

# List of Illustrations

Figure 0.1. Blanche Bay area in the early 1980s.	2
Figure 0.2. Volcano distribution in Papua New Guinea and Solomon Islands.	3
Figure 1.1. Geological map of north-eastern New Britain and southern New Ireland.	8
Figure 1.2. Tolai fishermen working fish trap nets.	9
Figure 1.3. <i>Tubuan</i> ceremony on Greet Harbour.	11
Figure 1.4. Philip Carteret sketch of Rabaul volcanoes in 1767.	13
Figure 1.5. John Hunter sketch of Rabaul volcanoes in 1791.	15
Figure 1.6. Wilfred Powell map of the St Georges Channel area in 1878–79.	16
Figure 1.7. Sketch map of Simpson and Greet harbours in 1872.	17
Figure 1.8. Bathymetry of the two named harbours in Blanche Bay mapped in 1875.	20
Figure 1.9. Portrait photograph of George Brown in later life.	27
Figure 1.10. Map of the Rabaul region in German times.	34
Figure 1.11. Commemorative plaque at Nodup.	35
Figure 1.12. Dawapia Rocks in 1883.	37
Figure 1.13. Bathymetric map of Blanche Bay, 1888.	40
Figure 1.14. Geography of the Old Protectorate and Island Territory in German times.	45
Figure 1.15. Portrait photographs of Eduard HERNSHEIM and Albert Hahl in later life.	46
Figure 1.16. The German steamer <i>Seestern</i> on Greet Harbour.	47
Figure 1.17. Matupit children in 1906–07.	48
Figure 1.18. SMS <i>Planet</i> in still waters.	52

Figure 1.19. Map of Rabaul town in 1913.	55
Figure 2.1. Australian troops after the 1914 invasion of Rabaul.	59
Figure 2.2. Viewing the 1878 crater of Tavurvur.	60
Figure 2.3. Fort Raluana and background volcanoes.	65
Figure 2.4. Aerial view of Tavurvur, Matupit Island and Vulcan Island.	67
Figure 2.5. Aerial view of Rabaul town, Dawapia Rocks and Vulcan Island.	70
Figure 3.1. Malaguna Road, Rabaul, before the 1937 eruption.	74
Figure 3.2. Chinatown and Yara Avenue, Rabaul.	74
Figure 3.3. Map of north-eastern Gazelle Peninsula including Rabaul town.	75
Figure 3.4. Meeting the arrival of a vessel at Rabaul's main wharf.	77
Figure 3.5. Painting of the SS <i>Montoro</i> at sea.	77
Figure 3.6. Entry gate to Government House in 1927.	79
Figure 3.7. View from Taliligap of the rising Vulcan Island.	86
Figure 3.8. Map of the 1878 Vulcan Island and the 1937 Vulcan cone.	87
Figure 3.9. Plinian eruption at Vesuvius in 1822.	90
Figure 3.10. Magazine photograph compilation of Vulcan in eruption in 1937.	92
Figure 3.11. <i>Golden Bear</i> photograph of Vulcan in eruption.	95
Figure 3.12. Vulcan eruption as photographed from Rapindik.	96
Figure 3.13. Pyroclastic flows from Vulcan as seen from Rabaul.	97
Figure 3.14. Trevitt wedding photographed at Rabaul.	99
Figure 3.15. Fully developed eruption column from Vulcan as seen from Kokopo.	100
Figure 3.16. Vulcan ash on car and coconut-tree damage.	106
Figure 3.17. Sketch of components of Vulcan eruption cloud.	111
Figure 3.18. Tsunami debris and grounded boats at Rabaul.	119
Figure 3.19. Lightning in night-time eruption cloud at Vulcan.	122
Figure 3.20. Car parking at Nodup after Rabaul evacuation.	129
Figure 3.21. Tavurvur eruption cloud as photographed from the SS <i>Montoro</i> .	133
Figure 3.22. Brett Hilder sketch of the scene off Nodup.	134
Figure 3.23. Evacuees at Nodup being ferried out to the SS <i>Montoro</i> .	134

Figure 3.24. Six photographs of Tavurvur eruption taken by Mr and Mrs Vagg.	136
Figure 3.25. Tavurvur in eruption probably as seen from Rapindik.	137
Figure 3.26. <i>Daily Telegraph</i> front page featuring the high Vulcan eruption column.	138
Figure 3.27. Brett Hilder sketch of Vulcan and Tavurvur eruptions at night-time.	144
Figure 3.28. Rabaul refugees at Kokopo beach.	146
Figure 3.29. Launch being unloaded at Kokopo beach.	146
Figure 3.30. Ships anchored at Kokopo and hulk of the <i>Loch Katrine</i> .	147
Figure 3.31. Nurses attending to refugees at Kokopo.	149
Figure 3.32. Camping out at Kokopo.	149
Figure 3.33. Vunapope procession and Vulcan eruption cloud.	150
Figure 3.34. Aerial view of Rabaul town and Vulcan on front cover of <i>Pacific Islands Monthly</i> magazine.	159
Figure 3.35. Aerial view of the new Vulcan cone and small eruption clouds.	160
Figure 3.36. Emissions from both Vulcan and Tavurvur as seen from Taliligap.	161
Figure 3.37. Small pyroclastic flows running down the flanks of the new Vulcan cone.	162
Figure 3.38. Ash-covered steps at the Rabaul Hotel.	164
Figure 3.39. Combined portrait photographs of McNicoll and Phillips in <i>Pacific Islands Monthly</i> article.	165
Figure 3.40. Brett Hilder map of Blanche Bay pumice field plus launch and ship tracks.	166
Figure 3.41. Rescue vessels at Kokopo and new Tavurvur emissions.	167
Figure 3.42. Mango Avenue damage.	168
Figure 3.43. Malaguna Road damage.	169
Figure 3.44. Yara Avenue damage.	170
Figure 3.45. Damage along Rabaul frontage near radio station.	171
Figure 3.46. Department of Lands building and palm damage.	173
Figure 3.47. Central administration building and ash-covered road.	174
Figure 3.48. Rabaul Hotel and compacted mud-ash deposit.	175

Figure 3.49. Roof collapse caused by ash loading.	176
Figure 3.50. Ash being removed from roof.	176
Figure 3.51. Clean-up operations in ash-affected Rabaul.	177
Figure 3.52. Burns Philp store after clearing ash from roof.	178
Figure 3.53. Fallen tree branches on roadside.	182
Figure 3.54. Recovery of coconut palms.	183
Figure 3.55. Return of evacuees to Rabaul.	184
Figure 3.56. The <i>Durour</i> on the slipway in front of the new Vulcan cone.	186
Figure 3.57. Vulcan ash covering the Baden-Jones's home.	187
Figure 3.58. House collapse caused by volcanic ash from Vulcan.	188
Figure 3.59. Vulcan cone and probable salt encrustations.	188
Figure 3.60. Excavating an occupied shelter buried by Vulcan ash.	189
Figure 3.61. Flooding in Rabaul.	190
Figure 3.62. Erosion gullies near Vulcan.	191
Figure 3.63. Erosion on Namanula Hill Road.	192
Figure 3.64. Construction of drains in Rabaul.	193
Figure 3.65. Cartoon of visiting volcanologist on volcanic cone.	194
Figure 3.66. Pumice floating on Simpson Harbour near wharf.	196
Figure 3.67. HMAS <i>Australia</i> visiting Blanche Bay.	197
Figure 3.68. Mrs Bignell on the rim of Vulcan cone.	197
Figure 4.1. Ash-covered <i>Durour</i> on slipway and Dr Stehn on foot track.	202
Figure 4.2. Caldera formation by outward explosion.	206
Figure 4.3. Caldera formation by inward collapse.	207
Figure 4.4. Map of the Greet Geothermal Field and Rabaul town.	209
Figure 4.5. Map of Tavurvur and the Escape Bay area.	210
Figure 4.6. Volcanological fieldwork at Escape Bay.	212
Figure 4.7. Water-filled 1878 crater near the new Vulcan cone.	213
Figure 4.8. Two ash layers exposed on a roof in Rabaul.	215
Figure 4.9. Map of contoured thicknesses of Vulcan and Tavurvur deposits.	216
Figure 4.10. Measuring temperatures at the northern foot of Vulcan.	218

Figure 5.1. First volcanological observatory to be built overlooking Rabaul town.	226
Figure 5.2. Volcano-monitoring equipment in observatory cellar.	227
Figure 5.3. Oblique aerial photograph of Vulcan cone in 1941.	230
Figure 5.4. Time series graph of Tavurvur temperature measurements, 1940–41.	231
Figure 5.5. Tavurvur in explosive eruption (Hawnt).	235
Figure 5.6. Tavurvur in explosive eruption (Hutchinson).	236
Figure 5.7. Incandescence in Tavurvur eruption cloud.	237
Figure 5.8. Visit to deep erosion gully near Vulcan.	241
Figure 5.9. Wartime military map of Rabaul.	243
Figure 5.10. Tavurvur in eruption during Japanese occupation.	245
Figure 5.11. Japanese volcanological observatory at Sulphur Creek.	247
Figure 5.12. Two-part sketch of buildings and bunker at the Japanese observatory.	248
Figure 5.13. Seismograph being used at Sulphur Creek observatory.	249
Figure 5.14. Oblique aerial drawing of eastern side of Simpson Harbour.	249
Figure 5.15. Japanese seismograph reinstalled at Rapindik after WWII.	250
Figure 5.16. Aerial photograph of bombing of Sulphur Creek area.	252
Figure 5.17. Map of Japanese caves and tunnels dug into pumice deposits.	253
Figure 5.18. Sketch of Kabiū–Tavurvur area plus submarine.	254
Figure 5.19. Two-part sketch of second Japanese observatory.	256
Figure 5.20. Remains of Rabaul town at the end of WWII.	257
Figure 5.21. Japanese sketch of the volcanoes of Blanche Bay.	257
Figure 6.1. Geological hazards map for the north-eastern Gazelle Peninsula.	264
Figure 6.2. Climbing out of the crater of Tavurvur volcano.	268
Figure 6.3. Visit to Mount Lamington, Papua, in May 1951.	270
Figure 6.4. Temperature measuring on Tavurvur.	274
Figure 6.5. Early earthquake epicentres for the New Guinea region.	274
Figure 6.6. Duke of Edinburgh's visit to the volcanological observatory.	275
Figure 6.7. Rabaul town and volcanoes as photographed from the observatory.	276

Figure 6.8. Aerial view of Tavurvur volcano in the early 1960s.	277
Figure 6.9. Observatory recording room in 1969.	279
Figure 6.10. Tectonic plates of the region of the Territory of Papua New Guinea.	282
Figure 6.11. Subduction of a tectonic plate.	283
Figure 7.1. Rob Cooke and Elias Ravian at a Rabaul Volcanological Observatory staff gathering.	286
Figure 7.2. Subducting plate beneath the Rabaul area.	288
Figure 7.3. Aerial-photograph mosaic of the north-eastern Blanche Bay area.	289
Figure 7.4. Early version of the 'seismic annulus' at Rabaul.	291
Figure 7.5. Graph of monthly earthquake counts between 1968 and 1994.	292
Figure 7.6. Centres of uplift and bulge structures in Blanche Bay.	294
Figure 7.7. Map of earthquake epicentres defining the seismic annulus in 1983–85.	300
Figure 7.8. East–west cross-section through the seismic annulus shown in Figure 7.7.	301
Figure 7.9. Ellipses formed by earthquake epicentres in Blanche Bay.	302
Figure 7.10. Pyroclastic deposits in a road cut near Kabakada.	306
Figure 7.11. Intrusion of magma up ring fault and its resulting deformation of the central block.	307
Figure 7.12. Map of proposed volcanic systems of the Rabaul area.	309
Figure 7.13. Anticipated extents of large pyroclastic flows and heavy ash falls in Gazelle Peninsula.	313
Figure 7.14. Fiftieth anniversary ceremony of the 1937 volcanic disaster.	314
Figure 8.1. Double-layer ash cloud from Tavurvur on 19 September 1994.	320
Figure 8.2. Initial explosive eruptions from Vulcan as seen from the south on 19 September 1994.	321
Figure 8.3. Vulcan and Tavurvur in double eruption on 22 September 1994.	322
Figure 8.4. Space shuttle image of Vulcan and Tavurvur eruption clouds.	324
Figure 8.5. Vulcan ash cloud positions tracked by NOAA satellite at different times.	325
Figure 8.6. Thicknesses of 1994 ash from Vulcan and Tavurvur plotted as isopachs.	326

## LIST OF ILLUSTRATIONS

Figure 8.7. Aerial view of ash damage in northern part of Rabaul town.	328
Figure 8.8. Close-up aerial view of roof and tree damage in Rabaul town.	328
Figure 8.9. Lakunai Airfield damage including ash-covered aircraft.	329
Figure 8.10. Small Tavurvur eruption and general view along the Turagunan– Watom Island line.	335
Figure 8.11. Night-time incandescent strombolian eruption at Tavurvur.	336
Figure 8.12. Plot of ‘north-east’ earthquake epicentres for 1994–98.	337
Figure 8.13. October 2006 Tavurvur eruption as seen from the south.	338
Figure 8.14. Visitors to the RVO recording room in October 2006.	339
Figure 8.15. Distant incandescent explosive eruption at Tavurvur at night.	341
Figure 9.1. John Siune painting of Prime Minister Chan’s helicopter visit over Rabaul.	344
Figure 9.2. Map of damage assessment results for Rabaul town.	346
Figure 9.3. Vulcan 1937 sample as photographed through a microscope.	353
Figure 9.4. Seismic tomography of the north-eastern Gazelle Peninsula area.	355
Figure 9.5. Subduction and magma-formation cross-section.	356
Figure 9.6. Magma mixing and low-velocity anomalies.	359

This text is taken from *Return to Volcano Town: Reassessing the 1937–1943 Volcanic Eruptions at Rabaul*, by R. Wally Johnson and Neville A. Threlfall, published 2023 by ANU Press, The Australian National University, Canberra, Australia.