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NOTES ON THE VOLCANOES MOUNT BAGANA AND MOUNT VICTORY, TERRITORY OF PAPUA AND NEW GUINEA

by

I.E. Smith

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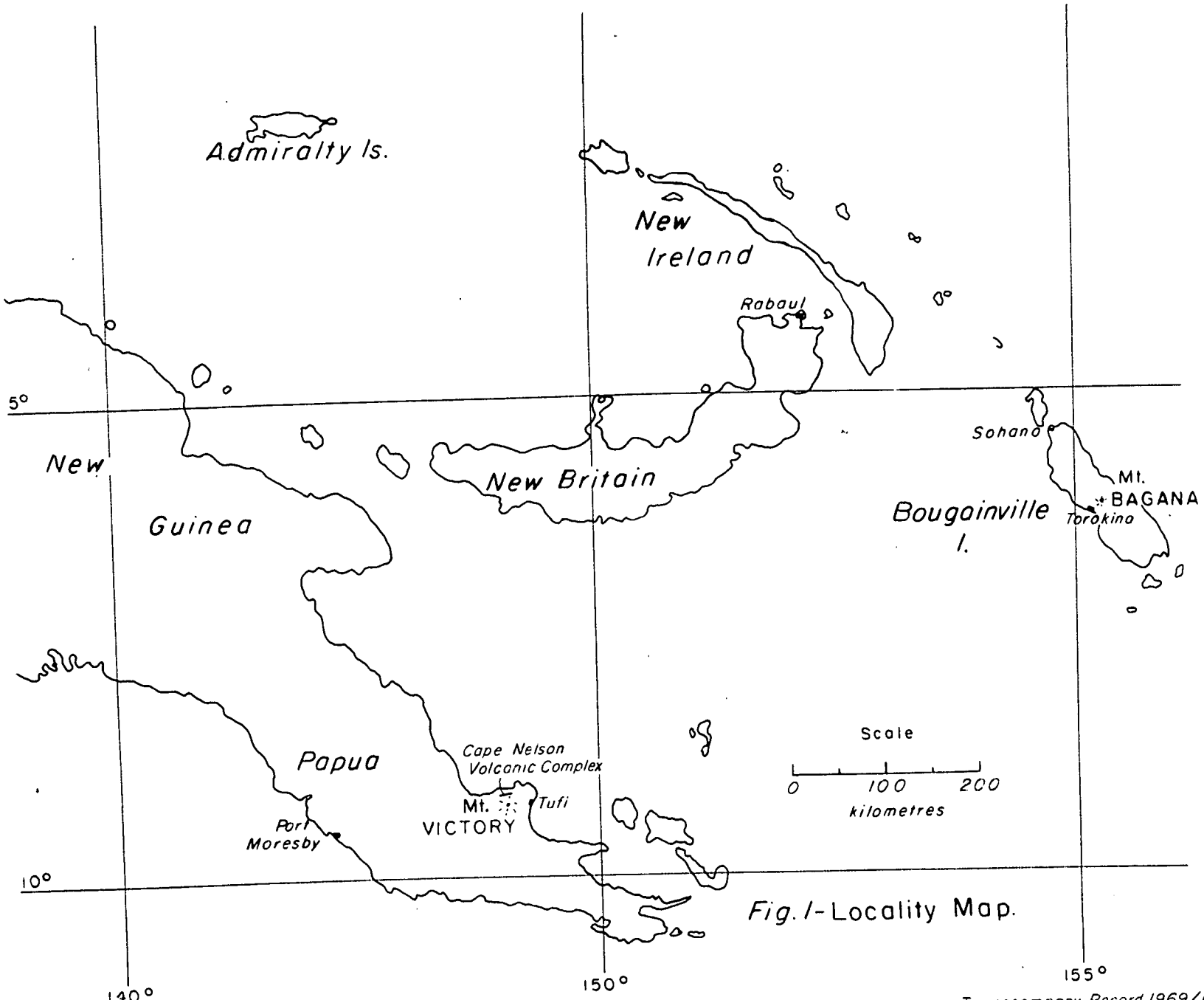

Fig. 1 - Locality Map.

To accompany Record 1969/12 P/A 229

SUMMARY

Mount Bagana is an active andesitic volcano situated in the center of Bougainville Island, T.P.N.G. It is probably the most active volcano in New Guinea (Fisher, 1957), and in recent years it has produced major eruptions during which lava flows and/or nuée ardentes were emitted. The history of activity from the volcano dates from 1883 (Guppy, 1887), but is fragmentary and no continuous reports exist for the period up to 1950. Thirty two centres of population lie within a radius of about 20 kilometres of the summit of Mount Bagana and these contain a minimum population of 3,561 people. Judging from the results of previous eruptions, population centres within 20 kilometres of Mount Bagana on the south western side could be adversely affected by major eruptions in the future. There are 5 population centres in this category.

Mount Victory is an active andesite volcano in eastern Papua. The summit area is complex and consists of a well formed crater, the remnants of two older craters, and three lava domes one of which may have formed during the last eruption. Reports exist of an eruption in the early part of the 19th century (Fisher, 1957). The most recent phase of activity commenced in the late 19th century with the eruption of nuée ardentes, this was probably followed by a prolonged period of dome building which continued until the 1930's. Two main lava types have been recognized so far, a porphyritic hornblende andesite and a more basic pyroxene bearing andesite. Forty-one population centres lie within a radius of about 20 kilometres from Mount Victory. Evidence suggests that centres close to the main rivers draining the volcano may suffer adversely in the event of another eruption.

INTRODUCTION

This report is in two parts. The first part is largely a compilation of published and unpublished work dealing with the form, petrography and eruptive history of Mount Bagana, an active volcano on Bougainville Island, T.P.N.G., and includes a section on the distribution of population centres in the vicinity of the volcano. The second part presents field observations and preliminary petrography resulting from a visit, in September 1968, to Mount Victory, an active volcano in eastern Papua. Sections on the eruptive history and the distribution of population in the vicinity of Mount Victory are included.

MOUNT BAGANA

Type: Strato-volcano in active building stage associated with older volcanic centres.
District: Bougainville, Territory of New Guinea.
Geographical position: Central Bougainville Island, 16 km north east of Torokina.
Co-ordinates: Latitude 6°8'40" south; longitude 155°11'20" east.
Altitude: 1702 metres.

Introduction

This report is largely a compilation of published work, unpublished B.M.R. records and the unpublished monthly reports of the vulcanological observatory in Rabaul. An aerial inspection following a report of activity in September 1967 represents the authors only first hand experience of the volcano. Most of this work was carried out while the author was temporarily stationed at the Rabaul vulcanological observatory during 1967.

Mount Bagana is an active strato-volcano situated approximately half way down the central mountain chain of Bougainville Island, Territory of New Guinea (Fig. 1). It is one of the most active volcanoes in New Guinea (Fisher, 1957), and may have been entirely built up since the end of the Pleistocene (Blake and Miezitis, 1967). Observations of activity date from the early 1880's (Guppy, 1887) although records are fragmentary. In recent years there have been major eruptions during which lava flows and/or nuée ardentes were emitted in 1950, 1952, 1953, 1960, 1962, 1964, 1965, and 1966 (Fisher, 1957; Rabaul Observatory Monthly Reports 1950-1967).

Bagana is a conical mountain built up of tongue shaped or spatulate andesitic lava flows with subordinate tuff and agglomerate, and derived alluvial fan deposits. Previous reports have described the crater as being poorly defined and approximately 440 metres across (Fisher, 1957; Blake and Miezitis, 1967); the summit crater in September 1967 was fairly well defined and contained a viscous lava flow which was flowing through a gap in the crater wall and down the southern slopes of the volcano. In recent years a number of lava flows have issued from this gap in the crater wall; the two most recent ones were those erupted in early 1966 and mid to late 1967. Earlier lava flows have originated from all sides of the crater (Fisher, 1957); these have usually been erupted through minor gaps in the crater rim.

Lava flows from Mount Bagana are steep sided, up to 50 metres thick and locally have marginal levees and transverse furrows; the flows are less than 50 metres wide near the crater but become much wider near the base of the cone (Blake and Miezitis, 1967). The lava flows are characteristically extremely viscous and may flow slowly for months after their initial eruption before finally solidifying. Their cooling rates are correspondingly slow and their surfaces continue to

steam for years after their eruption; this affect is particularly marked after rain. When not in actual eruption the summit of the volcano is in a state of vigorous fumarolic activity and large quantities of vapour at high temperatures are continuously given off both from within the crater and from around the outer crater rim.

The lavas that have been erupted from Mount Bagana are augite andesites; they contain phenocrysts of augite, plagioclase and magnetite with minor hornblende and hypersthene. The groundmass consists of plagioclase, hypersthene, magnetite and clear brown glass (Blake,1968). These rocks are described as 'fairly typical calc-alkaline andesites', (Blake,op cit.).

ERUPTIVE HISTORY

Most of the reports of activity from Mount Bagana come from people who live in the vicinity of the volcano or from the crews of boats in the area. These people are generally untrained in volcanic observation and their reports are at times inaccurate and conflicting. In the account which follows an attempt has been made to provide as accurate a picture as possible of the eruptive history of Mount Bagana as it has been received in reports to the vulcanological observatory in Rabaul. It is important to note that Bagana is in a sparsely populated area and so it is not unlikely that minor activity could occur without a report being received at the vulcanological observatory.

From time to time there have been reports of eruptions and emission of lava from various points on the slopes of the volcano. There is no evidence of any vent of parasitic crater from which such activity could occur and the reported activity was probably associated with the movement of lava flows down the flank of the volcano.

The eruptive history of Mount Bagana is fragmentary until shortly after World War II; since then reports have been made more or less continuously to the vulcanological observatory in Rabaul. The most common type of activity from this volcano is normal explosions of varying intensity from the central crater. At times these explosions have resulted in quite wide spread ash falls. Lava flows and nuée ardentes accompanied by the extrusion of lava domes are also recorded.

The earliest report is of normal explosions from the main crater during December 1883 or January 1884 but Bagana was apparently continuously active for at least 15 to 20 years before then (Fisher, 1957). Between 1884 and 1937 no details are known and the next recorded eruption, in 1937, was witnessed from Kieta, 50 km distant. On the 15th May 1938 a severe eruption caused a fall of ash at Kieta. During the war years there was little or no explosive activity until

1945-46 when light explosions accompanied the ejection of scoria. Lava flows were emitted in 1946-47 (Blake and Miezitis, 1967).

Activity 1948-53

A gradual build up of activity commenced in 1948 culminating in a maximum between June and September 1950 after which there was intermittent activity with maxima between March and September 1952 and between June and August 1953. In late 1953 the volcano entered a period of quiescence.

The eruptions during 1950 gave rise to lava flows and nuée ardentes and a lava dome was extruded. At the height of activity in late September there were up to five eruptions a day, each accompanied by a loud roaring with pumice and ash ejected to a height of 10,000 metres. By this stage, lava flows had established definite channels down the sides of the mountain.

During November 1950 the volcano was quiet. In December there was ejection of steam accompanied by spasmodic rumblings. The lava flow on the south south west side of the cone was observed to be still moving.

Early in 1951 a recrudescence of somewhat intense activity occurred which declined about April but continued with diminished intensity until the end of the year (Best, 1956). Early 1952 again witnessed an intensification of activity beginning with an eruption on February 28th. Between March and September there were explosions with emission of lava and nuée ardentes accompanied by frequent earth tremors. Between 18th and 21st March, fifteen nuée ardentes and forty five explosives were observed. Three of these were extremely violent with dust clouds rising to 10,000 metres.

A further period of intensified activity took place between June and August 1953. This was characterized by normal explosions from the crater and by nuée ardentes. Notable eruptions occurred on July 10th and 25th and also during August.

Activity 1959-61

By 1959 viscous lava flows from the 1948-53 activity had descended to the foot of the cone on the northwest and southwest flanks. The cone was completely denuded and beyond its base, vegetation was sparse and apparently still recovering from the effects of nuee ardentes.

Toward the end of January 1959 Bagana was reported to be emitting a thin column of white and blue vapour to 1,200 metres above the summit. In September frequent tremors and continuous emission of vapour clouds were observed. Frequent explosions, sometimes several a day, were heard inland and a glow over the mountain was seen at night. From January to May 1960 activity increased.

In May 1960 Bagan erupted with the emission of ash clouds accompanied by dull rumblings and by thin white vapour charged with sulphur dioxide. Two large very thick lava flows were observed to have descended the south west and south eastern flanks, both appeared hot and the south eastern flow was probably still moving. There was no evidence of damage to surrounding vegetation from recent explosive activity.

Between June 1960 and July 1961 there was no report of activity. On July 26th, 1961, brown ash clouds were seen rising in considerable volume from Bagana. Vapour was also seen emerging from what was apparently a fumarole low down on the slopes of the volcano.

Activity 1962

On 15th February, 1962 Bagana erupted. A breach was made in the eastern wall of the crater through which lava issued every five to ten minutes. Major activity continued until April but its effects were restricted to the volcano itself. In May fluctuations in the quantity of vapour emitted from the summit were reported where previously emission had been constant. Earth tremors were reported and the eastern lip of the crater was seen to have been altered in shape and a part of it removed. Smoke and lava were belching from the volcano regularly every five or ten minutes. Dead fish were common in the streams flowing from the base of the volcano.

In July 1962 three lava flows were seen descending the southern slopes. Two fumaroles about half way down the cone gave off regular pulses of vapour, approximately once every ten minutes. Lava flowed continuously from the south eastern portion of the crater. A divided vapour column indicated two separate active centres within the crater, one on the south-east and the other on the north-west side. These two vents were puffing alternately at approximately ten minute intervals.

Activity 1964-65

There was no reported activity between October 1962 and April 1964. On 24th April, 1964 Bagana erupted with loud explosions, producing vast mushroom shaped clouds. This activity coincided with a large tectonic earthquake centered in the New Guinea Highlands (Rabaul observatory monthly report).

During October the most prominent activity was observed by Branch (1967) to be continuous voluminous emission of steam from the whole summit area, with a mild steam explosion sometimes containing a little ash ejected every ten minutes from the western side of the summit area. These clouds rose to 600 metres above the summit. A deep red glow was seen from the crater at night.

The crater area at this time resembled a strong solfatara field with thick sulphur deposits around the margin. Steam was being emitted at low pressures and at temperatures which were probably between 150°C and 200°C. The 1952 flow down the western flank of volcano was still steaming strongly and the slopes adjacent to the flow were also steaming. Temperatures measured at about 1,000 metres a.s.l. were 89°C and 99°C.

A new lava flow was advancing slowly along the northern side of the 1952 flow and the snout of this flow had reached approximately 1,000 metres a.s.l. The flow was blocky, about 30 metres thick and was advancing at the rate of a few inches per hour. Activity in October 1964 appeared to be mild and stable (Branch, 1967).

In December continuous emission of gas was reported from Bagana. Frequent changes in the volume of gas given off were noted and from time to time some black ash clouds were emitted. Up to seventeen gas vents scattered from top to bottom of the cone were seen from the west coast at times. Steam was being continuously emitted from the area north of the 1952 lava flow on the western flank of the volcano.

A red glow was visible at the summit from 7th to 9th and from 11th to 14th January 1965. By May 1965 the snout of the lava flow which was descending down the north side of the 1952 flow was at approximately 500 metres a.s.l. On July 29th increased activity was reported from Bagana. On the western side vapour was seen issuing from the base and rising to 2,000 metres a.s.l. Steam was issuing from lava flows, this was probably due to recent rains. The volume of steam emitted increased at the end of the month.

Activity 1966

During early 1966 there was a build up of activity culminating in a large eruption toward the end of May. Increased gas emissions from fumaroles on the western slopes of Bagana and a fluctuating glow from the summit and at intervals from different places down to 600 metres a.s.l. were reported on 20th March. Incandescent lava was reported on the slopes of the volcano between 20th and 25th March. A lava flow was observed at an altitude of approximately 1,000 metres a.s.l. on 7th April.

In the early part of May 1966 lava flows were observed on the southern, north western and eastern flanks of Bagana. On the morning of 5th there were abnormally large explosions and the south west slope was covered by ejectamenta, brown ash clouds rose to an estimated 1,000 metres above the summit. The focus of this eruption was located on the south eastern side of the crater. On 7th there were ejections of ash laden vapour clouds which rose up to 3,000 metres above the summit and a few boulders were ejected down the eastern slope.

From 16th to 26th of the month the volcano was subjected to minor earth tremors up to strength 5 MM. Continuous emission of white vapour in greater quantities than usual were reported on 18th. On 20th and 21st there was continuous emission of ash laden vapour. This cloud was diffuse in texture and light grey in colour. A glow over the summit was noted on 24th. On 25th there was continuous emission of large quantities of white to grey vapour. The vapour cloud was a diffuse light grey on 26th and a glow was observed over the summit that night. Late on 27th a large dark grey ash laden cloud was emitted and an appreciable area of the sky in the vicinity of the volcano was darkened. Ash fell at Piva on 28th. On 29th an ash laden cloud lay over the volcano and there was a report of a new crater opening at the south west of the summit.

On 30th May a large eruption sent a nuée ardente down the southern slopes of the volcano and an area of forest from 6 to 7 kilometres radius from the crater area on the south and south west flanks was destroyed and burnt. Ash from this eruption fell on Piva. On 31st ash clouds surrounded the summit and wind blown ash reached Sohano 96 kilometres distant. Approximately 20 small explosions at one to two minute intervals accompanied the emission of vapour clouds which rose high in the sky. Leaves, some green and some charred, together with ash, fell on Piva. Ash from eruptions during the last three days of May fell widely on the flanks of the volcano within a 16 kilometre radius of the summit.

The violent eruption at the end of May destroyed the south east side of the summit area. At the beginning of June 1966, vapour, with some dust, was escaping quietly from the breach. The ash cover was seen to extend over the southern flanks of the volcano and along the Saua River valley to a distance of 9½ kilometres from the summit. The northern side of Bagana was apparently free from ash.

Activity during June 1966 was minor. Activity associated with the movement of lava flows down the cone was reported at the beginning and again at the end of the month. A summit glow was observed on the night of the 11th, and on 12th there were approximately eight explosions followed by rumblings on 13th.

Mount Bagana was observed from the air in October 1966 and in April 1967; at these times the lava flow from the May 1966 eruption was still moving down the southern slopes of the cone. The average rate of movement of this flow was calculated to be just over 40 feet per day.

An aerial inspection of Mount Bagana was carried out on 23rd September 1967 following a report of increased activity. A thick white vapour was being emitted from numerous small vents within the crater and on the outer crater rim. A lava flow was flowing out through a gap in the crater rim on the south south east side and flowing over the top of the earlier 1966 flow. The snout of the flow was between 200 and 300 metres below the crater.

POPULATION DISTRIBUTION

Figure 3 shows the location of population centres within a 20 kilometre radius of Mount Bagana. This map and the population figures given below are based on information supplied by Administration officers on Bougainville Island. Population figures are tabulated below.

Within 10 kilometres	Population
Korobi	97
Sito	47
Tengerepaia	131
Within 15 kilometres	
Betriopaia	139
Keriana (Diskon)	110
Leisiopaia	109
Within 20 kilometres	
Atangato	47
Karatu	93
Kegiri	108
Koiar (Koiare)	147
Kopani	322
Kopikiri	113
Manatai Mission	
Mapioro (Mapearo)	170
Nasiwoiwa	169
Mom	33
Piva	63
Sirioripaia	205
Sisisi (Sisivi)	218

In addition the following villages and plantations lie just outside the 20 km radius.

Atamo	311
Arigua Plantation	
Borvi Plantation	
Karnovitu	191
Kurwina Plantation	
Laruma	40
Leikoia No. 1	81
Numa Numa Plantation	
Okowapaia	144
Ruruvu	135
Tenakau Plantation	
Togarau	240

Mount Bagana is surrounded on three sides by rugged mountains but on the south western side it is open to the coast. On the evidence of previous eruptions, for example that of May 1966, when a nuée ardente swept down the Saua River to a distance of 9½kilometres from the crater the area to the south west of the volcano is the most likely to be affected by an eruption in the future.

MOUNT VICTORY

Type: Strato-volcano.
District: Northern District; Territory of Papua.
Geographical Position: North eastern Papua, 30 kilometres south west from Tufi government station.
Co-ordinates: Latitude 9°11'40" south; longitude 149°04'00" east.
Altitude: 1925 metres.

Introduction

This report records field observations and preliminary thin section petrography carried out as a part of the Bureau of Mineral Resources mapping programme in eastern Papua. Mount Victory is an active andesitic volcano which makes up the southwestern part of the Cape Nelson volcanic complex on the north east coast of Papua (Fig. 1). It carries a cover of dense rain forest which tends to be stunted in the vicinity of the summit. Much of the forest is relatively poor in species and is in a successional stage having developed after destruction of the original rain forest during an eruption in the last century (Haantjens, 1964).

Previous work on Mount Victory is very limited; a brief account of the location, form and structure, and eruptive history is given by Fisher (1957); Branch (1965), comments on the effects of volcanic loading in the area and the volcano is mentioned in passing by Ruxton (1966) in his paper on the volcanic associations to the west. Morgan (1963, 1966), briefly describes the petrography of two specimens of lava from the summit of Mount Victory and presents a chemical analysis of one of the specimens. Mount Victory lies within the area covered by the C.S.I.R.O. Land Research Series No. 12 (1964).

FORM AND PETROGRAPHY

The lower slopes of Mount Victory rise gently from the alluvial plains on three sides; to the north east the volcano abutts against Mount Trafalgar, a deeply dissected extinct volcano, and the two are separated by a low saddle approximately 300 metres in elevation. The upper 500 metres of Mount Victory are relatively steep, rising to an irregular summit area on which a number of recent constructional features can be observed. The summit area is illustrated in Figure 5.

The main features of the summit area are a fairly well preserved crater which is open to the east and a recent dome on its south eastern side. The highest part of the crater rim is on the northern side and the highest point on the volcano is on the south east dome. A low ridge representing the rims of two old craters runs south from the main crater between the south east dome and two smaller domes on the south and west of the summit area. Small lava spines occur on all three of the domes and one of these, on the south dome, is known as The Thumb. A shallow lake lies in a low area between the crater and the domes.

The whole summit area carries a cover of thick scrub with the exception of some patches of grass and reeds in the crater and a small solfatara field on the northwestern outer rim of the crater. Warm odourless vapour is issuing quietly from a number of vents in this field; this is the only present day activity on Mount Victory.

An arcuate structure approximately 300 metres below the summit on the north north western side of the volcano may represent the rim of an old crater formed during an earlier cycle of activity. If this is the case then the present summit area has been built up within this older crater and has buried it on all but the northern side.

Four small parasitic cones of the order of 50 metres in elevation are preserved on the southwestern slopes of the volcano at an altitude of approximately 500 metres. A number of lava flows which originated from these cones can be clearly delineated in aerial photographs and they are illustrated in Figure 5; all are covered by dense rain forest. Two further parasitic cones occur on the saddle between Mount Victory and Mount Trafalgar. In the crater of the larger of these two there is a small lake known as Lake Ridubidubina.

Preliminary thin section petrography indicates two main lava types; a porphyritic hornblende bearing andesite and a slightly porphyritic basic andesite in which pyroxene is the dominant ferromagnesian mineral.

Porphyritic andesites are the most common rock type. Plagioclase, usually sodic labradorite, is invariably present as phenocrysts and as small crystals in the groundmass. Hornblende is always present as the dominant ferromagnesian mineral and it is usually accompanied by subordinate biotite, both of these occur as phenocrysts and as small crystals in the groundmass. Small augite crystals are a common minor constituent rarely representing more than 5 per cent of the rock by volume. Hypersthene is a minor component of some specimens. Opaque minerals are a ubiquitous minor accessory.

The basic andesite consists of plagioclase and augite; specimens are usually slightly porphyritic. Hornblende and biotite occur as minor constituents in some specimens and minor opaque minerals are usually present.

Inclusions are common in the porphyritic type. They usually consist of hornblende which is sometimes accompanied by plagioclase. One specimen contained an inclusion consisting of augite and hypersthene with minor plagioclase.

Morgan (1963) suggests that a porphyritic lava type collected from the crater of Mount Victory is a dacite rather than an andesite on the basis of a silica percentage of 62.7. In the absence of chemical data the rocks described in this report are termed andesites as they possess many of the features of typical orogenic andesites as given by Taylor and White (1966).

ERUPTIVE HISTORY

Reports exist of a volcanic eruption from Mount Victory in the early part of the 19th century (Fisher, 1957). The most recent activity took place in the late 19th and continued into the early 20th century. In 1932, Mr Cridland, a retired magistrate at present living at Tufi, spoke to two natives who could remember an eruption from Mount Victory. The natives described two 'rivers' which flowed down the north west and south west slopes of the volcano burning the vegetation on their way. These 'rivers' destroyed a number of villages and caused an unknown number of deaths before finally reaching the coast. Mr Cridland estimated that this eruption probably took place about 1890.

The volcano appears to have been more or less continuously active from this time until the 1930's. The crews of ships passing by in the early 20th century used the volcano as a beacon and according to Mr Cridland the crater area was still emitting vapour and a red glow was visible over the summit at night in the 1930's.

Fisher (1957) describes several midly solfataric areas that could be observed within the crater area; the two main ones were situated in the south west and north east of the crater area. At present, (September, 1968) the only solfataric area in evidence is a small area on the outer crater rim on the north west side. Vapour issuing from this area is only warm, and there is no sulphurous smell.

Thick fresh looking ash deposits occur in the Kopwei river which flows down the north north west slopes of the volcano. These could well be accounted for by a Pelean type of eruption producing nuée ardentes and this would support the natives' description of a 'burning river' descending the volcano. Unfortunately records are scanty but it seems possible that the lava dome on the south east of the summit area is a result of this most recent phase of activity. The accounts of nuée ardentes followed by long continued mild activity are strongly reminiscent of the activity of Mount Lamington (Taylor, 1958) which after violent activity between 1951 and 1953 entered a phase of dome building which is continuing at the present time.

The headwaters of the Kopwei and Ajova Rivers rise on the flanks of the south east dome and it seems likely that these two rivers would exert some directional control on material emitted during an eruption. The Ajova River course could well have been the 'burning river' described by a native as flowing down the south east slopes of the volcano, and the Kopwei River is probably the course of the 'burning river' which flowed down to the north west.

POPULATION DISTRIBUTION

The distribution of population centres within a 20 kilometre radius of the summit of Mount Victory is given in Figure 4. This information has been taken from the Royal Australian Survey Corps 1:250,000 series sheet SC558 (overprint March 1966) Tufi. For clarity the villages on the coast between Tufi and Cape Nelson have been omitted from the figure; these villages are well outside the 20 km radius and are shielded from the possible effects of an eruption from Mount Victory by the quite considerable bulk of Mount Trafalgar.

Within 10 kilometres

- Boa
- Kwin
- Moum
- Oi-Ai
- Penari

Within 15 kilometres

- Ambon
- Itoto
- Kuruaku
- Ororo
- Urufum

Within 20 kilometres

- Aku
- Gobe
- Giriwa
- Kamabun
- Kanane
- Koreaf
- Kumuwara
- Lora
- Mafuia
- Managa
- Moiawa
- Murina
- Oreia
- Sanada
- Totore
- Uwe
- Wanari
- Wanigela

Immediately outside the 20 kilometre radius

- Angoroga
- Berubona Mission
- Dove 1
- Dove 2
- Fonibaru
- Fornu
- Foru
- Ilamaroro
- Itonamata
- Iu-ai-iu
- Jarub
- Karikari
- Little Dove
- Oreresan

The eruption late last century produced nuée ardentes which flowed down the north west and south flanks of the volcano, probably down the courses of the Ajova and Kopwei Rivers and reached the coast, 20 km from the summit. In the event of activity in the future it is quite possible that population centres within a 20 km radius particularly those located close to one or other of the major rivers running off the volcano could be adversely affected.

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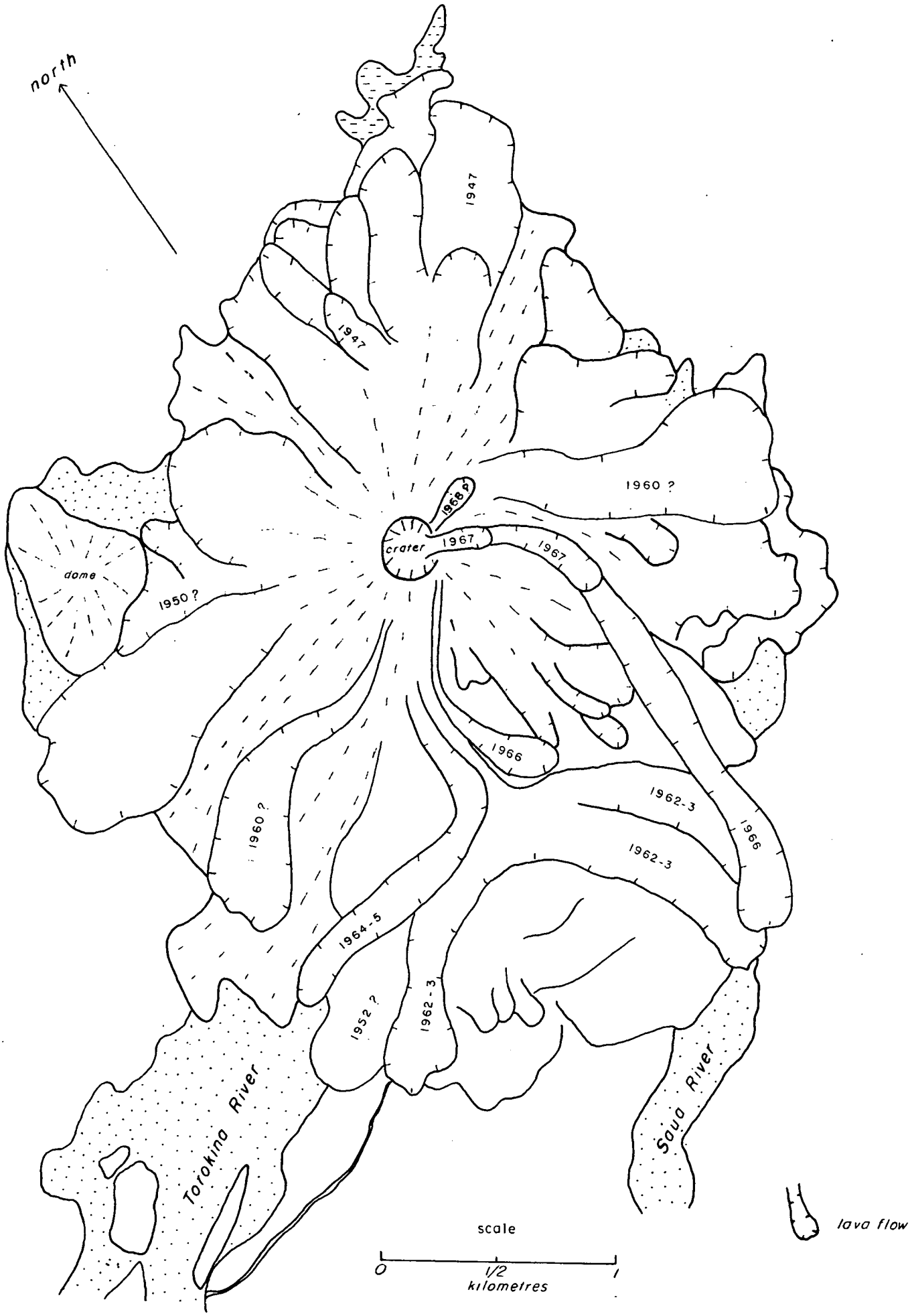
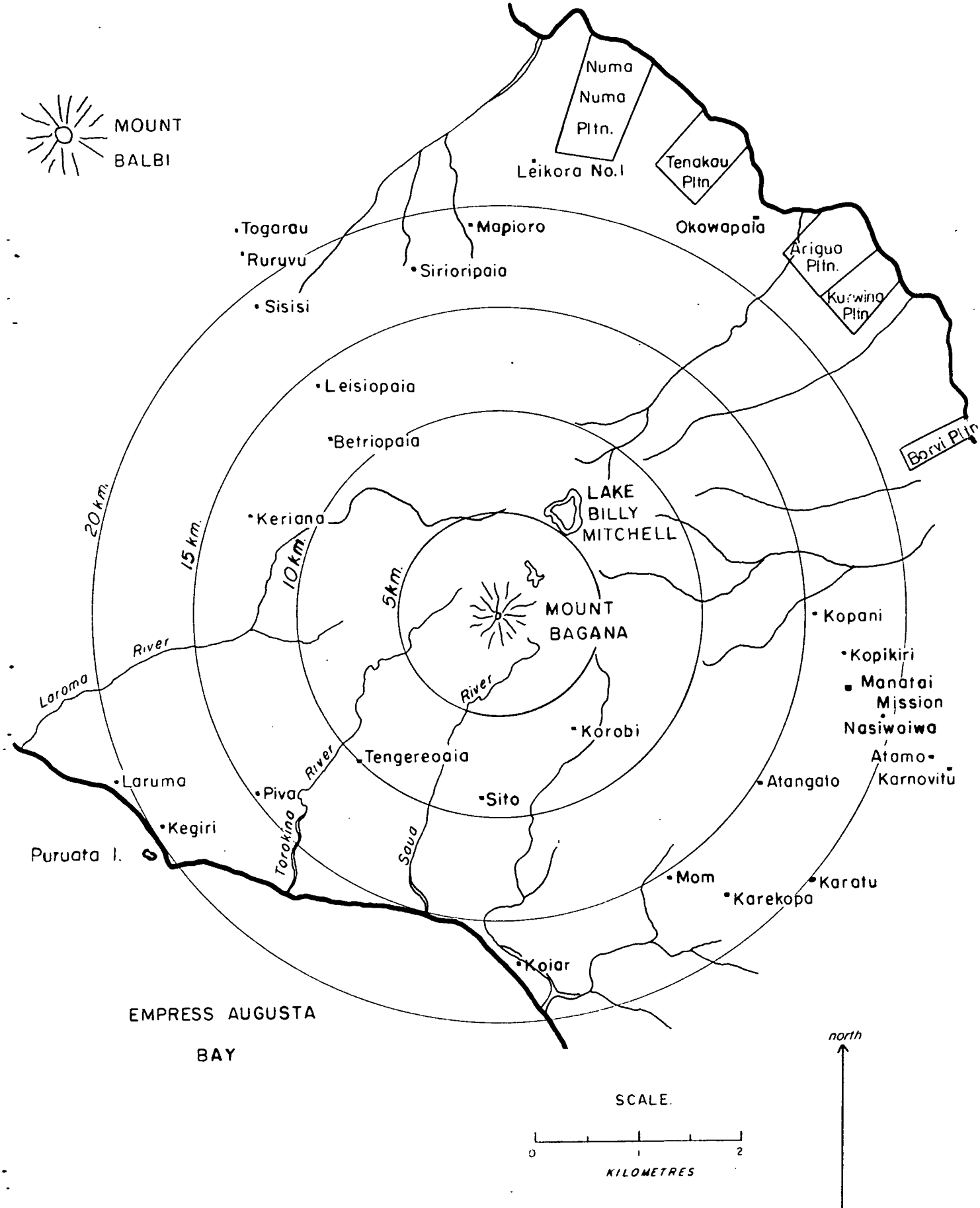


Fig. 2 - Mount Bagana, showing distribution of recent lava flows
(Based on aerial photographs taken in 1947 & 1963.)



Fig,3 - Distribution of population within a 20 kilometre radius of Mount Bagana.

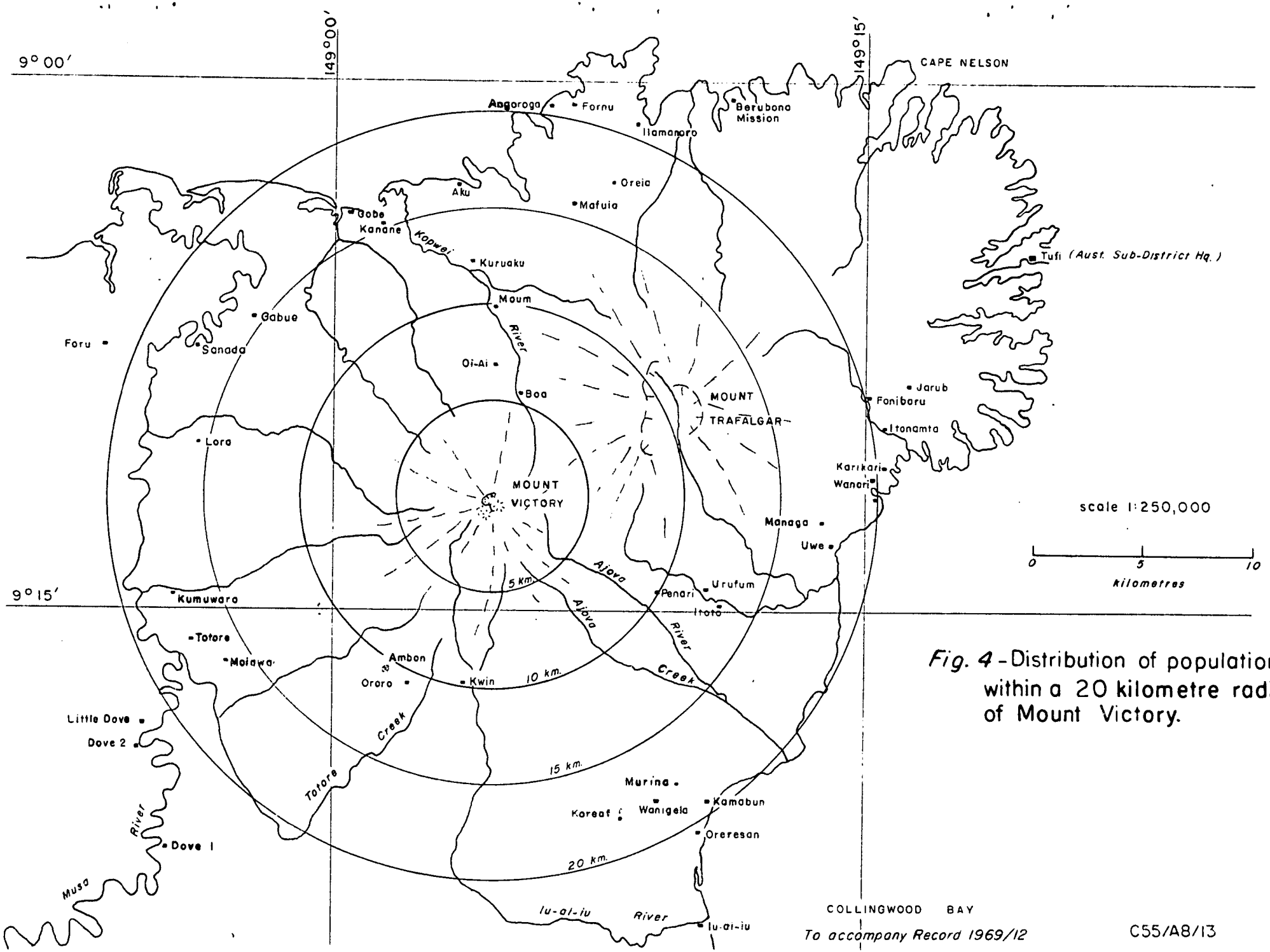


Fig. 4 - Distribution of population within a 20 kilometre radius of Mount Victory.

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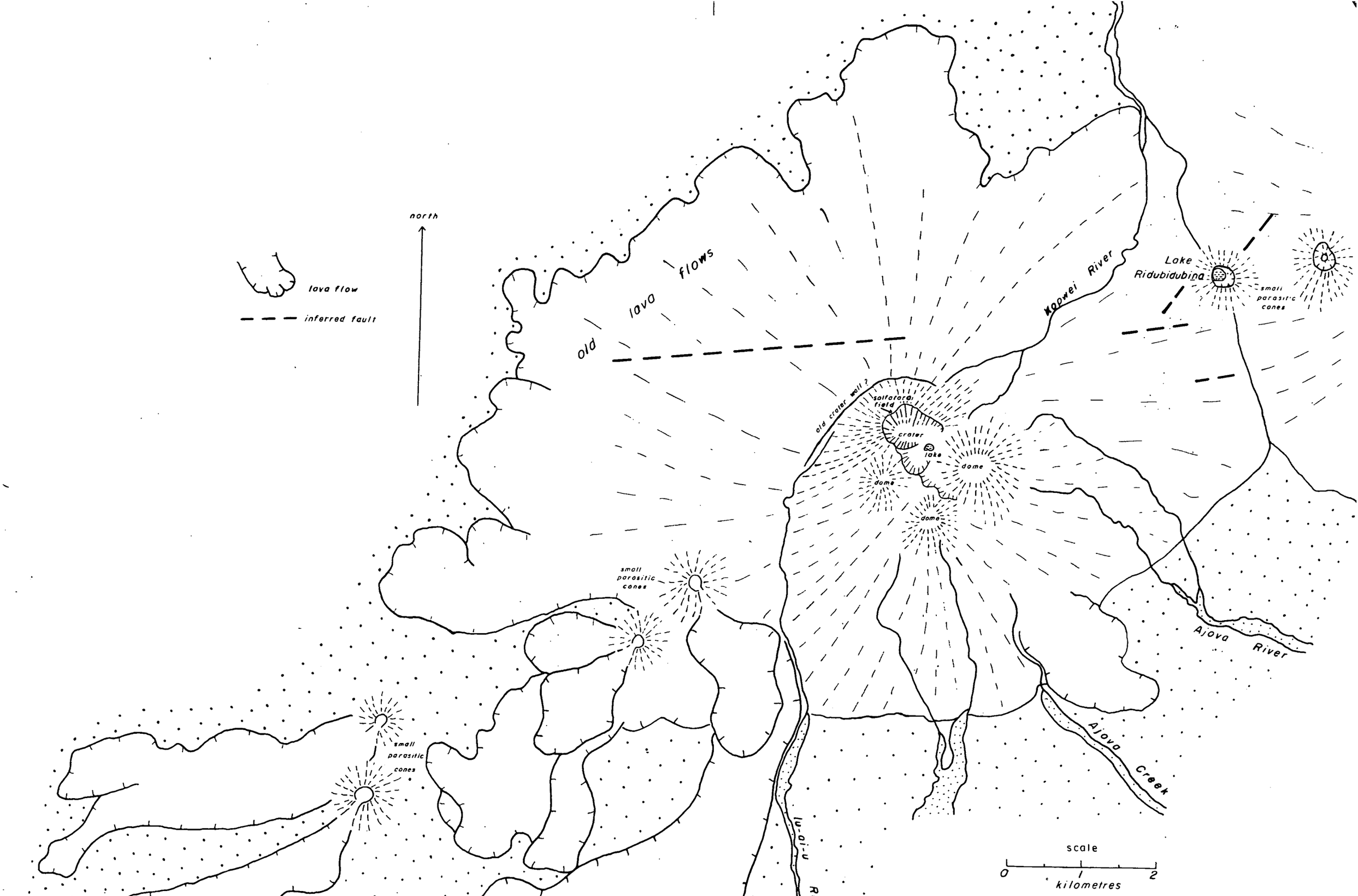

Fig. 5 - Sketch map of Mount Victory showing the summit area and the parasitic cones on the flanks.
(based on aerial photographs taken in 1956).