145.  
 — del F. Angitola, 106.  
 — del L. d'Averno, 90.  
 — del Reno, 141, 143, 148.  
 — di Po di Levante, 143, 145.



- Foce di Varano, 134.  
 Foenna, T., 284, 489.  
 Foggia, 134, 367, 380, 381, 382, 482, 483, 528, 531, 533, 535, 536, 540, 541, 542.  
 Foglia, F., 489, 511.  
 Fogliano, L., 43, 501.  
 Foiba, 38.  
 Foiba, T., 246.  
 Foligno, 316, 317, 319, 320.  
 Follone, F., 350, 351.  
 Follonica, 75, 82, 83, 84, 85.  
 —, gulf of, 75.  
 Fondi, L., 43, 87, 287, 288, 289, 290, 502.  
 Fondo, 213.  
 Fontanili, 253, 257, 259, 263, 266.  
 Foppiano, 203.  
 Forche Caudine, *see* Caudine Forks.  
 Forest communities, 445-51.  
 — cover, 462.  
 Forgia, T. (Lentina, F.), 395.  
 Forli, 27, 482.  
 Formazza, 204.  
 Formia, 93, 94, 95, 96, 288.  
 —, bay of, 87, 290.  
 Formiche, P., 165.  
 Forno, M., 8.  
 — di Zoldo, 233.  
 Foro, F., 489.  
 Forte dei Maroni, 85.  
 Fortino, P., 101.  
 Fortore, F., 46, 136, 328, 380, 383, 510.  
 Fossato, 353.  
 — pass, 315, 316.  
 Fosso Reale, 296.  
 Framura, 73.  
 Francavilla, 349.  
 — (Sicily), 399.  
 — al Mare, 137.  
 — Angitola, Staz. di, 109, 110.  
 Francesco, P., 91.  
 Frane, 36, 491, 495.  
 Frascati, 281.  
 Freddo, F., 396.  
 Fregene, 79, 82.  
 Friuli, 254, 262, 263, 264, 447.  
 Frontiers, 3-9; Austrian, 7, 8; French, 6; Swiss, 6, 7; Yugoslavia, 9; frontier changes after 1918, 8, 9.  
 Frosinone, 483.  
 —, F., 489.  
 Frost, 422, 437.  
 Fucecchio, 273.  
 Fucino basin, 43, 313, 323, 324.  
 Fumaiolo, M., 309.  
 Furiano, T., 171, 397.  
 Fusaro, L., 43, 89, 95, 502.  
 Fuscaldo, Marina di, 105, 109.  
 Futa pass, 308, 310.  
 Gabiet, L., 497.  
 Gadera, F., 234, 506.  
 Gaeta, 87, 93, 94, 95, 96, 288.  
 —, gulf of, 85, 96, 291.  
 Gaiana, T., 489.  
 Galatone, 125.  
 Galera, P., 70.  
 Gallico, Fiumara, 108, 360.  
 — Marina, 109.  
 Gallipoli, 125, 126, 127, 374, 420, 529, 533, 535, 540.  
 Gallivaggio, 219.  
 Gallo, C., 128, 129, 169, 176, 394.  
 —, M., 169.  
 Game (animals and birds), 467, 468, 469.  
 Gangi, 401.  
 Garda, 212, 213.  
 —, L., 28, 31, 41, 42, 44, 50, 189, 211, 212, 213, 222, 252, 260, 420, 433, 499.  
 Gardena, F., 234.  
 — pass, 234.  
 Gardone, 211, 212.  
 Garessio, Plate 46.  
 Garfagnana, 267, 270, 301, 303.  
 Garga, F., 352.  
 Gargano, M., 26, 29, 365, 366-7, 380, 382, 383-5, 415, 467, 483, 485.  
 —, M., peninsula, 23, 43, 131, 132-4, 145, 364, 365, 383-5, 436, 437.  
 Gargnano, 212.  
 Garigliano, 99, 101, 103.  
 —, F., 46, 87, 288, 290, 291, 292, 293, 509.  
 Garlate, L., 208, 209, 499.  
 Gatto, P. (Pax Tecum), 153, 154, 155, 157.  
 Gazza, T., 210.  
 Gazzi, 480.  
 Gela (Terranova), 163, 166, 167, 168, 400, 402.  
 —, F., 165, 167, 400, 402.  
 —, gulf of, 163, 165.  
 Gennargentu (Sardinia), 424, 439.  
 Genoa, 57, 64, 65, 67, 70, 71, 302, 304, 305, 420, 431, 436, 479, 525, 527, 531, 532, 533, 534, 536, 537, 540, 542.  
 —, gulf of, 62, 304, 306, 415, 436, 442, 489.  
 Genuardo, M., 396.  
 Genzano di Lucania, 281, 369, 370.  
 Geology, 23-32.  
 — table, 24.  
 Gerace, 362.  
 — Marina, *see* Locri.  
 Gerbidi, 258.  
 Germanasca, T., 197.  
 Germano, P., 92.  
 Gerolomini, 90.



- Gesso, T., 195.  
 Giacomo pass, 203.  
 Giamutri, I., 73.  
 Giardini, 178.  
 Giarre, 180.  
 Gibilmesi, M., 395.  
 Gigilio, I., 73.  
 Gimino, 245.  
 Ginosa, 371.  
 —, Staz. di, 122.  
 Giogo Alto, 216.  
 Giogo pass, *see* Il Giogo.  
 Gioia, 109, 110, 111, 112, 359.  
 —, gulf of, 103, 107, 111.  
 —, plain, 105, 107, 109, 110, 111, 112, 347, 358-9, 360, 361.  
 — del Colle, 379.  
 Gioiosa, 119, 357, 361, 362.  
 — Marea, 176.  
 — Marina, 116, 119.  
 Giovenco, F., 43.  
 Giovi, M., 307.  
 — pass, 62, 304, 305.  
 Giovinazzo, 129, 131, 135, 136.  
 Giovo, 64.  
 —, M., pass, 217.  
 Girgenti, *see* Agrigento.  
 Girifalco, 355.  
 Giulianova, 139, 141.  
 Glaciated landforms, 38-9.  
 Glaciation, 31, 188, 197, 199, 202, 212, 215, 217, 218, 238, 270, 326, 339.  
 Glaciers, 31, 39, 52-3, 198, 199, 202, 203, 210, 212, 214, 215, 216, 229, 232, 234.  
 Glorenza (Glurns), 223, 224.  
 Golfo del Cofano (Vermia bay), 157, 158.  
 Gonfolina gorge, 271, 273.  
 Gorgona, I., 73.  
 Gorizia (Görz), 29, 191, 241, 244, 248, 256.  
 Gornalunga, F., 401, 403.  
 Gorzano, M., 321, 325, 326.  
 Gosse, *see* Colle Isarco.  
 Gottedrasizza (Hotederšica), 250.  
 Gottero, M., 270, 306.  
 Grado, 146, 148.  
 Gragnano, 299.  
 Graham's Shoal, 474.  
 Gran Paradiso, 20, 52, 198, 199, 201.  
 — — national park, 467.  
 — Pilastro, 218.  
 — Sasso d'Italia, 22, 52, 311, 312, 314, 322, 325, 388, 428.  
 — Zebbru, 216.  
 Granatello, 90.  
 Grand Combin, 203.  
 Grande, P., 165.  
 —, T., 357.  
 — di Imera, F., 398.  
 Grande di Monticchio, L., 502.  
 Granitola, 158.  
 —, C., 157, 158, 161, 163, 166, 167, 168.  
 Graphite, 25.  
 Grappa, M., 228, 235.  
 Gravina, 365, 375.  
 Gravina, 369, 371, 380.  
 —, T., 370.  
 Greco or gregale, 415.  
 Gremi, M., 356.  
 Grignano, 149.  
 Grigno, 231.  
 Grisafi, C., 111.  
 Grivola, 199.  
 Groane, 254.  
 Grödentel, *see* Valle di Gardena.  
 Gronolo, F., 69.  
 Grossa, P., 149.  
 Grosseto, 75, 77, 83, 274, 275.  
 —, Marina di, 82, 84.  
 Grosso, C., 103.  
 —, C. (Sicily), 170.  
 Grotta, 248.  
 Grotta Dragona, 89.  
 Grottaglie, 371, 373, 374.  
 Grotte di Nerone, 81.  
 Grotto, 165.  
 — Matera, 94.  
 Grue, T., 489.  
 Grumo Appula, 375, 377, 379.  
 Gua, T., 506.  
 Gualdo Tadino, 315, 316.  
 Guardia, 105.  
 Guardiagrele, 388.  
 Gubbio, 315, 316.  
 Guelfo pass, *see* Bratello pass.  
 Guglielmo, M., 211.  
 Gurrída, L., 43.  
 Hail, 432.  
 Heaths, 456.  
 Herbs, communities of, 457-8.  
 Herculaneum, 91, 297, 472, 482.  
 Hidalo, P., 75.  
 Hohe Tauern, 217.  
 Hotederšica, *see* Gottedrasizza.  
 Humidity, 422.  
 Hyblean hills, *see* Iblei, Mi.  
 Iblei, Mi., 23, 166, 177, 390, 391, 401-2.  
 Ica, 157.  
 Idice, T., 489, 512.  
 Idria, 25, 28, 245.  
 —, F., 249, 250, 507.  
 Idro, F., 373.  
 —, L., 29, 42, 203, 211, 499.  
 Iesi, 389.  
 Iglesias (Sardinia), 439.  
 Iglesiente (Sardinia), 25.



- Il Castello, 308.  
 — Fondaco, 115.  
 — Giardino, 127.  
 — Giogo pass, 308, 310.  
 Illasi, 227.  
 Imera Meridionale, F., *see* Salso, F.  
 — Settentrionale, *see* Grande di Imera.  
 Imperia, 60, 64, 65.  
 Imperial canal, 273.  
 Incisa, 283.  
 Inganno, T. dell', 171.  
 Inglese, P., 97.  
 Inice, M., 395.  
 Intermesole, M., 326.  
 Intra, 206.  
 Ionian coast, of Calabria, 31, 117, 357, 424, 430; of Sicily, 178-85, 430.  
 — Sea, 3, 44, 55, 56, 401, 409.  
 Irminio, F., 165, 166.  
 Iron mines, 201.  
 Iron-ore, 14, 27.  
 Irsina, 370.  
 Isarco (Eisack), F., 45, 192, 205, 216, 217, 221, 224-5, 234, 506.  
 Ischia, I., 3, 32, 85, 89, 471, 472, 474, 484, 485, 489.  
 Isclero, F., 333.  
 Iseo, 220.  
 —, L., 41, 44, 205, 206, 209, 252, 260, 499.  
 Isère, river 201.  
 Isernia, 327, 482.  
 Isola Bella, 178.  
 — Capo Rizzuto, 116.  
 — delle Femmine, 176, 394.  
 — di Dino, 101.  
 — d'Istria, 151, 155.  
 — di Ustica, 168, 332, 525.  
 — Grande (Isola dello Stagnone), 158.  
 — Vendicari, 182.  
 Isoletta, 292.  
 Isolotto Troia, *see* Scoglio dello Sparviere.  
 Isonzo, F., 43, 45, 141, 146, 191, 239, 240, 241, 249, 250, 264, 265, 507.  
 Ispica (Spaccaforno), 402.  
 Istria region, 20, 26, 37, 241-50; climate, 415, 420, 426, 432, 433-4, 513, 525, 526, 531, 534, 535, 538, 539; coast, 149-57, 420; communications, 151, 152, 154, 244-5, 246; lakes, 500; physical features, 241, 243; population, 155; ports, 155, 157; rivers, 50; vegetation, 154, 243, 244, 441, 442, 447, 455.  
 — Bianca, 245, 247-8.  
 — Grigia, 245, 246, 247.  
 — Rossa, 244, 245-6.  
 Italian East Africa, 1.  
 — Somaliland, 1.  
 Italo-German Institute of Marine Biology, 155.  
 Italy, area, 2; position, 1-3.  
 —, continental, 19, 20-1, 44, 45; climate of, 407, 432-5, 513, 525-7, 531-5, 538-9, 541-2.  
 —, insular, 19; climate of, 407, 424, 437-9, 517-18, 525, 529-32, 534-42.  
 —, peninsular, 19, 21-3, 45-6; climate of, 407, 420, 421, 422, 423, 425, 426, 427, 432, 435-7, 514-17, 525, 527-9, 531-3, 534-42; vegetation of, 449, 450.  
 Iudrio, T., 9.  
 Ivrea, 27, 31, 194, 199.  
 Izzo, P., 180.  
 Jôf di Montasio, 240.  
 — Fuart, 240.  
 Judicarian valley, 209, 211, 212.  
*See also under I.*  
 Kalterersee, *see* Caldaro, L.  
 Karawanken, 239.  
 Karfreit, *see* Caporetto.  
 Kastel, L., 497.  
 Kirchheim, *see* Circhina.  
 Klagenfurt (Austria), 192, 239.  
 Klausen, *see* Chiusa.  
 L'Altissima, 216.  
 La Crista, 358.  
 — Manfiana, 339.  
 — Montagnola, 328.  
 — Pietra, 90.  
 — Rava, R., 327.  
 — Rotonda, 335, 337, 339.  
 — Saliera, 97.  
 — Serra, 258.  
 — Spezia, 70, 71, 73, 525.  
 —, gulf, 70.  
 — Spina, M., 338, 339.  
 — Testa, 129.  
 — Verde, F., 113.  
 — Verna, 303.  
 Labbro, M., 276.  
 Lacedonia, 382.  
 Ladispoli, 79, 82, 83.  
 Laga, Mi. della, 321.  
 Lagastrello pass, Plate 114.  
 Lago, L., *see* Co, L.  
 Lagonegro, 338.  
 Lagoon and Delta Zone, 33, 34, 141-6, 256, 262, 265, 266.  
 Lagoons, 34, 43, 77, 78, 81, 86, 131, 133, 141, 143, 145, 146, 165, 179, 262, 265, 281; (*Laguna morta*), 34, 141, 264; (*viva*), 34, 141, 264.  
 Lagosta, I., 3, 437.  
 Laguna Caorle, 264.  
 — di Comacchio, 43, 143, 147, 266.



- Laguna di Grado, 145, 146, 148, 264.  
 — di Marano, 145, 148, 264.  
 — di Orbetello, 77.  
 — Veneta, 145, 147, 148, 264, 265.  
 Laigueglia, 60.  
 Laives, 223.  
 Lakes, 41-3, 496-502; crater, 32, 42, 277, 281, 296; dammed by landslips or alluvium, 42-3; drained, 43; glacial, 41-2; influence on river regimes, 47, 50; of limestone districts, 42.  
 Lambro, T., 262.  
 —, F. (Cilento), 99.  
 Lame, 491, 492.  
 Lamon, 236.  
 Lamone, F., 46, 308, 309, 489, 512.  
 Lampedusa, I., 3.  
 Landform types, 32-40.  
 Landslips, 31, 36, 238, 275, 302, 328, 330, 339, 388, 397, 400, 480; effects of, 495; frequency, 494; liability to, 491-5; types of, 491-4.  
 Langhe, 26, 302, 304, 305.  
 Lao, F., 102, 338, 339.  
 Larch woods, 446, 447.  
 Lario, L., *see* Como, L.  
 Lasa, 224.  
 Latemar, M., 231.  
 Latera, 278.  
 Laterza, 369, 371.  
 Latifundia, 457.  
 Latin valley, 287, 288, 290, 292-3.  
 Latium, 31, 46, 269, 322, 468, 482, 485, 489, 494, 501.  
 Lattani, M., 291.  
 Lattari, Mi., 294, 295, 298.  
 Laurana, 154, 155, 157, 243.  
 Laureana, 356.  
 Lauria, 338, 339.  
 Lauro, M., 402.  
 Lavagna, 68.  
 —, F., 65, 69, 305, 508.  
 Lavarone, 227.  
 Lavello, 370, 380.  
 Laveno, 206, 207.  
 Lavino, T., 511.  
 Lavis, 213, 222.  
 Lazzaretto, 155.  
 Lazzaro, 481.  
 Le Cornate, M., 275.  
 — Fornaci, 85.  
 — Grazie, M., 277.  
 — Lavezze, 428.  
 — Tavernole, 292.  
 Lead, 26.  
 Leale, 237.  
 Lecce, 129, 366, 371, 372, 373, 374, 431, 483, 516, 538, 539.  
 Lecco, 207, 208, 209, 251.  
 —, L., 41, 207, 208, 209.  
 Ledro, L., 500.  
 Leghorn (Livorno), 73, 83, 84, 85, 268, 271, 420, 424, 436, 484, 514, 525, 528, 531, 532, 533, 534, 536, 537, 540, 542.  
 Legnone, M., 209.  
 Leiro, T., 64.  
 Lemene, F., 506.  
 Lenna, T., 369.  
 Lentina, F., *see* Forgia, T.  
 Lentini, 32.  
 —, F. (*see also* S. Leonardo), 179, 402, 403.  
 — (Biviere), L., 402, 403, 502.  
 Leonessa, 321.  
 Leonforte, 401.  
 Lepini, Mi., 282, 287, 288, 289-90.  
 Lerici, 70, 73.  
 Lesichina, 247.  
 Lesima, M., 306.  
 Lesina, L., 43, 136, 383, 385, 480, 502.  
 Lessini, Mi., 26, 189, 222, 226, 227.  
 Letimbro, T., 508.  
 Levanna, M., 198.  
 Levante, 416.  
 Levanto, 69, 70.  
 Leveno, 206, 207.  
 Levico, L., 500.  
 Li Galli, I., 92.  
 — Foi di Picerno, M., 337.  
 — Spechi, M., 125.  
 Libeccio, 415.  
 Libya, 1.  
 Licata, 162, 163, 166, 167, 168, 400.  
 Licosia, P., 97, 435.  
 —, M., 97, 99.  
 Lido, *see* Litorale di Lido.  
 — d'Avola, 182, 183.  
 — di Iesolo, 145.  
 — di Lombardi, 145.  
 — di Noto, 185.  
 — di Roma, 79, 83, 84, 85.  
 — S. Nicolo, 149, 155.  
 Lignite, 26, 276.  
 Liguria region, 21, 468, 469, 479, 500; climate, 414, 415, 420, 422, 423, 426, 435, 436, 514, 525, 527, 531, 532, 533, 534, 536, 537, 540, 542; coast and topography, 57-73; communications, 64, 70, 71; population, 65, 71; ports, 65, 73; vegetation, 64-5, 71, 303, 448, 461.  
 Ligurian Sea, 3.  
 Lima, F., 307.  
 Limatola, 294, 333.  
 Limestone, 37-8; plateaux, 37-8; lakes, 42.  
 Limone, 212.  
 Linaro, C., 79.  
 Linguaglossa, 404.  
 Linosa, I., 3, 32.  
 Lipari (Eolie), I., 3, 32, 168, 473, 485.  
 Lipuda, T., 120.



- Liri, F., 43, 46, 286, 288, 290, 292-3, 312, 314, 321, 327, 509.  
 Liro, F., 218.  
 Litorale del Cavallionio, 145.  
 — di Lido, 145, 148, 264.  
 — di Pellestrina, 145.  
 Littoral sands, 33-4.  
 Littoria, 83, 85, 282.  
 Livenza, F., 506.  
 Livigno, 214, 215.  
 Livorno, *see* Leghorn.  
 Ljubljana (Laibach; Yugosl.), 1, 244.  
 Lo Serrone, 337.  
 Locana, 198.  
 Locarno (Switzerland), 204, 207.  
 Locone, F., 369, 370.  
 Locri (Gerace Marina), 116, 119.  
 Lombardy, 26, 251, 252, 254, 255, 257, 260-2, 469, 482, 498-9.  
 Lomellina, 259.  
 Longarone, 234, 236, 237.  
 Loppio, 213, 222.  
 Lorenzo, R. di, 60.  
 Loreto, 388.  
 Lovello, M., 218.  
 Lovere, 220.  
 Lucania, 45, 51, 330, 365, 482-4, 489, 491, 493, 502; coast, 97-103; communications, 102-3; lakes, 502; population, 103; ports, 103; vegetation, 103, 448, 467, 468, 470.  
 Lucca, 25, 82, 269, 273.  
 Lucera, 135, 383.  
 Lucrino, L., 90.  
 Lugano, L., 41, 206, 207, 208, 498.  
 Luino, 207, 208.  
 Lunga, P., 155.  
 Lungo Superiore, L., 498.  
 Lungro, 350.  
 Lunigiana, 270.  
 Lussino, I., 3, 153, 248.  
 Lussinpiccolo, 526, 531, 532, 533, 534, 535, 538, 539, 541, 542.  
 Lutago, 218.  
 Lys, T., 201, 504.  
 Maccarese, Bonificazione di, 79.  
 Macchia, 455-6.  
 Macerata, 389.  
 Maddalena pass (Col de Larche), 194, 195.  
 Maddaloni, 295.  
 Madonie, Mi., 171, 390, 393, 396, 397-8.  
 Madonna, P., 149, 151.  
 — del Capo, *see* Portofino, P.  
 — di Cristo, 384.  
 Madonnuzza, P., 170.  
 Mae, T., 232, 233.  
 Maestro or Maestrale, 415.  
 Magazzalo, F., 161.  
 Maggia, F. (Switz.), 206.  
 Maggiorasca, M., 306.  
 Maggiore, F., 285.  
 —, L., 27, 28, 41, 43, 44, 192, 194, 203, 206, 208, 258, 433, 497.  
 —, M. (Campania), 89, 287, 290-2, 293, 294.  
 —, M. (Istria), 153, 243, 244, 245, 426, 248.  
 —, M. (L. Garda), 213.  
 —, M. (Umbria), 318.  
 Magnisi, P., 180, 402.  
 Magra, F., 45, 70, 73, 266, 270, 301, 306, 489, 508.  
 Magredi, 254, 264.  
 Maida, 355, 356.  
 Maiella, 22, 31, 311, 312, 314, 322, 326.  
 Maiolo, P., 62.  
 Maiori, 92, 94, 96.  
 Maira, T., 194, 447.  
 Maledia glacier, 194.  
 Malfrancata, T., 120, 121, 126, 127.  
 Malles, 224, 225.  
 Maloia pass (Switz.), 218.  
 Malpertugia, T., 171.  
 Malvito, 348.  
 Mammola, 116.  
 Mancinare, M., 315.  
 Mancuso, M., 105, 106, 353.  
 Mandrioli pass, 308.  
 Manerba, 260.  
 Manfredonia, 127, 131, 133, 134, 135, 136, 381, 382, 385, 482.  
 —, gulf of, 23, 30, 127, 128, 131, 133, 365, 380, 480.  
 Mangart, M., 8.  
 Mantova di Mezzo, L., 499.  
 — Inferiore, L., 499.  
 — Superiore, L., 499.  
 Mantua (Mantova), 255, 260, 420, 430, 527, 531, 533, 534, 539, 541.  
 Maralunga, P., 70.  
 Marano, *see* Cupra Marittima.  
 —, T., 489.  
 Marble quarries, 74, 270.  
 Marcellinara, 355.  
 Marcello, 87.  
 Marches, The, 482, 483, 489, 501.  
 Marchesato, 23, 347, 355, 362, 363, 489.  
 Marcianise, 294.  
 Marcite, 255, 261, 458.  
 Mare Grande, *see* Taranto, bay of.  
 — Piccolo, 369, 373.  
 Marecchia, F., 511.  
 Maremma, 73, 268, 274-5, 276, 280, 282, 467, 468.  
 Marengo, 257, 259, 305.  
 Marepotamo, F., 359.  
 Margherita di Savoia, 131, 133, 134, 135, 136, 382.



- Marina, *see proper name*.  
 Marinella, 161, 163, 167.  
 Marineo, 395.  
 Marino, 281.  
 Marmarole, 234, 235.  
 Marmolada, 20, 232, 234.  
 Marmontana, M., 214.  
 Marobbio, 417.  
 Maroglio, F., 400.  
 Marradi, 309.  
 Marroggia, T., 312, 320.  
 Marsala, 158, 159, 390, 391, 395.  
 Marsciano, 319.  
 Marsica, 313, 324, 326, 327, 484.  
 Marsico Nuovo, 338.  
 Marta, F., 277, 278, 509.  
 Martano, M., 318, 319, 320.  
 Martignano, L., 501.  
 Maruggio, M., 337.  
 Mary, M., 199.  
 Marza, P., 165.  
 Marzamemi, 182, 183, 185.  
 Marzano, M., 332, 335.  
 Marzeno, T., 489.  
 Massa, C., 92.  
 —, Marina di, 85.  
 —, Marittima, 83.  
 Massaciuccoli, L., 43, 74, 501.  
 Massafra, 369, 371, 379.  
 Massalubrense, 92, 94, 298, 299.  
 —, Marina di, 97.  
 Masseria i Pali, 125.  
 — Xireni, 174.  
 Massico, M., 87, 89, 94, 287, 290-1, 294.  
 Massoncello, M., 73, 75.  
 Matera, 370, 371.  
 Matese, 31, 293, 318, 326-7, 483.  
 —, L., 42, 327, 502.  
 Matterhorn, *see Cervino*, M.  
 Mattinata, 384.  
 Mattuglie, 243.  
 Mauria pass, 239.  
 Mavone, F., 511.  
 Mazara, T., 159.  
 — del Vallo, 158, 159, 163, 391.  
 Meadows, 458.  
 Mediterranean Sea, salinity of, 407.  
 Meduna, T., 230, 237, 264.  
 Meduno, 226, 237.  
 Melandro, T., 337.  
 Mele, C., 60.  
 Meledrio, T., 211.  
 Melfa, F., 327, 509.  
 Melfi, 341, 484.  
 Melito, F., 111.  
 — di Porto Salvo, 2, 111, 119.  
 Mella, F., 210, 262.  
 Menaggio, 208.  
 Mendicino, 348.  
 Mendola pass, 211, 213.  
 Mera, F., 205, 218.  
 Meraglia pass, 398.  
 Merano, 29, 205, 215, 217, 223, 225.  
 Mercantour, 28, 193, 194.  
 Mercury, 276.  
 Mergozzo, L., 497.  
 Meridian, prime, 2.  
 Merlera, P., 153.  
 Merse, F., 508.  
 Merula, F., 60.  
 Meschio, T., 50, 229, 230, 236.  
 Mesco, P., 62, 70.  
 Mesima, F., 108, 109, 359, 510.  
 — trough, 347, 356, 357, 358.  
 Mesolcinia, 7.  
 Messina, 174, 177, 178, 184, 185, 391, 393, 399, 436, 480, 481, 482, 483, 484, 487, 529, 531, 532, 534, 535, 537, 539, 540, 541.  
 — earthquake, 480-1.  
 —, Straits of (Stretto di Messina), 23, 108, 176, 177, 389, 398, 409, 416, 430, 479, 481, 490.  
 Meta, 31, 314, 318, 322, 326-7.  
 Metaponto, 368.  
 —, Staz. di, 123.  
 Metapontum, 122, 126, 127, 368.  
 —, plain of, 119, 122, 127.  
 Metauro, F., 22, 29, 46, 301, 302, 310, 388, 389, 511.  
 Metramo, F., 510.  
 Mezzano, L., 278.  
 Mezzatorre, 99.  
 Mezzo, L., 224.  
 — Lombardo, 213, 222, 223.  
 Mezzola, L., 218, 498.  
 Miave glacier, 202.  
 Migliarino, 147.  
 Mignano, 290, 291, 292.  
 Mignone, T., 77, 79.  
 Milan, 191, 192, 207, 254, 256, 257, 482, 483, 484, 485, 513, 526, 531, 532, 533, 534, 535, 539, 541, 542.  
 Milazzo, 173, 174, 175, 176, 397.  
 —, gulf of, 168, 173, 174.  
 — peninsula, 23, 168, 173.  
 Mileto, 110, 358, 359.  
 Miletto, M., 327.  
 Millifret, M., 230.  
 Mincio, F., 44, 50, 212, 260, 261, 262, 505.  
 Minerva, C., 92.  
 Minervino, 374, 379, 380.  
 Mingardo, F., 99, 336.  
 Minori, 92, 96.  
 Minturno, plain of, 87, 93, 96, 287, 289, 291.  
 Mirage, 430.  
 Miramare, 434.  
 Mis, T., 232.  
 Miseno, C., 89.  
 —, L. (Mare Morte), 89.



- Mistretta, 393, 398.  
 Misurina pass, 235.  
 Moccone, F., *see* Mucone, F.  
 Modena, 44, 256, 266, 430, 483, 484.  
 Modione, F., 161.  
 Mola di Bari, 129, 131, 135, 136, 377.  
 Molfetta, 131, 135, 136.  
 Molinatico, M., 306, 307.  
 Molini, C., 178, 179.  
 Molino, P. (Torre Nuovo), 74, 75.  
 Molise, 311, 312, 325, 326, 327-8, 491, 501.  
 Mollarella, *see* Rocca Muddafedda.  
 Mollarino, R., 327.  
 Molveno, L., 213, 500.  
 Momo, 258.  
 Monara, P., 69.  
 Monasterace, Marina di, 116.  
 Monastero, *see* Münster.  
 Monate, L., 43, 207, 499.  
 Moncenisio, *see* Cenis, M.  
 —, L., 41, 497.  
 Mondello, 169, 175, 176, 394.  
 Mondovi, 301.  
 Mondragone, 87, 93, 96.  
 Moneglia, 69, 70.  
 Monfalcone, 21, 146, 147, 148.  
 Monferrato hills, 21, 26, 45, 255, 257, 258, 259, 260, 301, 304, 305, 435.  
 Mongerbino, C., 169.  
 Monginevro pass, 197.  
 Mongioie, M., 57.  
 Mongiove, 199.  
 Monreale, 175, 395.  
 Monopoli, 128, 129, 131, 134, 135, 366, 375, 377, 437.  
 Montagna Grande, 396.  
 Montagnola Senese, 276.  
 Montalbano Staz. di, 123.  
 Montalto, 351.  
 — (Aspromonte), 359, 360.  
 Montana, 244.  
 Mont Blanc (M. Bianco), 6, 20, 28, 52, 193, 198, 199, 201, 202.  
 Monte Procida, pier, 93, 96.  
 — S. Angelo, 135, 384.  
 Montea, 101, 338, 346.  
 Montecarlo, 273.  
 Montecristo, I., 73.  
 Montefiascone, 278.  
 Montegiordano, Staz. di, 122.  
 Monteleone, *see* Vibo Valentia.  
 Montello, 228, 229, 263.  
 Montelupa, 273.  
 Montemesola, 373.  
 Montemurro, 338.  
 Montepescali, 83.  
 Montepulciano, L., 284, 501.  
 Monterosso, 70, 71.  
 Montesarchio, 333.  
 Montevarchia, 283.  
 Monticchio, L., 340, 502.  
 Monticelli, 131.  
 Montone, F., 46, 308, 489, 512.  
 Montreo, 245.  
 Monturo, Staz. di, 116.  
 Monviso, 20, 44, 193, 196.  
 Moraines, 31, 206, 207, 212, 222, 238, 251, 252, 255, 258, 260, 262, 270.  
 — terminal, 35, 39.  
 Morano Calabro, 339.  
 Morella, M., 307.  
 Mori, 222.  
 Mormanno, 339.  
 Moro, F., 489.  
 Morrone, 311, 312, 314, 322, 325, 326.  
 Mortara, 259.  
 Mortella, 90.  
 Morto, L., 41, 50, 229, 500.  
 Moschiena, 154, 155.  
 Mottola, 369.  
 Mozic, M., 240.  
 Mucone (Moccone), F., 351, 352.  
 Mugello, 304, 308.  
 Mulberry, 453.  
 Multedo, 64.  
 Münster (Monastero; Switz.), 7, 220.  
 Muraglione pass, 308.  
 Murge, 37, 127, 129, 131, 364, 365, 366, 367, 369, 371, 374-80, 382, 437.  
 — Salentine, 125, 128, 371, 374.  
 — Tarantine, 123, 371, 373.  
 Murgia Catena, 371, 380.  
 Mureto pass, 214.  
 Muro Lucano, 329, 335.  
 Murro di Porco, C. (Penisola della Maddalena), 180, 183, 402.  
 Musone, T., 386, 388, 489.  
 Mussolini canal, 81, 127, 282.  
 Muta, L., 224.  
 Naia, T., 319, 320.  
 Nambino, M., 215.  
 Naples, 30, 90, 93-5, 96, 288, 296, 298, 324, 333, 340, 436, 437, 472, 479, 480, 482, 483, 525, 528, 531, 532, 533, 534, 536, 537, 540, 541, 542.  
 —, gulf of, 32, 85, 89, 286, 296.  
 Nappe, -s, 187, 188, 193, 194, 199, 203, 205, 214, 217, 225.  
 Nardo, 373.  
 Narni, 318, 319, 320.  
 National parks, 467.  
 Natisone, 240.  
 Nava pass, 64, 195.  
 Nebrodi, Mi. (Le Caronie), 171, 175, 390, 393, 397, 398.  
 Negro, C., 180, 182, 185.  
 Nemi, L., 42, 281, 501.  
 Nera, F., 46, 285, 318, 319, 320, 509.  
 —, P., 153, 245, 248.  
 Nero, C., 59.



- Nero, M., 384.  
 — del Basto, L., 498.  
 Nerone, M., 309, 316.  
 Nervesa, 263.  
 Nervi, 67.  
 Nervia, T., 59, 507.  
 Nese, T., 489.  
 Nestore, F., 319, 489.  
 Neto, F., 120, 343, 353, 363, 510.  
 —, plain of, 119, 120, 122, 126.  
 Netto, M., 261.  
 Nettuno, 81, 85.  
 Neva, F., 60.  
 Nevoso, M. (Krainer Schneeberg), 248, 249, 250, 434.  
 Nicastro, 355.  
 Nice (France), 195.  
 Nickel, 27.  
 Nicosia, 401.  
 Nicotera, 109, 112, 358, 359.  
 —, Marina di, 107, 109, 112.  
 Nisida, I., 90.  
 Noasca, 198.  
 Noce, T. (Central Alps), 213, 215, 222, 506.  
 —, F., 101; *see also* Castrocucco, F.  
 Nocera, 95, 288, 295, 298, 332, 333.  
 —, plain of, 106.  
 —, Staz. di, 109.  
 —, Ternesese, 353.  
 Nola, 295, 298.  
 Noli, 62.  
 —, C., 62.  
 Norcia, 319, 321.  
 North Latin hills, 267, 269, 277-8, 285.  
 Northern Plain, 19, 20, 21, 29, 31, 35, 39, 64, 82, 191, 192, 206, 207, 228, 250-66, 301, 485; climate, 406, 407, 408, 409, 411, 416, 418, 420, 422, 424, 426, 427, 428, 430, 432, 434-5, 513, 525, 526-7, 531, 532, 533, 535, 538, 539, 541-2; coast, 141-9; communications, 147, 221, 226, 255-7, 260; physical features, 251-2; population, 148, 257; ports, 149; rivers, 44-5, 253, 262, 266; vegetation, 147, 253-5, 441, 454, 456, 458, 459.  
 Noto, 166, 183, 184, 185, 402.  
 — Marina, 182, 183.  
 Novara, 191, 255, 256, 258, 259, 260.  
 Nova Siri, Staz. di, 123.  
 Novate, 218.  
 Numana, 137, 141, 386, 387.  
 Nuovo, M., 296, 472.  
 Oak, deciduous, 446, 449; holm, 450.  
 Odle, 233, 234.  
 Ofantino, 134.  
 Ofanto, F., 46, 131, 329, 334, 335, 340, 367, 369, 370, 374, 375, 380, 381, 382, 484, 510.  
 Offida, 489.  
 Oglio, F., 41, 44, 50, 205, 209, 215, 220, 221, 505.  
 Ognina, 179, 185.  
 —, C., 180, 182, 183.  
 Oliva, F., 106.  
 Olive, 452; *see also* under Vegetation.  
 Oliveri, 173, 176, 397.  
 Oliveto, M., 300.  
 Oltre il Colle, Plate 60.  
 Ombrone, F., 45, 75, 274, 275, 276, 489, 508.  
 —, T., 273.  
 Omo, P., 64.  
 Oneglia, 60.  
 Opi, 324, 326.  
 Oppio pass, 307, 310.  
 Ora (Auer), 231, 232.  
 Orba, T., 305.  
 Orbetello, 43, 77, 82, 84, 85.  
 Orcia, F., 489, 508.  
 Orco, T., 198, 504.  
 Oreto, F., 512.  
 Orfano, M., 260, 261.  
 Oria, 374.  
 Oristano (Sardinia), 469.  
 Orlando, C., 168, 171, 173, 174, 176, 397.  
 —, M., 87.  
 Ormea, 195.  
 Orolo, T., 227.  
 Orsera, 152.  
 Orsetti, M., 379.  
 Orsiera, M., 197.  
 Orsigna, M., 309.  
 Orso, C., 92, 93.  
 Orta, L., 41, 203, 251, 258, 497.  
 — Nova, 382.  
 Orte, 278, 320.  
 —, F., 326.  
 Ortisei (St. Ulrich), 234.  
 Ortles (Ortler), Mi., 20, 188, 205, 214, 215, 223.  
 Ortona, 137, 139, 140, 141, 386, 389.  
 Orvieto, 269, 276, 278, 286, 494.  
 Osa, F., 77.  
 Osoppo, 237, 238.  
 Ospedaletti, 59.  
 Osternig, M., 8.  
 Ostia, 279.  
 Ostiglia, 260, 266.  
 Ostuni, 377, 379.  
 Osvinica, 248.  
 Otranto, 128, 129, 133, 134, 135, 371, 373, 483.  
 —, C., 127, 128, 135, 374.  
 Oulx (Ulzio), 197.  
 Outwash plains, 35.  
 Ovindoli, 323.



- Pachino, 185, 402.  
 Paci, C., 107, 108, 111, 112.  
 Paderno, 253.  
 Padola, 235.  
 Padua, 29, 147, 148, 256, 482, 533.  
 Padule di Fucecchio, 276.  
 Paestum, 93, 94, 102, 299.  
 —, plain of, 93, 94, 286.  
 Paganella, M., 213.  
 Pagani, 299.  
 Paglia, F., 46, 276, 286, 489, 509.  
 Pagliara, F. di, 177.  
 Paladina, M., 356.  
 Palagianello, 369.  
 Palagiano, 369, 371.  
 Pale di S. Martino, M., 233.  
 Palermo, 163, 169, 170, 175, 176, 391,  
 394, 397, 432, 438, 479, 483, 484,  
 517, 525, 529, 531, 532, 534, 535,  
 536, 537, 540, 541, 542.  
 —, gulf of, 168, 169, 170, 174,  
 175.  
 Palinuro, 99.  
 —, C., 99, 336.  
 Palla Bianca, 216.  
 Pallanza, 41, 207.  
 Palma, 295.  
 —, F., 162.  
 —, Marina di, 162, 163, 167.  
 Palmanova, 9, 264.  
 Palmaria, 70.  
 Palmi, 110, 111, 112, 358, 360, 484.  
 Palo, 79, 82.  
 —, L. di, 335.  
 Pan di Zuccherò, 217.  
 Panagia bay, 176, 180, 183.  
 Panaro, F., 45, 302, 489, 507.  
 Pantano di Lentini, 403.  
 — Grande, 177.  
 — Morghella, 182.  
 — Piccolo, 173.  
 — S. Agostino, 87.  
 — S. Gregorio, 335.  
 Pantelleria, I., 3, 32, 473, 485.  
 Panzano, 146, 148.  
 — bay, 146.  
 Paola, 109, 110, 348.  
 —, L. di (L. di Sabaudia), 43, 85,  
 501.  
 —, Marina di, 105, 109, 112.  
 Paparella, 158.  
 Paraggi, 67.  
 Parata, M. della, 380.  
 Parenzo, 151, 152.  
 Parma, 71, 256, 430.  
 —, T., 51, 507.  
 Partanna, 396.  
 Partinico, 175, 395.  
 Passaggio, P., 169.  
 Passero, C., 165, 166, 167, 182, 185,  
 389.  
 Passes, Alpine, 64, 191, 195, 197, 201,  
 202, 203, 207, 210, 215, 216, 217,  
 218, 224, 225, 233, 235, 433; Apen-  
 nine, 304, 305, 306, 307, 309, 310,  
 312, 315, 317, 324.  
 Passirio, R., 217, 223.  
 Pastures, high mountain, 457.  
 Pasubio, M., 226, 227.  
 Paterno, 404.  
 Patria, L., 43, 89, 95.  
 Patti, 174, 176.  
 —, gulf of, 168, 173.  
 —, Marina di, 173.  
 Pavia, 253, 255, 256, 259, 260, 430, 482.  
 Pavione, M., 233.  
 Pazzano, 357.  
 Pecoraro, M., 356.  
 Pederobba, 228.  
 Pegli, 64.  
 Peglia, M., 319.  
 Pelagosa, I., 414, 437, 528, 532, 533,  
 538, 540.  
 Pellachia, M., 321.  
 Pellaro, P., 108, 109, 110, 111, 112, 116,  
 117, 119, 360, 361, 481.  
 Pellegrino, M., 169, 394, 396.  
 Pellice, T., 196, 197, 259, 483.  
 Pelmo, M., 234, 235.  
 Peloritani, M., 29, 174, 175, 176, 177,  
 178, 183, 390, 397, 398-9, 490.  
 Peloro, C. (Punta del Faro), 168, 173,  
 174, 176, 177, 178, 184, 389, 397,  
 398, 399.  
 Pelvo d'Elva, 196.  
 Pelvoux, 193.  
 Peneplain, 36.  
 Penisola della Maddalena, *see* Murro di  
 Porco, C.  
 — Magnisi, 180, 402.  
 Penna, P., 136, 386.  
 Pennata, P., 89, 97.  
 Penne, 389.  
 —, P., 131.  
 Pennino, M., 316.  
 Pergine, 228.  
 Pergusa, L., 399, 502.  
 Perosa, 197.  
 Pertosa, 336.  
 Pertusa pass, 399.  
 Perugia, 315, 319, 435, 437, 482, 484,  
 529, 533, 535, 536, 540.  
 —, L., *see* Trasimeno, L.  
 Pesaro, 27, 137, 139, 140, 141, 387, 389,  
 483.  
 Pescara, 139, 140, 141, 515.  
 —, F., 45, 46, 312, 325, 326, 386, 389,  
 511.  
 Pescarenico, L., *see* Garlate, L.  
 Pescatori, I. dei, 207.  
 Peschici, 133, 134, 135, 385.  
 Peschio, M., 280.



- Pesto, *see* Paestum.  
 Petilia, 123.  
 Petrace, F., 108, 111.  
 Petrella, M., 290, 323.  
 Petrizia, 116.  
 Petrulla, 382.  
 Pettoranello pass, *see* Castelpetroso pass.  
 Piacenza, 30, 255, 256, 257, 266, 418, 434, 482, 527, 531, 533, 534, 535, 539, 541.  
 Pian Castagnaio, 276.  
 Piana dei Greci, 395, 396.  
 — della Forca, 355.  
 — della Stoppa, 396.  
 — delli Scrisi, 358.  
 — di Cecita, 352.  
 — di Cortale, 355.  
 — di Monteleone, 358.  
 — S. Maria, 355.  
 Pianazzo, 219.  
 Piani d'Aspromonte, 106, 360.  
 — del Carra, 355, 356.  
 — dell' Acqua Fredda, 358.  
 — di Carmelia, 360.  
 — Melia, 360.  
 Piano Chiusa, 360.  
 — del Dragone, 330, 334.  
 — del Lago, 106, 347, 350, 353.  
 — del Rocca, 356.  
 — della Limina, 356.  
 — delle Cinquemiglia, 313, 323, 324, 325.  
 — di Fugazza, 226, 227.  
 — di Pongali, 359.  
 — di Sorrento, 91.  
 — di Vena, 355.  
 — Don Rocco, 360.  
 — Sanguinario, 115.  
 Pianopoli, 355.  
 Pianosa, I., 73.  
 Piastre pass, 307.  
 Piave, F., 45, 51, 141, 145, 191, 226, 228, 229, 235-6, 239, 263, 265, 506.  
 — glacier, 229.  
 — Vecchia, 145.  
 Piazza Armerina, 401.  
 Picco dei Tre Signori, 218.  
 — della Croce, 224.  
 Picentini, Mi., 330, 332, 334-5, 340.  
 Piedicolle, 192, 241.  
 Piediluco, L., 501.  
 Piedimonte d'Alife, 293, 327.  
 Piedmont (Piemonte), 2, 251, 252, 257-60, 489, 497-8.  
 — plain, 29, 193, 258.  
 Pietra leccese, 371, 372.  
 Pietra Ligure, 61, 65.  
 — Varano, 293.  
 Pietrapertosa, 341.  
 Pietre verdi, 63, 304.  
 Pietro, P., 165.  
 Pietro Nere, P., 136, 139.  
 Pieve di Cadore, 235, 236.  
 — di Soligo, 229, 235.  
 — Ligure, 67.  
 Pievepelago, 307.  
 Pilieri, P., 166.  
 Pillonet, M., 199.  
 Pinewoods, black, 446, 447; lowland and coastal, 450; mountain, 446-7; Scots, 446, 448; Swiss, stone, or Cembra, 446, 447; white-barked woods, 447.  
 Pingente, 246, 247.  
 Pinzano, 262.  
 Piombino, 75, 82, 83, 84, 85.  
 — peninsula, 75, 82, 84.  
 Pioppi, Marina dei, 99.  
 Piraino, C., 173.  
 Pirano, 151.  
 Pirola, L., 498.  
 Pisa, 45, 73-4, 82, 83, 84, 271, 484.  
 —, Marina di, 74, 82, 83.  
 Pisanino, M., 271.  
 Pisano, M., 74, 267, 269, 270, 271, 273.  
 Pisciotta, 99, 102, 103.  
 —, Marina di, 99.  
 Pisino, 246.  
 Pisogne, 220.  
 Pisticci, 370.  
 Pistoia, 269, 273, 482.  
 Piuca (Poik), F., 248, 250.  
 Piz Boe, 234.  
 — Lat, 6.  
 Pizzo, 107, 109, 110, 111, 112, 480.  
 —, P., 125.  
 — Antenna (M. della Principessa), 397.  
 — Arera, M., 210.  
 — Bernina, M., 20, 28, 214.  
 — d'Alvano, 333.  
 — d'Andolla, M., 6.  
 — dei Tre Signori, 210.  
 — della Presolana, 210.  
 — di Coca, 210.  
 — Palermo, 329, 336.  
 — Poverello, M., 398.  
 — Scalino, 214.  
 — Tresero, 215, 216.  
 Pizzolungo, P., 157.  
 Pizzutta, M. la, 395.  
 Place-names, 14-16.  
 Plaia, C., 170, 171.  
 Plains, alluvial, 34; outwash, 35; volcanic, 40.  
 Planina, 248, 250.  
 Plants, index of, 463-6.  
 Platani, F., 46, 161, 162, 167, 396, 400, 512.  
 Platano, T., 335, 337.  
 Plateaux, limestone, 37-8; Pliocene, 36-7; volcanic, 40.  
 Plezzo, 240, 241.



- Pliny, 472, 473.  
 Po, F., 19, 21, 34, 43, 44, 45, 46, 51, 141, 143-5, 147, 196, 253, 254, 256, 257, 259, 261, 262, 263, 265, 305, 411, 421, 423, 448, 458, 467, 504.  
 — della Gnocca, 145, 265.  
 — della Pila, 143, 145, 265.  
 — delle Tolle, 145, 265.  
 — delta, 43, 143-5, 147, 265.  
 — di Goro, 145, 265.  
 — di Levante, 145, 265.  
 — di Maestra, 145, 265.  
 — di Volano, *see* Canale Volano.  
 Poda Bambolo, 83.  
 Pofi, 292.  
 Poggio Ballone, 75, 275.  
 — Bretta, 489.  
 — di Montieri, 275.  
 — di Pietraporciano, 276.  
 — Evangelista, 278.  
 — Imperiale, 383.  
 — Talamonaccio, 77.  
 Pola, 151, 152, 155, 157, 247, 525, 526, 532, 533, 534, 535, 538, 539, 541, 542.  
 Polcevera, T., 489.  
 Policastro, 97, 102.  
 —, gulf of, 31, 97, 99, 103, 335, 336.  
 — Venere, 102.  
 Polignano, 135, 136.  
 — a Mare, 129, 131.  
 Polja or polje, 38, 250.  
 Poljanske Sora (Yugoslavia), 8.  
 Polla, 336.  
 Pollina, F. di, 171, 397.  
 Pollino, M., 22, 31, 121, 332, 338, 339, 346, 349, 424, 493.  
 Polveracchio, M., 334.  
 Pomer, 154.  
 Pomezia, 282.  
 Pompei, 295, 297, 298, 472.  
 Pompeii (Ancient), 472, 482.  
 Ponor, 38.  
 Pontassieve, 45, 283, 308.  
 Ponte all' Isarco (Waidbruck), 224.  
 — Baio, 50.  
 — Galera, 279.  
 — nelle Alpi, 229, 236.  
 — S. Martino, 199.  
 — Sele, 299.  
 Pontebba, 239.  
 Pontecorvo, 293.  
 Pontedera, 271, 273.  
 Pontelagoscuro, 51.  
 Pontine, I., *see* Ponza, I., and Vento-  
 tene, I.  
 — Marshes, 43, 81, 83, 85, 267, 268, 280, 281-2, 470.  
 Pontinia, 282.  
 Ponza, I., 3, 32, 73, 85, 483.  
 Popoli, 325, 326.  
 Population, 65, 71, 84-5, 95-6, 103, 111-12, 117, 119, 126-7, 135, 140, 148, 155, 158, 159, 167, 175, 184, 189, 190, 257, 367, 388, 393, 398.  
 Populonia, 82, 84, 85.  
 Porciano, 489.  
 Pordoi pass, 235.  
 Porlezza, 208.  
 Poro, M., 105, 107, 109, 110, 347, 356, 357-8.  
 Porrello, C., 166.  
 Porretta (Collina) pass, 307.  
 Porsena, M., 245, 250.  
 Port' Ercole, 77, 85.  
 Portecagnano, 299.  
 Portella, M., 106, 353.  
 Porticello, 170, 176.  
 — di Castrocucco, 102.  
 Portici, 96, 97, 297.  
 Portiere, C., 81.  
 Porto, 145, 148, 264.  
 Porto Albona, 153, 154, 155, 157.  
 — Bado, 153, 154.  
 — Bianco, 148.  
 — Buso, 9, 149.  
 — Canale di Badino, 85.  
 — Carnizza, 153, 154.  
 — Cesareo, 373.  
 — Cesenatico, 148.  
 — Civitanova, 139, 140, 141.  
 — Clementino, 79, 82, 85.  
 — Cosini, 148.  
 — Cuie, 154, 157.  
 — d'Ascoli, 139.  
 — del Quieto, 151, 152.  
 — di Badisco, 136.  
 — di Baseleghe, 145, 149.  
 — di Caleri, 145.  
 — di Capotiale, 133, 134.  
 — di Castro, 135.  
 — di Cattolica, 141.  
 — di Chioggia, *see* Chioggia.  
 — di Cittanova d'Istria, 157.  
 — di Cortellazzo, 145, 148.  
 — di Faloncera, 149.  
 — di Lido, 145, 148.  
 — di Malamocco, 145, 148.  
 — di Maratea, 102.  
 — di Miseno, 89, 94, 96.  
 — di Orsera, 157.  
 — di Palinuro, 99, 102, 103.  
 — di Piave Vecchia, 148.  
 — di Pola, 151, 152.  
 — di Potenza Picena, 137.  
 — di Tricase, 128, 135.  
 — di Umago, 157.  
 — di Vado, 62.  
 — Empedocle, 162, 163, 167, 168, 400.  
 — Fano, 141.  
 — Garibaldi, 143, 147, 148.  
 — Gerbo, 180.



- Porto Levante, 148.  
 — Lignano, 145, 149.  
 — Maratea, 101.  
 — Maurizio, 60.  
 — Palo (Menfi), 161, 163, 167, 168.  
 — Parenzo, 157.  
 — Pirano, 155.  
 — Preluca, 157.  
 — Recanati, 139, 140, 389.  
 — Rosega, 146, 148.  
 — Rovigno, 157.  
 — S. Cataldo, 128, 136.  
 — S. Erasmo, 87, 96.  
 — S. Giorgio, 137, 139.  
 — S. Margherita, 148.  
 — S. Stefano, 77, 82, 83, 84, 85.  
 — S. Venere, *see* Marina di Vibo Valentia.  
 — Salvo, 87, 96.  
 — Senigallia, 141.  
 — Ulisse, 165.  
 — —, P., 166.  
 — Vecchio, 85.  
 — Veruda, 157.  
 — Vignoble, 153.  
 — Volano, 148.  
 — Xiffonio, 185.  
 Portofino, 67, 70, 71, 73.  
 — —, P. (Madonna del Capo), 67.  
 — promontory, 57, 70, 71.  
 Portopalo, 166, 168, 183, 185.  
 Portorose, 151, 155.  
 Portovenere, 70, 71, 73, 306.  
 — peninsula, 69.  
 Ports, 65, 73, 85, 96-7, 103, 112, 119, 127, 135-6, 141, 149, 155, 157, 159, 168, 176, 185.  
 Poschiano, L., 498.  
 Posillipo, C., 90, 94.  
 Positano, 91, 92, 96, 298.  
 Posticeddu, 131.  
 Posto Suina, 125.  
 Postumia (Adelsberg), 248, 250.  
 — Gate, 244, 250.  
 Potenza, 330, 331, 341, 426, 437, 492, 493, 511, 517, 529, 531, 532, 533, 535, 536, 540, 541, 542.  
 — —, F., 317, 386, 387.  
 Pove, 228.  
 Pozzallo, 165, 166, 167, 168, 402.  
 Pozzillo, 179, 185.  
 Pozzo, 120.  
 Pozzolane, 280.  
 Pozzuoli, 90, 94, 96, 97, 296, 472.  
 Pra, 64, 65.  
 Praia, 101, 102, 103.  
 Praiano, 96.  
 Prato, 273.  
 Pratolino pass, 308.  
 Pratomagno, 283, 303, 307, 308, 315.  
 Pre-Apennine region, 21-2, 25, 26, 28, 33, 45, 266-86, 306, 495; climate, 514, 525, 528, 531, 532, 533, 534, 536, 537, 538, 539, 540, 541, 542; coast, 73-85; communications, 82, 83, 269, 278; physical features, 267; population, 84-5; ports, 85; vegetation, 84, 268.  
 Pré S. Didier, 199, 201.  
 Predazzo, 231.  
 Predil pass, 239.  
 Prem, *see* Primano.  
 Prena, M., 326.  
 Presciutto, P., 125.  
 Pressure, atmospheric, 409.  
 Prevallo, 248.  
 Prickly pear, 440, 454.  
 Primano, 249.  
 Primiero, 230, 233.  
 Primo, 60.  
 Primolano, 228.  
 Priola, P., 176.  
 Priolo, 183.  
 Priverno, 289, 290.  
 Procida, I., 3, 89.  
 — —, M. di, 89.  
 Promontore, 154.  
 — —, C., 149, 151, 152, 153, 154, 155, 157.  
 Pronunciation of Italian, 12-14.  
 Pruno, T., 336.  
 Pulicchio di Gravina, 380.  
 Punta Argentera, 28, 194.  
 — Bucie, 196.  
 — Cervina, 217.  
 — dei Due Rocchi, 163.  
 — del Faro, *see* Peloro, C.  
 — di Valrossa, 6.  
 — Dufour (Dufourspitze), 203.  
 — Lago Bianco, 216.  
 — Secca, *see* Scalambri, C.  
 — Sorapis, 235.  
 Puntazza, 170.  
 Puolo, Marina di, 97.  
 Puschlav, *see* Val di Poschiavo.  
 Pusiano, L., 43, 499.  
 Pusteria valley, 205, 224-5, 234, 433.  
 Putignano, 379.  
 Pyrites, 276.  
 Quaderna, T., 489.  
 Quarnero (Carnaro) channel, 149, 153, 433.  
 — —, I., 415, 422, 442.  
 Quarto dei Mille, 67.  
 Quercianella Sonnino, 74.  
 Quietto, F., 152, 246, 507.  
 Quinto al Mare, 67.  
 Raccolana, T., 240.  
 Rada di Punta Secca, 168.  
 — di Taormina, 178.



- Radeče (Ratschach) pass, 8, 239.  
 Radici pass, 307.  
 Radicofani, M., 267, 276.  
 Rafre, M., 199.  
 Raganello, T., 339, 349.  
 Raganzino, P., 165.  
 Ragusa, Marina di, 165, 166, 168.  
 Rainfall, 423-6, 433, 434, 435, 436, 437, 438, 439; season of, 424.  
 Raisi, P., 169, 394.  
 Raisigelbi, C., 171.  
 Rama, C., 394.  
 Ramaceto, M., 306.  
 Randazzo, 180, 397.  
 Rapallo, 67, 69, 70, 71, 73, 306.  
 —, gulf (Golfo Tigullio), 67, 69.  
 Raparo, M., 339.  
 Rapido, F., 292, 293, 327.  
 Rasocolmo, C., 174.  
 Rassina, 308.  
 Ravello, 96, 298.  
 Ravenna, 143, 147, 148, 254, 266, 482, 483, 485.  
 Re, M. (Nanos), 249.  
 Reatini, Mi., 318, 321.  
 Recco, 67, 70, 73.  
 Recina (Fiumara), F., 249.  
 Reclamation, 444.  
 Regalbuto, 401.  
 Reggio Calabria, 108, 112, 360, 393, 430, 480, 481, 482, 484.  
 — Emilia, 483.  
 Regi Lagni, 294, 295.  
 Regilione, P., 165.  
 Regina, L., 501.  
 Reifemberg, *see* Rifemberg.  
 Reka, T., 149.  
 —, *see* Timavo, F.  
 Reno, F., 45, 46, 307, 309, 489, 512.  
 Renon, 217.  
 Resia, L., 224.  
 —, T., 240.  
 — (Reschen) pass, 205, 224, 225.  
 Resina, 91, 297.  
*Resorgive*, *see* Fontanili.  
 Reventino, M., 105, 106, 347, 352, 353.  
 Rhodes, island of, 1.  
 Riardo, 291, 293.  
 Ricadi, Staz. di, 109.  
 Riccioni, 137.  
 Rienza, F., 45, 204, 216, 224, 225, 505-6.  
 Rieti, 46, 311, 318, 320, 321, 435.  
 Rifemberg, 248.  
 Rignano, 283.  
 — Garganico, 384.  
 Rimini, 21, 137-40, 141, 143, 147, 148, 266, 387, 388, 483.  
 Rio d'Arco, 91.  
 Riomaggiore, 71.  
 Ripa, T., 489.  
 — Sottile, L., 501.  
 Ripaberarda, 489.  
 Ripalta, Staz. di, 139, 140.  
 Ripetta, 51.  
 Riposto, 178, 179, 180, 185, 393, 404.  
 Risano, T., 149.  
 Risorgimento, 2.  
 Ristola, P., 125.  
 Riva, 203, 212, 222.  
 — Ligure, 60.  
 — S. Stefano, 60.  
 — Trigosa, 69, 73.  
 Rivers, 44-51, 253, 262, 266, 311, 312, 331, 343, 346, 380, 387; alpine, 50; central Italy, 51; Emilian, 51; Po, 51; regime, 46-51; Sardinia, 51; Sicily, 51; southern Italy, 51.  
 River-bank woods, 451.  
 Riviera di Levante, 57, 65-73, 420, 436.  
 — di Ponente, 57-65, 420, 422, 426, 435, 436.  
 Rivoli, 258, 259.  
 — (Venetia), 222.  
 Rizzuto, C., 115, 116.  
 Rocca Busambra, 393, 396.  
 — d'Ambin, 197.  
 — di Cambio, 323.  
 — di Mezzo, 323.  
 — Ficuzza, 396.  
 — Muddafedda (Mollarella), 162.  
 — Novara, 399.  
 Roccabernardo, Staz., 115, 116, 117.  
 Roccamonfina, 32, 87, 89, 287, 288, 290, 291, 294.  
 Roccastrada, 275.  
 Roccella Ionica, 113, 114, 117, 119.  
 Rocce-tetto, 365, 370.  
 Rocchetta, M., 234, 235.  
 — S. Antonio, 382.  
 Rocciamelone, 198.  
 Rock-plants, 458, 461.  
 Rodi, 133, 134, 135, 136, 383, 385.  
 —, I., *see* Rhodes.  
 Roen, M., 213.  
 Rogliano, 352.  
 Roglio, T., 489.  
 Roia, F., 6, 59, 489, 508.  
 Romagna, 482, 483, 489.  
 Romagnano, 335, 337.  
 Roman Campagna, 79, 82, 267, 268, 277, 278-80.  
 Romanengo, 261.  
 Rome, 30, 83, 269, 275, 279, 280, 282, 285, 288, 322, 414, 420, 424, 436, 482, 514, 528, 531, 532, 533, 534, 536, 538, 539, 540-2.  
 Rondinella, P., 122.  
 Ronco, F., 512.  
 —, P., 149, 151.  
 Ronzina, 241.  
 Rosa, M., 20, 28, 193, 194, 199, 202, 203.



Rosa, M. la, 356.  
 — dei Banchi, M., 198, 199.  
 Rosandra, T., 149, 247.  
 Rose, M. (Sicily), 396.  
 Rosolini, 402.  
 Rossano, 352, 363.  
 Rosselo, C., 162.  
 Rossi, Mi., 404.  
 Rota Greca, 348.  
 Rotondo, M., 317.  
 Rovereto, 225, 227.  
 Roviano, 322.  
 Rovigno, 152, 155.  
 Rovigo, 148.  
 Rubicone, F., 489.  
 Rufeno, M., 276, 285.  
 Ruppa, 247, 248, 249.  
 Ruzzo aqueduct, 388.

All names prefixed by S., San, Sant', Santi, Santo, &c., will be found indexed in alphabetical order immediately after the letter S.

Saint Bernard pass, Great, 193, 194, 201; Little, 194, 201.  
 — Gotthard pass, 192, 207, 209.  
 Sankt Ulrich, *see* Ortisei.  
 S. Agata (Sicily), 177.  
 — (Sorrentine peninsula), 94.  
 —, Fiumara, 108, 360, 361.  
 — di Militello, 173, 174, 175.  
 S. Alessio, C., 177, 481.  
 S. Aloia, 337.  
 S. Ambrogio, 171, 174, 293.  
 S. Ampeglio, C., 59.  
 S. Andrea, C., 177, 178.  
 —, I., 125.  
 —, Staz. di, 116.  
 — di Albona, 154.  
 S. Angelo, Marina, 122, 127.  
 —, M. (Sorrentine peninsula), 298.  
 — d'Alife, 293.  
 — de' Lombardi, 329, 340.  
 S. Anna, F., 400.  
 S. Antonio, C., 171.  
 — pass, 328.  
 S. Benedetto del Tronto, 141, 388.  
 S. Bernardo pass, 64.  
 S. Biaggio, 174, 178.  
 S. Calogero, M., 396.  
 S. Canziano, 50, 249.  
 S. Cataldo, 131, 374.  
 — (Sicily), 170.  
 —, P., 121.  
 S. Colombano, 261.  
 S. Croce, C., 60.  
 —, C. (Sicily), 176, 180, 402.  
 —, L., 229, 230, 236, 500.  
 —, M., 335.  
 —, M. (Roccamonfina), 291.  
 S. Demetrio, 349.

S. Didero, 197.  
 S. Donato Val di Comino, 324.  
 S. Egidio (*or* S. Giovanni), L., 384.  
 S. Elia, 170.  
 —, M., 371, 379.  
 S. Eufemia, 347.  
 —, gulf of, 103, 106, 107, 110, 111, 479.  
 —, plain of, 105, 106, 109, 110, 111, 112, 355.  
 — Gizzzeria, Staz. di, 109.  
 — Lamezia, 110, 116.  
 — Marina, Staz., 106.  
 S. Ferdinando, 109, 112.  
 S. Fili, 348.  
 S. Fiora, 276.  
 S. Francesco, 237.  
 S. Fratello, 398.  
 S. Gillio, 258.  
 S. Giorgio, 131.  
 — alla Marina, 129.  
 — Ionico, 373.  
 S. Giovanni (Istria), 249.  
 —, L., *see* S. Egidio.  
 — alla Vena, 51.  
 — Rotondo, 384.  
 — Valdarno, 283, 284.  
 S. Giuliano (Lucania), 51.  
 — (Sicily), *see* Erice.  
 — (Tuscany), 271.  
 — (*or* Erice), M., 395.  
 —, P., 158.  
 S. Giuseppe, *see* Gallico, Fiumara.  
 — Iato, 395.  
 S. Ianni, I., 99.  
 S. Leonardo, 363.  
 — (Venetia), Plate 66.  
 —, F., 170, 171, 512.  
 — (*or* Lentini), F., 179.  
 S. Leone, 162, 163, 167.  
 S. Litterata, P., 105.  
 S. Lorenzo al Mare, 59, 60.  
 — Bellizzi, 339.  
 S. Lucerna, M., 348.  
 S. Lucia di Tolmino, 241.  
 S. Lucido, 105, 109.  
 S. Marco, 102.  
 —, C., 161, 166, 167, 168.  
 — in Lamis, 384.  
 S. Margherita Ligure, 67, 71, 73.  
 S. Maria, 295.  
 — di Castellabate, 97, 102, 103.  
 — di Conca, 87.  
 — di Leuca, 125, 538.  
 —, C., 125, 126, 127, 128, 129, 134, 135, 364, 371.  
 — la Scala, 179, 185.  
 — Maggiore, 204.  
 — pass, 220.  
 S. Marinella, 79, 84, 85.  
 S. Marino, 26, 386, 387.  
 S. Martino di Finita, 339.



- S. Michele, M., 275.  
 — di Leme, 244.  
 — di Pagana, 69.  
 S. Nicola, P., 158, 162.  
 S. Nicolo, 170.  
 — l'Arena, 170.  
 S. Panagia, C., 180.  
 S. Pellegrino valley, 234.  
 S. Pier d'Arena, 64.  
 S. Pietro, P., 70.  
 — del Carso, 248.  
 — in Selve, 245.  
 — Vernotico, 373.  
 S. Remo, 59, 65, 513.  
 S. Rossore, 470.  
 S. Severa, 79.  
 S. Severina, 363.  
 S. Severino, 332.  
 — Rota, 333, 334.  
 S. Severo, 30, 134, 135, 380, 383, 384, 436, 483.  
 S. Simeone, M., 238.  
 S. Sosti, 349.  
 S. Spirito, 129, 131.  
 S. Stefano, 171.  
 —, F., 171.  
 — di Camastra, 171, 174, 175.  
 S. Tecla, 178, 179, 185.  
 S. Terenzo, 70.  
 S. Velletri, 131.  
 S. Vicino, M., 317.  
 S. Vincenzo, 74, 75, 82.  
 S. Vitale, 254.  
 S. Vito, 140.  
 —, C., 123, 126.  
 —, C. (Sicily), 157, 158, 168, 169, 393.  
 — de' Normanni, 375.  
 — lo Capo, 158, 169, 170, 175, 176.  
 — Chietino, 137, 141.  
 — — Marina, 139.  
 Sabatini, Mi., 32, 277, 278, 472.  
 Sabatino, L., *see* Bracciano, L.  
 Sabato, F., 333, 334.  
 Sabaudia, 85, 282.  
 —, Lago di, *see* Paola, L.  
 Sabbioni, P., 145.  
 Sabina, 285, 313, 314, 321-2, 326.  
 Sabini, Mi., 278, 320, 321, 322.  
 Sacco valley, 268, 286, 292-3, 321.  
 Sacro, M., 329, 336.  
 Saga, 240.  
 Sagittario, F., 324, 326, 510.  
 Sala Consilina, 337.  
 Salarco, T., 489.  
 Salarno, L., 499.  
 Salentine peninsula, 119, 125, 127, 129, 364, 366, 367, 371-4.  
 Salerno, 91, 93, 94, 95, 96, 97, 288, 298, 299, 422, 483, 484.  
 —, gulf of, 85, 93, 97, 329, 335.  
 Salina Vecchia, 128.  
 Saline, F., 387.  
 Salo, 212, 260.  
 Salorno, 223.  
 Salpi, L., 131, 382, 502.  
 Salso, F. (trib. of Simeto), 401.  
 — (or Imera Meridionale), F., 46, 51, 163, 400, 512.  
 —, L., 131, 502.  
 Salto, F., 312, 318, 321, 322, 323.  
 Salvore, P., 149, 151, 152, 155, 243, 244, 245, 246.  
 Salzara, 83.  
 Sambiase, 355.  
 Samoggia, F., 489.  
 Sampieri, 165, 166, 168.  
 Sand-dunes, 33, 73, 74, 75, 77, 78, 81, 84, 86, 106, 113, 115, 120, 122, 123, 125, 128, 131, 133, 136, 143, 145, 157, 161, 162, 163, 165, 166, 169, 171, 173, 179, 182, 265, 279, 281, 295, 362, 368, 369, 403; vegetation of, 460-1.  
 Sandstones, 35-6.  
 Sangro, F., 46, 137, 312, 322, 324, 326, 467, 511.  
 Sannazzaro, 90.  
 Sannicandro, 385.  
 Sannio, Mi. del, 327, 328.  
 Sansego, I., 153.  
 Sansepolcro, *see* Borgo S. Sepolcro.  
 Sansobbia, T., 63.  
 Santeramo in Colle, 377, 380.  
 Santeramo, F., 309, 489, 512.  
 Santo, L., 213.  
 Sapri, 97, 101, 102, 103, 338.  
 Saraceno, F., 121.  
 —, M., 328.  
 Sarca, F., 50, 211, 213, 215, 505.  
 Sardinia, 1, 2, 3, 11, 19, 25, 26, 27, 29, 31, 32, 33, 37, 40, 41, 51, 467, 468, 469, 491; climate of, 407, 415, 416, 422, 424, 432, 437, 438-9, 518, 530-2, 534-6, 540-2.  
 Sarentini, Mi., 216, 217, 224.  
 Sarnico, 220.  
 Sarno, Mi. del, 295, 333, 334.  
 —, F., 294, 295.  
 —, plain of, 91, 294, 295, 298, 299.  
 Saronno, 254.  
 Sarzana, 83.  
 Saseno, I., 1.  
 Sass Rigais, 234.  
 Sassari (Sardinia), 438, 530, 531, 532, 534-6, 540-2.  
 Sasso Lungo, 231, 234.  
 Sassoferato, 316.  
 Saucolo, M., 332.  
 Sauro, T., 341, 342.  
 Save river, 239, 248, 250.  
 Savena, T., 489.  
 Savigliano, 259.  
 Savino, T., 489.



- Savio, F., 46, 489, 511.  
 Savoca, F. di, 177.  
 Savona, 20, 57, 62, 63, 64, 65, 192, 193, 479.  
 Savone, F., 293.  
 Savuto, F., 106, 347, 349, 350, 353, 510.  
 Sbocco del Timavo, 149.  
 Scaffaiolo, L., Plate 117.  
 Scala, 129.  
 — Greca, 183.  
 — pass, 197.  
 Scalambri (Scaramia), 30, 163, 165, 166, 167.  
 Scalea, 101, 102, 103.  
 Scaletta, C., 177, 178.  
 Scalone pass, 329, 347, 349.  
 Scanno, 324.  
 —, L., 42, 43, 493, 501.  
 Scaramia, *see* Scalambri, C.  
 Scarano, 279.  
 Scario, 102.  
 Scauri, M., 87.  
 Scheggia pass, 309, 312, 315, 316, 389.  
 Schiavonea, 122, 127.  
 Schio, 29, 227.  
 Schiso, C., 176, 177, 178, 179, 184, 404.  
 Schizzola, T., 489.  
 Schlanders, *see* Silandro.  
 Schwarz, L., 497.  
 Sciacca, 161, 162, 167, 168, 391, 394, 395, 399.  
 —, F., 161.  
 Sciale lo Riso, 133.  
 Sciave, 224.  
 Scilla, 108, 112, 359.  
 Scirocco, 414, 417, 426, 431, 436, 437, 438, 439.  
 Sclerophyllous bushes, 105, 110.  
 Scoffera, M., 306.  
 Scogli della Favorita, 90.  
 — Merlini, 64.  
 Scogliera di Tramontani, 159.  
 Scoglio Castelluccio, 180, 182.  
 — dello Sparviero (Isolotto Troia), 75.  
 — Tre Fratelli, 91.  
 Scoglitti, 166.  
 Scolo Chianetta, 286.  
 Scontrone, 324.  
 Scopello, 170, 202.  
 Scorzone, M., 375.  
 Scrivia, T., 259, 302, 305, 489, 507.  
 Scurcola, 323.  
 Sdobba, P., 146.  
 Sea, rough, 417; temperature of, *see* Temperature.  
 Sebino, L., *see* Iseo, L.  
 Secca, C., 163.  
 —, P., 162.  
 Secchia, F., 45, 302, 489, 507.  
 Seduto, M., 356.  
 Segesta, 391.  
 Segnale di Pratomagno, 307.  
 Segusino, 51, 236.  
 Seismic sea-waves, 479-80.  
 Sele, F., 46, 93, 94, 286, 287, 288, 299-300, 331, 335, 336, 366, 484, 509.  
 Sella, 232, 233, 234.  
 — pass, 232.  
 — di Palazzo, 370.  
 — di Sennes, 234.  
 — di Spinazzola, 370.  
 Sellari, M., 339.  
 Sellustra, T., 489.  
 Selva, T., 291.  
 — di Piro, 244, 248, 249.  
 — di Tarnova, 244, 249.  
 Seminara, 359, 360.  
 Sempione, *see* Simplon.  
 Semprevisa, M., 289.  
 Senigallia, 137.  
 Senio, T., 489.  
 Seno di Guidalocca, 169.  
 Sentino, T., 312.  
 Serapis, Temple of, 472.  
 Serchio, F., 45, 74, 269, 270, 271, 273, 274, 508.  
 Serio, F., 262, 505.  
 Serra del Cianci, 374.  
 — delle Grandini, 348.  
 — di Corigliano, 374.  
 — di Eleuterio, 374.  
 — Dolcedorme, 22, 329, 338, 339.  
 — la Croce, 492.  
 — S. Bruno, 356, 357.  
 Serralta S. Vito, 353, 356, 357.  
 Serralunga, M., 101, 338.  
 Serravalle pass, 271, 273.  
 Serre, 366.  
 Serre, 112, 347, 353, 355, 356-7, 360, 361-2.  
 Serriola pass, 316.  
 Sesana, 247.  
 Sesia, F., 252, 258, 504.  
 Sessa, 93, 291.  
 Sestola, 428.  
 Sestri, P., 69.  
 — Levante, 69, 70, 71, 73.  
 — Ponente, 63, 64.  
 Setta, T., 512.  
 Sette Comuni, 226, 227, 228.  
 Seveso, 254.  
 Sezze, 289.  
 Sferracavallo, 169, 170, 176.  
 Sgurgola, 292.  
 Shrubs, low, communities of, 457-8.  
 Sibari, plain of, 119, 121, 122, 126, 127, 349, 350, 351, 362, 363, 437.  
 —, Staz. di, 110, 122, 123.  
 Sibillini, Mi., 316-17, 321.  
 — chain, 311, 314, 325.  
 Sicani, Mi., 396.  
 Sicilian Strait (African Sea), 3, 56, 401.



- Sicily region, 1, 2, 3, 10, 11, 19, 23, 25, 26, 27, 29, 31, 33, 37, 389-405, 467, 468, 490, 502; climate, 407, 409, 414, 420, 422, 423, 424, 425, 426, 428, 430, 432, 437, 438, 442, 517-18, 525, 529, 530-2, 534-42; coasts, 157-85; communications, 158, 163, 166, 170, 174, 178, 179, 183, 393, 399, 401; physical features, 389; population, 159, 167-8, 175, 184, 393, 398; ports, 159, 168, 176, 185; rivers, 44, 46, 47, 51, 512; vegetation, 157, 166, 167, 174, 175, 183, 390-3, 441, 446, 447, 448, 449, 451, 454, 456.  
 Siculiana Marina, 162, 163, 167.  
 Siderno Marina, 119.  
 Siena, 275, 528, 531, 532, 533, 534, 536, 540, 541, 542.  
 — trough, 30, 267, 269, 274, 275.  
 Sierio, M., 337.  
 Sieve, F., 283, 307, 308, 508.  
 Signa, 273.  
 Signora Pulita, M., 377.  
 Sila, 37, 112, 115, 120, 121, 347, 349, 351, 352-3, 354, 355, 362, 363, 489.  
 — Grande, 350, 352, 353, 424.  
 — Piccola, 352, 353, 362.  
 Silandro, 224.  
 Sile, F., 506.  
 Silizza, F., 8, 239.  
 Sillaro, T., 489.  
 Silvi Marina, 137.  
 Simbruini, Mi., 321, 322.  
 Simeto, F., 46, 51, 179, 403, 512.  
 Similaun, M., 216.  
 Simplon (Sempione) pass, 192, 203, 207.  
 Sinnaro, 176.  
 — Marina, 173.  
 Sinni, F., 46, 126, 330, 339, 341, 342, 368, 489, 510.  
 Sinopoli, 110.  
 Sintria, T., 489.  
 Sinuessa, 93.  
 Siracusa, *see* Syracuse.  
 Sirente, M., 323, 325.  
 Sirino, M., 331, 338, 339.  
 Sissol, L., *see* Arsa, L.  
 Sistiana, 149.  
 Siusi, 231, 234.  
 Slates, 25, 28.  
 Snow, 426-9, 433, 434, 437, 438, 439.  
 Soana, T., 198.  
 Solagno, 228.  
 Solanto, *see* Cape Grosso.  
 Solarino, 402.  
 Solfatara, 296, 297, 471, 472.  
 Soligo, T., 229.  
 Solunto, 395.  
 Somma, M., 291, 297, 320, 472.  
 Soncino, 261, 483.  
 Sondrio, 209, 219, 433, 526, 531, 533, 534, 535, 539, 541.  
 Soprano, C., 163.  
 — del Basto, 498.  
 Sora, 326, 483.  
 Sori, 67.  
 Soriano, 356.  
 Soro, M., 398.  
 Sorrentine peninsula, 89, 91-3, 94-5, 96, 97, 287, 288, 298-9, 329, 435, 493.  
 Sorrento, 91, 92, 94, 96, 97, 298, 299.  
 —, P., 92.  
 Sottile, C., 92.  
 —, P., 149.  
 Soverato, 115, 116, 117, 119.  
 —, F., 357.  
 Spaccaforno, *see* Ispica.  
 Spadafora, 176.  
 Sparagio, M., 395.  
 Sparanise, 95.  
 Spartivento, C., 111, 112, 117, 119.  
 Sperlonga, 87, 93, 95.  
 Spezia, *see* La Spezia.  
 Spezzano, 349, 350, 351.  
 Spiaggia del Castello, 133, 134.  
 — del Scialmarino, 133.  
 — di Serapo, 87.  
 — Granatello, 90.  
 — Miliscola, 89.  
 Spigno, M., 133, 384.  
 Spinazzola, 335, 366, 369, 370.  
 Spinetta, 94.  
 Spinone, L., *see* Endine, L.  
 Spinosa, M., 318.  
 Spinoso, 338.  
 —, P., 107, 358.  
 Splügen (Spluga) pass, 205, 209, 218.  
 Spöl valley, 215.  
 Spoleto, 45, 318, 319, 320.  
 Spotorno, 62.  
 Spruce woods, 446, 447.  
 Squillace, 119, 355, 357.  
 —, gulf of, 105, 112, 114, 479.  
 —, Staz. di, 116.  
 Squinzano, 373.  
 Stabiae, 91.  
 Staffora, T., 302, 489.  
 Stagno Biviere, 165.  
 — di Burano, L., 501.  
 — di Orbetello, L., 501.  
 Stagnone, 158.  
 Staletti, 356.  
 —, P., 115, 116, 119, 355, 362.  
 Stazzo, 179, 185.  
 Stella, M., 357.  
 —, M. della, 97, 99, 102, 335.  
 —, F., 507.  
 Stelvio pass, 214, 215, 219, 220, 225.  
 Sterzing, *see* Vipiteno.  
 Stilaro, F., 114.  
 Stilo, 357.



- Stilo, C., 111, 114, 115, 117.  
 Stradella, 256, 266, 306.  
 — Gate, 257, 259, 261, 265.  
 Stresa, 41, 207.  
 Strigno, 228.  
 Stromboli, I., 471, 473, 474.  
 Strongoli, 363.  
 Studerno, 220.  
 Stufe (Bagna) di Nerone, 90.  
 Stura di Demonte, T., 193, 194, 195, 489.  
 — di Lanzo, T., 35, 198, 258, 259, 504.  
 Sturla, F., 67, 508.  
 Subasio, M., 315, 318, 320.  
 Sulmona, 46, 313, 323, 324, 325, 326, 389, 423.  
 Sulphur, 26-7, 399, 400.  
 Sunshine, 431.  
 Superiore (dei Pescatori), I., 207.  
 Susa, 197.  
 Sutura, Plate 147.  
 Suvero, C., 105, 106, 109, 110.  
 Swell, 417.  
 Sybaris, 349; *see also* Sibari.  
 Syracuse (Siracusa), 177, 178, 180, 183, 184, 185, 390, 391, 402, 420, 422, 482, 483, 518, 530, 532, 534-6, 538, 540, 542.  
 —, bay of, 176, 180.  
 Tabor, M., 193, 195, 197.  
 Taburno, M., 329, 332-3.  
 Tacina, F., 352, 353, 362, 363, 483.  
 Taggia, F. di (Argentina), 60, 508.  
 Tagliamento, F., 45, 141, 145, 148, 191, 192, 225, 237, 238, 239, 240, 252, 253, 254, 262, 264, 265, 507.  
 Tagliata, 79.  
 Talamone, 77, 82, 84, 85.  
 Talvena, M., 233.  
 Talvera, R., 506.  
 Tammara, 327.  
 Tanagro, F., 299, 336, 337, 510.  
 Tanaro, F., 44, 195, 257, 258, 259, 305, 426, 507.  
 Taormina, 23, 30, 177, 183, 184, 397, 399.  
 —, C., 178.  
 Taranto, 31, 123, 125, 126, 127, 366, 367-9, 371, 373, 417, 480, 525, 537, 538.  
 —, bay of (Mare Grande), 123.  
 —, gulf of, 23, 46, 110, 331, 367, 368, 480; climate, 420, 437; coast, 119-27; communications, 122, 125; population, 126-7; ports, 127; vegetation, 126, 467.  
 Taranto-Tavoliere corridor, 23, 341, 364, 367-71, 374, 379, 381.  
 Tarcento, 263.  
 Taro, F., 45, 302, 304, 306, 489, 507.  
 Tarquinia, 83.  
 Tarsia, 350, 351.  
 Tartaro, F., 505.  
 Tarvisio, 192, 237, 238, 239, 241.  
 Taureana, 109.  
 Tavernelle, Plate 114.  
 Tavo, F., 325.  
 Tavoliere di Lecce, 373.  
 — di Puglia, 127, 128, 131, 133, 134, 135, 328, 365, 380-3, 384, 385, 437, 451.  
 Teano, 291.  
 Teglia, T., 489.  
 Teiro, T., 64.  
 Telegrafo, M., 234.  
 Tellaro, 70.  
 —, T., 183, 402.  
 Tempa Candore, 342.  
 — di Conca, 339.  
 Temperature, 417-21, 422, 433, 434, 436, 437, 438; of sea, 406.  
 Temu, 221.  
 Tenda pass, 64, 192, 195.  
 Tenna, F., 388, 511.  
 Teramo, 325, 388, 389.  
 Terlago, 222.  
 —, L., 213.  
 Termeno (Tramin), 223.  
 Termini Imerese, 171, 174, 175, 176.  
 —, gulf of, 170, 395.  
 Terminillo, M., 318, 321.  
 Terminio, M., 329, 334.  
 Termitosa, Staz. di, 122.  
 Termoli, 136, 139, 140, 312, 328, 388, 389.  
 Terni, 29, 313, 318, 319, 320.  
 — basin, 46.  
 Terone, P., 89.  
 Terra di Lavoro, 40, 287, 294, 295, 296, 297.  
 Terra rossa, 243, 244, 246, 365, 373, 374, 377, 385.  
 Terraces, 31, 104, 105, 107, 108, 111, 115, 121, 122, 133, 161, 162, 173, 174, 177, 201, 208, 210, 212, 219, 220, 223, 224, 227, 231, 236, 256, 258, 259, 260, 261, 263, 267, 321, 337, 343, 348, 353, 356, 358, 359, 362, 368, 369, 375, 379, 380, 382, 384, 390, 394, 395, 400, 401, 402, 403; alluvial and gravel, 34, 35, 252, 258, 337; marine and littoral, 35, 177.  
 Terracina, 81, 83, 85, 95, 96, 281, 282.  
 Terragnolo, 227.  
 Terranova, *see* Gela.  
 Terrasini, 169, 175.  
 Terzigno, 297.  
 Tesino, T., 386.  
 Testa del Gargano, 131, 133, 135.  
 — di Rutor, 199.  
 Tevere, F., *see* Tiber.



- Tezio, M., 315.  
 Thunder, 432.  
 Tiber, river, 22, 31, 44, 45, 51, 79, 82, 267, 268, 269, 276, 278, 279, 282, 284, 285-6, 309, 312, 314, 319, 320, 435, 509.  
 Ticino, F., 20, 41, 44, 50, 193, 206, 207, 257, 258, 260, 262, 504, 505.  
 Tidone, T., 489.  
 Tientsin concession, 1.  
 Tifata, M., 89, 291, 292, 294, 332.  
 Tigullio, *see* Rapallo, gulf of.  
 Timavo (Reka), F., 50, 146, 149, 248, 249, 250, 507.  
 Time, Central European, 2.  
 Timeto, F., 173.  
 Timpa, M., 398.  
 — del Tempo, 493.  
 — Grande, 123, 363.  
 Tindari, C., 173, 399.  
 Tinibras, M., 194.  
 Tino, I., 70.  
 Tirano, 192, 219, 220.  
 Tiriolo, 352, 355.  
 Tirol, High, 204, 216-18.  
 Tirso, F. (Sardinia), 51, 439.  
 Titano, M., 387.  
 Tivoli, 279, 280, 322.  
 Toblach, *see* Dobbiaco.  
 Toblino, 222.  
 —, L., 213.  
 Tocci, 123.  
 Toce, F., 192, 203, 204, 206, 207, 505.  
 Todi, 45, 286, 318.  
 Tofane, Mi., 234.  
 Togano, M., 204.  
 Toggia, L., *see* Fisch.  
 Tolfa, Mi. della, 32, 79, 269, 277, 279.  
 Tolmezzo, 239.  
 Tolmino, 240, 245, 249, 250.  
 Tombolo, 77.  
 Tombolo della Gianella, 77.  
 — di Feniglia, 77.  
 Tonale pass, 205, 215, 221.  
 Tonnara del Secco, 176.  
 — di Scopello, 176.  
 Tono, P., 173.  
 Topino, F., 316, 318, 320, 509.  
 Topographical regions, 19-23; *see also* Chapter IV.  
 Torbido, *see* Turbido.  
 Tordino, F., 386, 388.  
 Torgiano, 320.  
 Torino, *see* Turin.  
 Torino di Sangro, Staz. di, 139.  
 Torre Alta, *see* Torre Gaveta.  
 — Anastasia, 93.  
 — Annunziata, 90, 91, 94, 96, 97, 295, 297, 299.  
 — Archirafi, 179.  
 — Astura, 81, 281.  
 Torre Bassano, 90.  
 — Bonagia, 159.  
 — Caldara, 79, 81.  
 — Canne, 128, 129, 131.  
 — Canneto, 125.  
 — Carnosa, 129.  
 — Cesareo, 123, 125.  
 — Cherchiara, Staz. di, 123.  
 — Chianca, 123.  
 — Colonne, 170.  
 — Columena, 123, 125.  
 — degli Iscolelli, 99.  
 — dei Marmi, 60.  
 — del Greco, 90, 96, 97, 297.  
 — del Lauro, 171.  
 — del Pagliarolo, 97.  
 — del Pizzo, 125.  
 — del Telegrafo, 99.  
 — dell' Alto Lido, 123.  
 — dell' Ovo, 123.  
 — di Capo Bianco, 101.  
 — di Caprioli, 99.  
 — di Ere, 62.  
 — di Mola, 87.  
 — di Monalto, 82.  
 — di Rivoli, 133.  
 — di Rocca Vecchia, 131.  
 — di Roseto, 121.  
 — di S. Marco, 93, 94.  
 — Disperata, 375.  
 — Egnaxia, 129, 131.  
 — Focce, 87.  
 — Fogliano, 85.  
 — Gaveta (Torre Alta), 87, 89, 93, 94, 96.  
 — Gennaro, 128, 131.  
 — Giovanni, 125.  
 — Guaceto, 128.  
 — Ioppolo, 107.  
 — La Chianca, 133.  
 — Lapillo, 123, 125.  
 — Maggiore, M., 318, 319, 320.  
 — Mattarelle, 128.  
 — Mattoni, 122.  
 — Melissa, 120, 126.  
 — Mileto, 127, 133, 135, 136, 139, 140.  
 — Molini, 125.  
 — Mozza, 75, 111.  
 — Mucchia, 137.  
 — Muzza, 99.  
 — Nuovo, *see* Molini, P.  
 — Palidoro, 82.  
 — Paola, 81.  
 — Porticello, 133.  
 — Presciutto, 123.  
 — Rinalda, 131.  
 — Ripagnola, 129.  
 — Rondinella, 123.  
 — Rosci, 108.  
 — Sabea, 123, 125.  
 — S. Cataldo, 169.



- Torre S. Caterina, 125.  
 — S. Foca, 131.  
 — S. Isidoro, 125.  
 — S. Leonardo, 128, 131.  
 — S. Liberata, 77, 85.  
 — S. Maria, 107.  
 — S. Nicola, 99.  
 — Salandrella, 122.  
 — Scanzano, 122.  
 — Scauri, 87, 93, 95, 96.  
 — Scibiliana, 158.  
 — Scifo, 116.  
 — Specchia Ruggeri, 128.  
 — Spinosa, 99.  
 — Squillace, 123.  
 — Suda, 125.  
 — Tre Fontane, 163.  
 — Vado, 125.  
 — Vendicari, 182, 183.  
 — Veneri, 128, 131.  
 — Verdura, 161, 163.  
 — Villanuova, 136.  
 — Viola, 93.  
 — Vittoria, 81, 85.  
 — Zozzoli (Sassoli), 123.  
 Torremaggiore, 380.  
 Torrita pass, 317.  
 — Tiberina, 279, 286.  
 Torto, F., 46.  
 —, F. (Sicily), 171, 174, 396, 397, 398.  
 Tossignano, 309.  
 Trabaria pass, 301, 309, 310, 315, 316.  
 Trabia, 171, 174.  
 Trachyte, 89, 277.  
 Trafoi glacier, 216.  
 Traghetto, 154.  
 Tramin, *see* Termeno.  
 Tramontana, 415.  
 Tramontana, P., 158.  
 Tramonti, 237.  
 Tranchina, F., 161.  
 Trani, 131, 135, 136, 377.  
 Trapani, 157, 158, 159, 390, 395, 483, 525.  
 Trappeto, 169, 170, 175.  
 Trasacco, 323.  
 Trasimeno, L., 42, 43, 46, 283, 284, 285, 318, 319, 320, 501.  
 Tratturo, 381.  
 Travertine, 279, 280, 320, 322.  
 Travignolo, F., 231, 506.  
 Trebbia, F., 45, 302, 507.  
 Tre Croci pass, 235.  
 — Fontane pass, 401.  
 Trebisacce, 126, 127, 349.  
 — Marina, 127.  
 Tredici Comuni, 222, 226, 227.  
 Trees and shrubs, cultivated, 451-4.  
 Treia, F., 509.  
 Trematerra, M., 356.  
 Trentino, 20, 25, 28, 189, 453.  
 Trento, 20, 29, 191, 213, 222, 225, 226, 228, 416.  
 Trentova Scoglio, 97.  
 Tresa, F., 285, 505.  
 Tresenda, 205, 219, 220, 221.  
 Tresino, M., 97.  
 —, P., 97.  
 Trevi, 320.  
 Treviso, M., 340.  
 Treviso, 148, 191, 256, 263, 482.  
 Trezzo, Plate 92.  
 Triari, C., 107, 108.  
 Tribulaun, M., 217.  
 Tricorno (Triglav), M., 240.  
 Trient, *see* Trento.  
 Trieste, 149, 151, 154, 155, 157, 244, 245, 246, 247, 415, 433, 434, 455, 484, 513, 525, 526, 532-5, 539, 541, 542.  
 —, gulf of, 149, 154, 245, 246.  
 Triflisco, 294.  
 Trigno, F., 46, 136, 328, 510.  
 Trinitapoli, 134.  
 Trino, 259.  
 Triolet glacier, 202.  
 Trionto, C., 120, 121.  
 —, T., 120, 127, 352, 363.  
 Tripolitania, 1.  
 Troia, P., *see* Ala, P.  
 Tronto, F., 46, 310, 314, 321, 322, 325, 326, 386, 387, 388, 489, 511.  
 Tropea, 107, 109, 111, 112, 358, 515.  
 Trulli, 375.  
 Truzzo, L., 498.  
 Tschitschenboden, *see* Cicci plateau.  
 Tufa, 31, 277, 377.  
 Tuff, 31, 32, 267, 287, 295.  
 Tufo, 394.  
 Tunisia, 3.  
 Turano, F., 321, 322.  
 Turbido, F., 111, 113, 114, 119, 362.  
 Turchino pass, 64, 305.  
 Turi, 379.  
 Turin, 28, 191, 192, 198, 256, 257, 258, 259, 419, 431, 483, 485, 527, 531, 532-5, 539, 541, 542.  
 Tusa, F., 171.  
 Tuscan archipelago, 3, 73.  
 — upland, 267, 271, 274-6, 489.  
 Tuscany, 25, 26, 27, 269, 303, 414, 415, 450, 467, 468, 469, 485, 489, 493, 501.  
 Tusciano, F., 93.  
 Tyrrhenian coast, 30, 31, 55-108, 411, 424, 426, 427, 430, 450, 460, 468, 470.  
 — Sea, 3, 21, 27, 29, 44, 55-108, 407, 409, 414, 415.  
 — trough, 267, 269, 275, 278, 281, 282, 286, 292, 301, 310, 314.  
 Ubas, P., 153.  
 Uccellina, Mi. dell', 77, 276.



- Udine, 191, 192, 256, 433, 482, 527, 531, 532, 533, 534, 535, 539, 542.  
 Ufita, F., 340.  
 Uia di Ciamarella, 198.  
 Ulysses, 92.  
 Ulzio, *see* Oulx.  
 Umago, 151, 152, 155.  
 Umbertide, 315, 319.  
 Umbria, 26, 29, 269, 313, 314, 318-21, 482, 489, 501.  
 Unica, F., 248, 250.  
 Unie, I., 153.  
 Urbania, 316.  
 Urbino, 389, 483, 528, 532, 533, 535, 536, 540, 542.  
 —, M., 315.  
 Ustica, I., 3, 32, 168, 525.  
*Uvala*, 38.  
 Vaccina, 83.  
 Vada, 82, 83, 85.  
 Vado, 62, 65.  
 —, C., 62.  
 Val Badia (Abteital), 232, 234.  
 — Bregaglia, 491.  
 — Camonica, 205, 209, 211, 215, 219, 220, 221.  
 — Canale, 239, 240.  
 — Carpano, 246.  
 — Cismon, 233.  
 — Corteno, 205.  
 — d'Aosta, 188, 189, 199, 201, 202, 447, 468, 491.  
 — d'Astico, 226, 227.  
 — d'Ossola, 203.  
 — d'Ultimo, 216.  
 — di Ala, 198.  
 — di Cala, 106.  
 — di Cembra, 222, 231.  
 — di Chiana, 43, 267, 275, 282, 284, 285, 286, 307, 310, 315.  
 — di Fassa, 232, 234.  
 — di Fiemme (Fleimstal), 231.  
 — di Ledro, 212.  
 — di Livigno, 215.  
 — di Martello, 216.  
 — di Non, 213, 222.  
 — di Poschiavo, 7, 214, 219.  
 — di Senales, 216.  
 — di Sesto, 8.  
 — di Sole, 204, 205, 211, 213, 215, 221, 225.  
 — di Susa, 192, 197, 199, 201, 447.  
 — di Viu, 198.  
 — Ferret, 199, 201, 202.  
 — Grande, 198.  
 — Lagarina, 222.  
 — Laterina, 284.  
 — Malenco, 219.  
 — Masino, 219.  
 Val Seriana, 210.  
 — Sesia, 202, 203.  
 — Sugana, 222, 226, 227-8.  
 — Tiberina, 45, 304, 308, 315.  
 — Trompia, 211.  
 — Veni, 199, 201, 202.  
 — Venosta (Vinschgau), 214, 216, 223-4.  
 — Roveto, 321, 322.  
 Valanidi, F., 108.  
 Valdarno, 45, 267, 275, 282, 284, 301, 307.  
 Valdemone, 174.  
 Valdesi, P., 176.  
 Valdetoni, 154.  
 Valdieri, 195.  
 Valdigna d'Aosta, 199.  
 Valgrisanche, 201.  
 Valguarnera, 401.  
 Vallaccia, M., 232.  
 —, T., 489.  
 Vallarsa, 227.  
 Valle, 145, 266; *see also* Laguna.  
 Valle Antigorio, 203, 204.  
 — Aurina, 218, 225.  
 — Bertuzzi, 143, 265.  
 — Brembana, 210.  
 — Carbonara, 385.  
 — Cavallina, 210, 221.  
 — d'Ampezzo, 235, 236.  
 — d'Ayas, 199, 201.  
 — d'Ega (Eggental), 231, 232, 234.  
 — del Artereva (Artanavaz), 201.  
 — del Bove, 404, 473.  
 — del Monaco, 492.  
 — del Po, 196.  
 — dell' Inferno, 297.  
 — di Cogne, 201.  
 — di Corteno, 219, 221.  
 — di Genova, 215.  
 — di Gardena (Gröden), 231, 232, 234.  
 — di Gressoney, 201.  
 — di Locano, 198.  
 — di Porto Lunga (Lunga), 153.  
 — di Resia, 250.  
 — di Rhêmes, 199, 201.  
 — di S. Giacomo, 218.  
 — di Stignano, 384.  
 — di Tramonte, 92.  
 — di Tron, 489.  
 — di Tures, 225.  
 — Formazza, 203, 204.  
 — Giralda, 143, 265.  
 — Isarco, 218.  
 — Isola, 143.  
 — Maira, 196.  
 — Rendena, 211.  
 — Sarentina, 217, 223.  
 — Stretta pass, 197.  
 — Vigizzo, 204, 207.



- Valleflorita, 357.  
 Valli di Comacchio, *see* Laguna di Comacchio.  
 Vallo di Bovino, 340.  
 — di Diano, 330, 335, 336-7.  
 — di Lucania, 336.  
 Vallombrosa, 303.  
 Vallone della Grazia, 169.  
 — delle Casazze, 165.  
 — di Brestovizza, 247.  
 — di Chiapovano, 249.  
 — di Fianona, 153, 157, 246.  
 — Pizzuto, 400.  
 Valpelline, 199, 202.  
 Valsavaranche, 199, 201, 467.  
 Valsura, R., 506.  
 Valtellina (Veltlin), 20, 204, 206, 209, 215, 219-20.  
 Valtournanche, 201.  
 Vandoies, 224.  
 Vannino, L., 497.  
 Vanoi, T., 231.  
 Vara, T., 45, 305, 508.  
 Varaita, T., 196, 507.  
 Varano, L., 43, 133, 385, 480, 502.  
 Varazze, 64, 65.  
 Varenna, 209.  
 Varese, 43, 207, 208.  
 —, L., 207, 499.  
 Varigotti, 62.  
 Varrano, 293.  
 Varraro, M., 362.  
 Vasto, 136, 139, 140, 386, 389, 436.  
 — Marina, 136.  
 Vatican State, 1.  
 Vaticano, C., 106, 107, 109, 110, 357.  
 Vaude, 254, 258.  
 Vedrette Giganti, M., 218.  
 Vegetation (for Index of plants, *see* pp. 463-6), 64-5, 71, 83, 84, 95, 103, 110-11, 117, 126, 134, 140, 147, 154, 159, 166, 167, 174, 175, 183, 188, 189, 243, 244, 253-5, 268, 288, 303, 313, 331, 366, 390-3, 440-66; aquatic, 459; coastal, 459-61; influence of climate on, 440; introduced, 460-1; marshland, 458-9; salt-marshes, 460; submerged, 460.  
 — regions: central European, 441, 442, 461; Mediterranean, 441, 442, 443, 450, 451, 453, 461.  
 Velia, 99, 102.  
 Velino, F., 314, 318, 320, 321, 322, 323, 509.  
 —, M., 31, 323.  
 Velme, 264.  
 Veltlin, *see* Valtellina.  
 Vena, Mi. della (dei Cicci, or Tschitschengebirge), 38, 245, 247.  
 Venda, M., 263.  
 Venere, M., 278.  
 Veneretta, M., 399.  
 Venerocolo, M., 210.  
 Venetia, 19, 26, 29, 251, 253, 255, 257, 262-5, 469, 482.  
 Venezia Euganea, 500.  
 — Giulia, 8, 9, 500.  
 — Tridentina, 9, 499-500.  
 Venice (Venezia), 43, 145, 147, 148, 155, 257, 264, 415, 434, 513, 525, 527, 531, 533-5, 538, 539, 541, 542.  
 —, gulf of, 149.  
 Venina, L., 499.  
 Venosa, 341.  
 —, Fiumara di, 370.  
 Venter Spiegel (Austria), 216.  
 Ventimiglia, 59, 64, 65, 192, 195.  
 Ventotene, I., 3, 32, 85.  
 Verbona, L., *see* Maggiore.  
 Vercelli, 255, 256, 259, 260, 469.  
 Verde, C., 59.  
 — del Basto, L., 498.  
 — di Val Cedra, L., 500.  
 Verdura, F., 161, 396, 512.  
 Vermenagna, T., 195.  
 Vermia bay, *see* Golfo del Cofano.  
 Vernazza, 70.  
 Verona, 46, 191, 192, 205, 222, 256, 257, 260, 262, 483.  
 Vescovo, M., 281.  
 Vesole, M., 336.  
 Vesubia, 483.  
 Vesuvius, M., 32, 90, 91, 94, 95, 96, 287, 288, 294, 296-8, 471, 472-3, 474-7, 485.  
 Vetta d'Italia, 1.  
 Vettica Minore, 94.  
 Vettore, M., 310, 317.  
 Viareggio, 74, 82, 83, 84, 85, 269.  
 Vibo Valentia, 356, 358, 483, 484.  
 —, Marina di (Porto S. Venere), 106, 107, 109, 110, 111, 112, 358.  
 Vibrata, T., 388.  
 Vicenza, 191, 225, 227, 256, 263, 482, 527, 531-5, 539, 541, 542.  
 Vico, 384.  
 —, L., 42, 278, 501.  
 — di Pantano, 294.  
 — Equense, 91, 97, 298.  
 Vieste, 133, 134, 135, 136, 366, 384, 385, 516, 538.  
 Vietri, 94, 96.  
 — Marina, 93, 97.  
 Viezzena, M., 232.  
 Vigevano, 259.  
 Viglio, M., 31, 321.  
 Villa Castelli, 379.  
 — Igia, 176.  
 — Margherita, 82.  
 — S. Giovanni, 90, 112, 360, 393.  
 Villamare, 99, 101.  
 Villanova Baltea, 201.

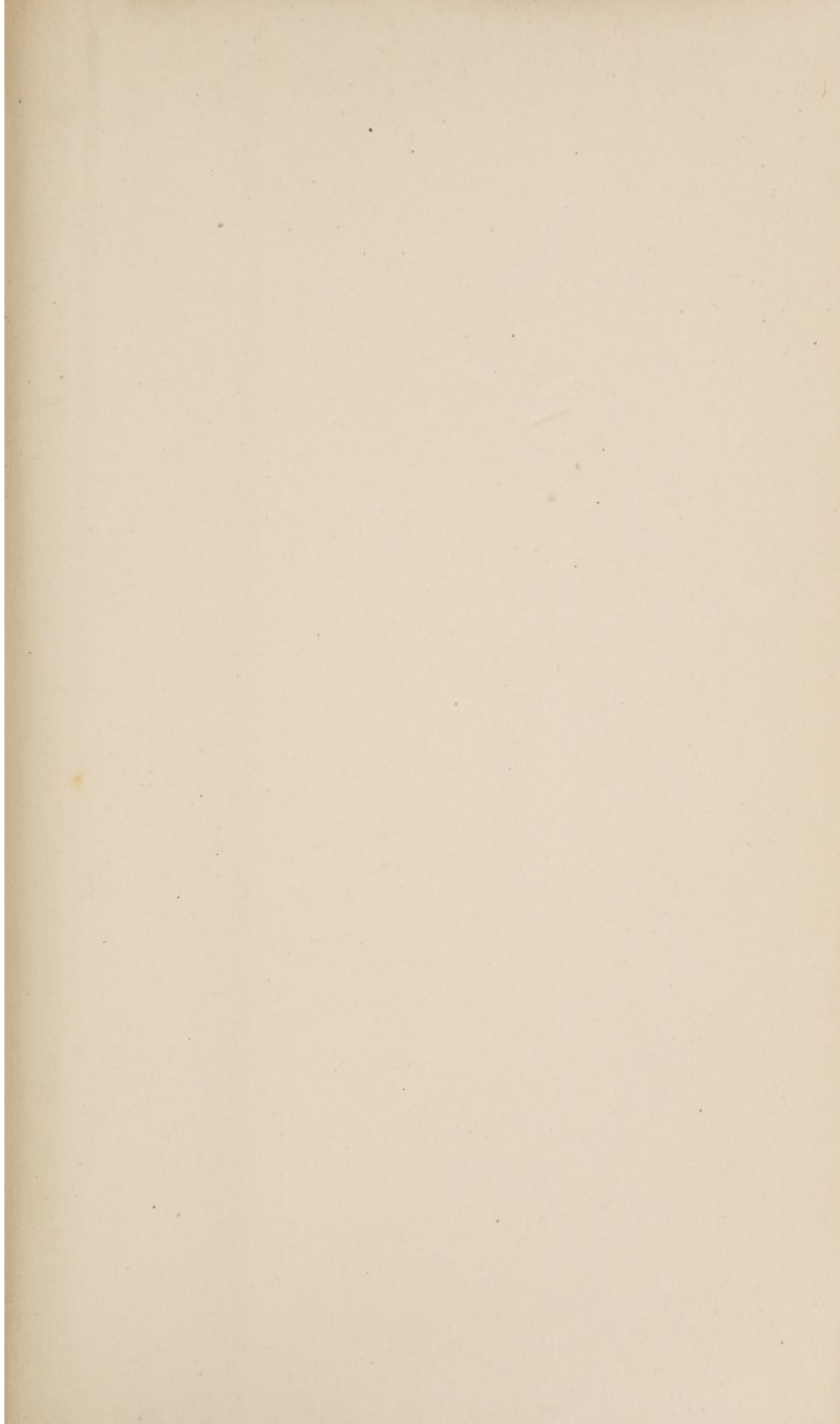


- Villetta Barrea, 324.  
 Vinadio, 195.  
 Vinchiatturo pass, 327.  
 Vine, 453; *see also under* Vegetation.  
 Vinschgau, *see* Valtellina.  
 Vipacco (Wippach), F., 244, 248, 249.  
 Vipacco-Timavo depression, 245, 248-9.  
 Vipiteno (Sterzing), 224.  
 Virgo, M., 89, 291, 292, 294, 332.  
 Visibility, 430-1.  
 Visinada, 245.  
 Viso, M., *see* Monviso.  
 Visso, 316.  
 — pass, 317.  
 Vitalba, 274.  
 Vittorio Veneto, 229.  
 Viverone, L., 43.  
 Voghera, 256.  
 Vognoli, P., 180.  
 Volano, 143, 148.  
 Volcanic activity, 471-7; cones, 39-40, 89, 267, 277, 279, 280, 287, 290, 291, 296, 297, 340, 401, 404; eruptions, 22, 297, 471-7; forms, 39-40, 471-4; lakes, 32, 42, 277, 281, 296.  
 Volcanoes, 26, 31, 32, 39-40, 267, 277, 278, 279, 280, 287, 290, 291, 292, 294, 296, 329, 390, 403, 404, 471-7.  
 Volosca, 153, 154, 155, 157, 243.  
 Volsini, Mi., 32, 79, 277.  
 Volterra, 30, 83, 494.  
 Voltri, 63, 64, 65.  
 Volturara, 328.  
 Volturino, M., 337, 424.  
 Volturino, F., 46, 89, 96, 268, 286, 287, 288, 290, 292, 293, 294, 310, 324, 326, 327, 435, 509.  
 Vomano, F., 322, 325, 326, 511.  
 Vrana, L., 500.  
 Vulcano, I., 473, 474.  
 —, T., 380.  
 Vulture, M., 31, 32, 329, 332, 340-1.  
 Waidbruck, *see* Ponte all' Isarco.  
 Water supplies, 30, 366.  
 Weisskugel, *see* Palla Bianca.  
 White-fir woods, 446, 447.  
 Winds, 409, 434, 439; force, 416; surface, 411-16; upper, 416.  
 Wippach, *see* Vipacco.  
 Yugoslavia, 5, 8, 151, 154, 239, 244-5.  
 Zafaglione, P., 163, 165.  
 Zaffarano, C., 170, 171, 175, 396.  
 Zapponea, 133.  
 Zappulla, F., 171.  
 Zara, 1.  
 Zeda, M., 206.  
 Zillertal, *see* Alps, Aurine.  
 Zimmara, M., 401.  
 Zinc, 26, 276.  
 Zinola, 62.  
 Zittola, T., 511.  
 Zoagli, 69.  
 Zolla, 249.  
 Zonzo, M., 300.  
 Zuffo, P., 153.  
 Zungri, 358.

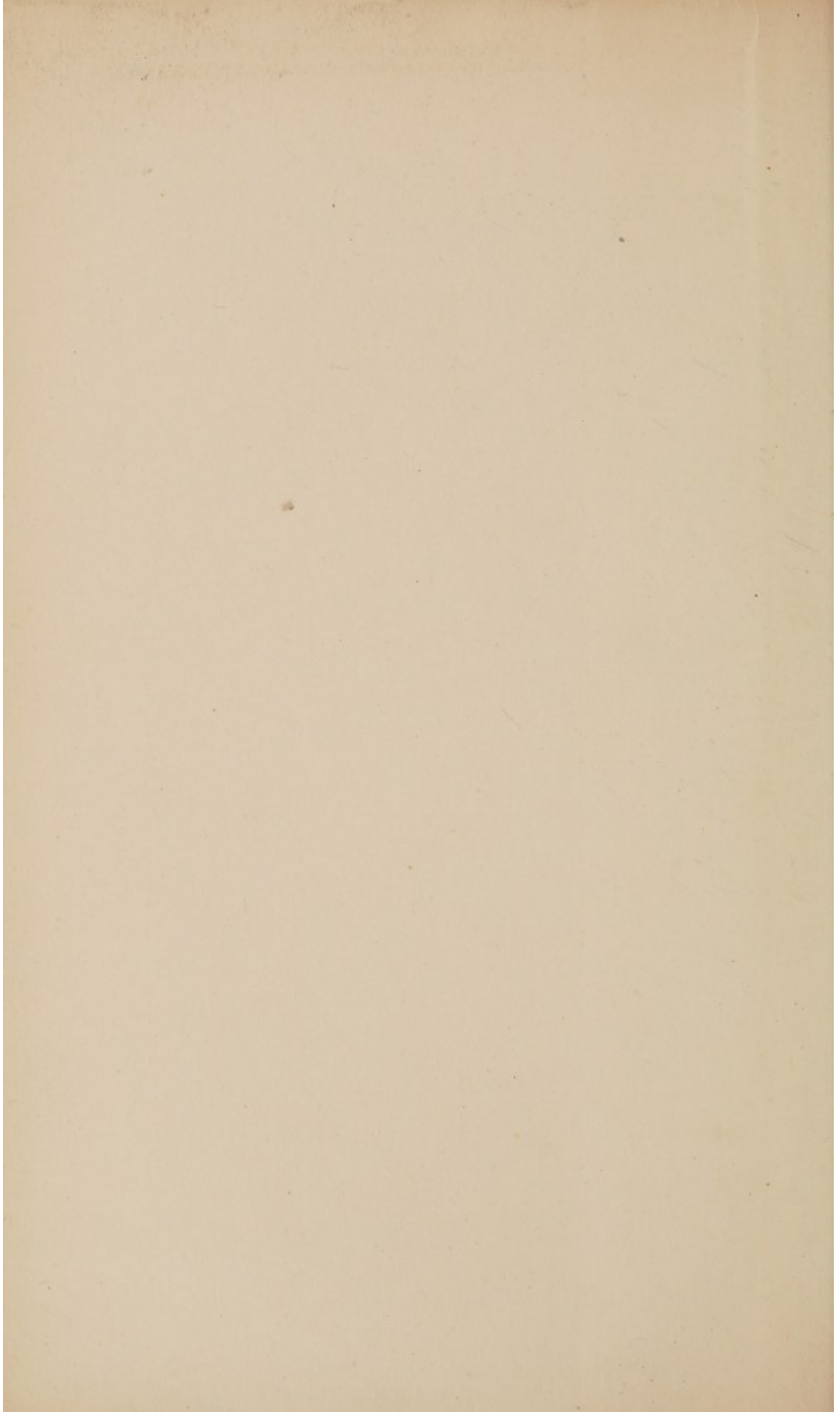


Adams, John Quincy	17
Adams, Thomas	18
Adams, William	19
Adams, William	20
Adams, William	21
Adams, William	22
Adams, William	23
Adams, William	24
Adams, William	25
Adams, William	26
Adams, William	27
Adams, William	28
Adams, William	29
Adams, William	30
Adams, William	31
Adams, William	32
Adams, William	33
Adams, William	34
Adams, William	35
Adams, William	36
Adams, William	37
Adams, William	38
Adams, William	39
Adams, William	40
Adams, William	41
Adams, William	42
Adams, William	43
Adams, William	44
Adams, William	45
Adams, William	46
Adams, William	47
Adams, William	48
Adams, William	49
Adams, William	50
Adams, William	51
Adams, William	52
Adams, William	53
Adams, William	54
Adams, William	55
Adams, William	56
Adams, William	57
Adams, William	58
Adams, William	59
Adams, William	60
Adams, William	61
Adams, William	62
Adams, William	63
Adams, William	64
Adams, William	65
Adams, William	66
Adams, William	67
Adams, William	68
Adams, William	69
Adams, William	70
Adams, William	71
Adams, William	72
Adams, William	73
Adams, William	74
Adams, William	75
Adams, William	76
Adams, William	77
Adams, William	78
Adams, William	79
Adams, William	80
Adams, William	81
Adams, William	82
Adams, William	83
Adams, William	84
Adams, William	85
Adams, William	86
Adams, William	87
Adams, William	88
Adams, William	89
Adams, William	90
Adams, William	91
Adams, William	92
Adams, William	93
Adams, William	94
Adams, William	95
Adams, William	96
Adams, William	97
Adams, William	98
Adams, William	99
Adams, William	100



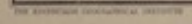








## # CZECHOSLOVAKIA



Year	0-14 (%)	15-64 (%)	65+ (%)
1960	35	60	5
1970	30	65	5
1980	25	70	5
1990	20	75	5

continued from page 100



