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DEPARTMENT OF NATIONAL DEVELOPMENT  
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THE APRIL 1964 ERUPTION OF MANAM VOLCANO

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by

C.D. Branch

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## THE APRIL 1964 ERUPTION OF MANAM VOLCANO.

### SUMMARY.

A small climactic eruption from a new vent high in the south-east valley of Manam volcano in April 1964 was preceded by five months of sporadic, weak ejection of ash mainly from the Main Vent. The continuous mild emission of white vapour characterized activity at the Southern Vent.

Suddenly at 1600 hours on the 16th April, the heavy emission of grey ash commenced from the Southern Vent. Fountaining of incandescent lava was seen at night accompanied by boulder flows in the upper south-east valley. Audible explosions occurred at the rate of 17 per hour on the 17th and gradually increased to 640 per hour on the 19th, then declined and became irregular until the 24th. Following a large felt earthquake on the 24th April, explosive activity increased from a new vent high in the south-east valley - the South-east Vent. Lava spatter was hurled to 1500 feet above the new vent every three to four seconds, accompanied by innumerable boulder flows down the south-east valley. A blocky lava flow of olivine basalt descended 3000 feet below the South-east Vent. The activity decreased to about 75 explosions per hour at the end of April and became irregular during May. On the 30th May 1964 explosions ceased and the only evidence of the South-east Vent was a widespread fumarole field steaming strongly in the general area of the vent.

### PREVIOUS ERUPTIVE HISTORY.

Manam (lat.  $4^{\circ}\text{S}$ , long.  $145^{\circ}\text{E}$ ) is a basaltic island volcano situated 10 miles off the north-western coast of New Guinea. The volcano is a symmetrical cone seven miles in diameter at the base, rising to a height of about 6000 feet above sea level. Taylor (1960) describes the cone as 'of the strato type and consists predominantly of fragmental material which is buttressed by numerous flows and dykes of basaltic lava. The most prominent topographical features are four great radial valleys, or chasms, which descent from the summit area and dissect the cone in azimuths between the cardinal points of the compass.' Ejecta from the two summit craters drain off in these valleys; ejecta from the Main (northern) Vent into the north-east and north-west valleys, and from the Southern Vent into the south-east and south-west valleys.

Manam is perhaps the most active volcano in the Territory of Papua and New Guinea and Fisher (1957) lists 12 eruptions between 1877 and 1947. Most eruptions were explosive, with minor lava effusion. A cycle of major activity began in 1956 reaching a climax in March 1958, and this has been documented by Reynolds (1957) and Taylor (1958 a,b ; 1960). Minor eruptions have occurred since then in March to May 1960; July to September, 1961; April, 1962; February, 1963; and April, 1964 (all described in monthly reports from the Vulcanological Observatory, Rabaul).

### THE NATURE OF THE CURRENT ERUPTION.

Activity leading to a small climactic eruption in April 1964 from a new vent in the head of the south-eastern valley began in November 1963, after a period of four months during which nothing but a little white vapour was emitted from both the Main and Southern Vents. The following data are divided into two sections, the first covering the preliminary activity from November 1963 to 15th April 1964 and the second details the main eruption commencing on the 16th April.

#### November, 1963 to 15th April, 1964.

Both the Main and Southern Vents emitted a little white vapour continuously until the 26th November, 1963, when activity at the Main Vent changed to the sporadic ejection of ash for one day (Fig. 1). A little ash fell at the Observation post at Waris on the following two days.

Grey ash was again ejected from the Main Vent from the 30th November to 6th December, followed by white vapour only for two days, after which mild, continuous ash emission recommenced.

The weakening of activity from the Main Vent on the 7th December coincided with the start of mild explosions of ash from the Southern Vent. The number of explosions per hour rose from three on the 7th, to five on the 8th, and reached a maximum of 15 per hour on the 9th. The rate decreased to one explosion per hour on the 10th when the continuous emission of ash commenced and lasted for two days. The weak to moderate emission of white vapour recommenced on the 13th December 1963 and continued until the 15th April, 1964.

At the Main Vent, the mild, continuous emission of ash that commenced on the 9th December did not change until the 25th January 1964, when activity increased. This coincided with the maximum deflation of the volcano as indicated by tiltmeter measurements (Fig. 1). Ash fell at Waris on the 25th and 26th and on the 26th the continuous ash ejection was accompanied by faintly audible explosions and a faint flow above the crater at night. Ash fell at Waris on the 30th January, and 2nd, 3rd and 8th of February. The activity then weakened and from the 13th to 20th mainly white vapour was emitted, with a tinge of brown ash in the vapour cloud. Following a tilt maximum on the 20th February (Fig. 1) activity increased: inaudible, weak ash explosions occurred at the rate of 29 per hour on the 21st, but decreased to 7 per hour on the 24th and ceased that day. Weak to moderate emission of vapour with a little ash commenced on the 25th February and was unchanged at the end of June 1964.

#### 16th April to June 1964.

Most of the activity outlined above was from the Main Vent, and from the end of February 1964 both vents had emitted vapour only.

Suddenly, at 1600 on the 16th April, 1964 the heavy emission of grey ash commenced from the Southern Vent. A short while afterwards a small boulder flow swept 4000 feet down the southern side of the south-east valley, igniting vegetation adjacent to the valley. Fountaining of incandescent lava was seen at night, accompanied by sporadic boulder-flows in the upper south-east valley.

On the 17th ash explosions, many audible, were occurring at the rate of 17 per hour. The explosions gradually increased to a maximum of 640 per hour at 1700 on the 19th and were accompanied by continuous rumbling. A north-easterly wind swept the ash away and on the 20th it fell in the Iassa to Tabele area on Manam and the Potsdam to Awar area on the mainland and formed a film a few millimetres thick. The rate of explosions declined to between 300 and 400 per hour on the 20th, then to 200 to 300 on the 21st. Most explosions were audible and sounded like distant thunder. Fountaining of lava and boulder flows were seen each night.

At 1000 hours on the 22nd G.W. D'Addario inspected the volcano during a 10 minute diversion on the DC3 flight from Madang to Wewak. The activity was mostly explosive, with rhythmic emission of ash and scoriae every few seconds. At the climax of each ejection, lava fountaining reached a height of 200 feet, falling back inside the orifice. The lava appeared bright red in full sunlight. An area of steaming ash was seen high in the south-east valley. The height of the Southern Vent was calculated to be 5700 feet above sea level.

On the 22nd, 23rd and 24th the rate of explosions fluctuated markedly from hour to hour ranging from 100 to 500: most were audible.

At 1556 hours on 24th April a large earthquake occurred in the New Guinea highlands near Mount Hagen, and was felt on Manam as intensity 5MM. No immediate response from the volcano was noted, but next day the activity had increased and the rate of explosions no longer fluctuated.



When the volcano was inspected from a chartered Cessna, by C.D. Branch at 1200 hours on the 25th, it was seen that a new vent 100 feet across had opened in the area noted as steaming by D'Addario on the 22nd. The lava column reached almost to the top of this vent, named the South-east Vent, but was drained off through a lava tunnel one or two hundred feet below the rim. A lava flow emerged from the tunnel and extended a little more than half way down the southern side of the south-east valley, where, because of high viscosity, it was almost at a standstill. Bubbles of gas bursting from the lava column every 4 to 10 seconds sent a spatter of orange-yellow molten rock to 500 feet above the crater. Activity at the Southern Vent was confined to the continuous emission of weak vapour and ash. That night, from Bogia, boulder flows were seen descending 2000 feet down the south-east avalanche valley every 5 to 10 minutes.

The island was circumnavigated by boat on the 26th. Activity from both the Main and Southern Vents was confined to continuous weak emission of vapour and ash. The ash was falling lightly in the Iassa area and doing no damage. Lava spatter from the South-east Vent high in the south-east valley was ejected 1000 to 1500 feet above the crater. It fell mainly around the vent then avalanched down the valley. Some fell into the south-west valley where it accumulated at the base of the cliff. Explosions occurred every 4 to 5 seconds (rate about 700 per hour) and most were audible, sounding like the ignition of a flame thrower.

The most spectacular activity during the eruption occurred that night, and was observed and photographed from a camp at the foot of the south-east valley (Pl. 1). Throughout the night loud explosions every 3 to 4 seconds threw orange-yellow lava spatter to heights of 1500 to 2000 feet above the crater. The spatter sprayed in an incessant rain on the surrounding cinder cone. At intervals of two or three minutes red-hot avalanches of the ejected material swept in radiating sheets to 2000 feet down the south-east valley. At 0530 hours on the 27th, following a strong 'soft' explosion, a possible small nuee ardente flowed swiftly to the base of the terminal cone in the valley, about 2500 feet below the summit. During the day the intensity of the explosions declined (Pl.2), but not their rate; on followings days the rate also declined gradually to between 50 and 100 explosions per hour at the end of the month.

The new lava flow, noted earlier, had descended about 3000 feet below the summit on the 27th (about 500 feet above the flow of February, 1963). The flow was blocky (Pl. 3), and moving on a front 100 feet across and 20 to 30 feet high, at the rate of a few inches per hour. A specimen collected from a red-hot block that rolled off the flow contains well developed olivine phenocrysts, and is an olivine basalt. (Appendixes 1 & 2).

During May, activity from the South-east Vent was explosive and fluctuated markedly, but on the whole decreased throughout the month. On the 1st May, audible explosions were occurring at the rate of 19 per hour. The rate then increased and reached a climax on the 5th when 103 audible explosions each hour were counted and a glow was observed above the crater. Next day the rate of explosions dropped to 52 per hour and no glow was seen that night. By the 8th only 24 explosions occurred each hour, but the glow reappeared and continued until the 17th. A maximum of 67 explosions per hour was counted on the 13th and light ash fell at Waris. The number of explosions decreased to six per hour on the 18th, rose to 30 on the 26th. By the 30th May explosions had ceased and the only evidence of the South-east Vent was a widespread fumarole field, steaming strongly, in the general area of the Vent. This condition remained unchanged at the end of June 1964. At the same time the Main and Southern Vents continued to emit vapour with a little ash.

No volcanic earthquakes were felt or recorded on a smoked paper mechanical shock recorder at Waris during this eruption.

#### TILT PHENOMENA.

Tilt measurements from the Waris Observation Post on Manam Island are plotted in Figure 1, and may be interpreted as follows. Late in 1963 the crater area was slowly subsiding but responded early in December to the approaching solstice, and commenced to rise. This was accompanied by increased volcanic activity from both vents as magma rose in the volcano. During January 1964 as the luni-solar influence waned, the volcano became deflated, and at the same time of maximum deflation (26th January, 1964), explosive activity increased at the Main Vent. Again, as the crater area rose during February, activity increased at the time of maximum inflation, but lasted only a few days.

Unfortunately no tilt measurements were made over the equinox, but immediately following the explosive outburst from the Southern Vent on the 16th April, the crater area subsided rapidly. It rose slightly a few days later as magma entered channels high in the volcano and commenced to pour out as a lava flow from the new South-east Vent. During the next three weeks while activity waned gradually, a balance was maintained between the inflow of magma from depth and the outflow at the surface. But by mid-May the inflow decreased and the volcano deflated. Following the cessation of activity at the South-east Vent at the end of May the crater area commenced to rise irregularly.

#### CONCLUSIONS

The April 1964 eruption was small by comparison with most previous eruptions, but was unusual in the interplay of activity between the Main and Southern Vents, culminating in the opening of a new, but short-lived, vent. The Main Vent was the most active in the preceding months, but the first major outburst on the 16th April was from the Southern Vent, with no response from the Main Vent.

A few days later a new vent opened only 400 or 500 yards from the Southern Vent, but at the same elevation. All activity quickly shifted to the new, South-east Vent, and declined rapidly at the Southern Vent. This suggests that the Southern Vent became blocked just below the orifice and the upwelling magma had to force a new passage to form the South-east Vent nearby. The blocked magma, under pressure, would erupt rapidly once the confining pressure was released. This would provide a mechanism to form the lava flow in the south-east valley in a very short period of time: the flow was not in existence when G.W. D'Addario inspected the volcano on the 22nd but by the 25th lava had flowed 3000 feet down the valley, and was in an advanced stage of cooling.

Activity virtually ceased at the South-east Vent only six weeks after it commenced. Now, depending on how severely the two vents are blocked, it is uncertain whether future activity will recommence from the Southern or South-east Vents. In this regard the activity on the 22nd June may indicate the future pattern. On this day a few weak ash explosions occurred at the Southern Vent, and fumarole activity at the South-east Vent ceased entirely, only to resume next day when the explosions stopped: it suggests that the Southern Vent is at present the more open of the two.

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APPENDIX 1

Olivine Basalt from the April, 1964, Eruption of Manam Volcano.

New Guinea

by

W.R. Morgan

The specimen, R.17706, was collected by C.D. Branch from the snout of an advancing lava flow in the south-east avalanche valley of Manam Volcano.

Thin section shows the lava to be seriate porphyritic, the phenocrysts ranging in size from 2.5 mm. down to the average groundmass grain-size of 0.015 mm. The phenocrysts form about 20 to 25% of the rock, and consist of plagioclase, augite, and olivine.

Plagioclase phenocrysts form tabular to sub-tabular crystals that show slight zoning on their margins. Many occur as parallel and interpenetrant growths. Their composition is about An 85, zoned to labradorite. Augite forms pale green, euhedral prismatic crystals. Olivine occurs as colourless, prismatic crystals with rounded margins; many olivine crystals are surrounded by a very thin rim of pale green granular clinopyroxene grains.

Groundmass crystals have random orientation, and are formed to tabular, commonly pellucid crystals of plagioclase, prismatic augite and probable hypersthene, together with octahedral black iron oxide. All the crystals are enclosed in a dark brown, somewhat altered glass that forms about 25% of the rock.

A few cognate xenoliths are present. Some consist of clusters of slightly intergrown grains of augite; others are similar, but also contain granular olivine. Another is formed of anhedral olivine grains sub-ophitically enclosing small laths of plagioclase. The diameters of these inclusions are about 1 to 1.5 mm. and the average size of the grains within them is about 0.3mm.

A very rough estimate of the percentage of minerals present is: plagioclase - 40; augite and (?) hypersthene - 25; Glass - 25; olivine - 5; black iron oxide - 5.

The specimen is a porphyritic olivine basalt which, generally speaking, is typical of Manam Volcano. The main difference between this sample and specimens from the 1957 eruption is the presence of phenocrystic hypersthene in the latter.

Analysis of Lava Flow from Manam  
Volcano T.P.N.G.

by

S. Baker

	<u>Percent</u>
SiO <sub>2</sub>	51.10
Al <sub>2</sub> O <sub>3</sub>	16.65
Fe <sub>2</sub> O <sub>3</sub>	4.98
FeO	4.00
CaO	10.60
MgO	6.80
Na <sub>2</sub> O	4.25
K <sub>2</sub> O	0.88
MnO	0.16
TiO <sub>2</sub>	0.58
P <sub>2</sub> O <sub>5</sub>	0.19
H <sub>2</sub> O(110°C)	Nil
Loss on ignition	Nil
	<hr/>
	100.19

Serial No. 1514





Plate 1. Lava spatter fountain and boulder flows from the South-east Vent on the night of 26th April, 1964.  
Neg.G/7151.



Plate 2: Activity at the South-east Vent on the morning of 27th April, viewed from the south-east valley. Nuee ardente debris from the 1957-58 eruption in the foreground.  
Neg. G/7152.

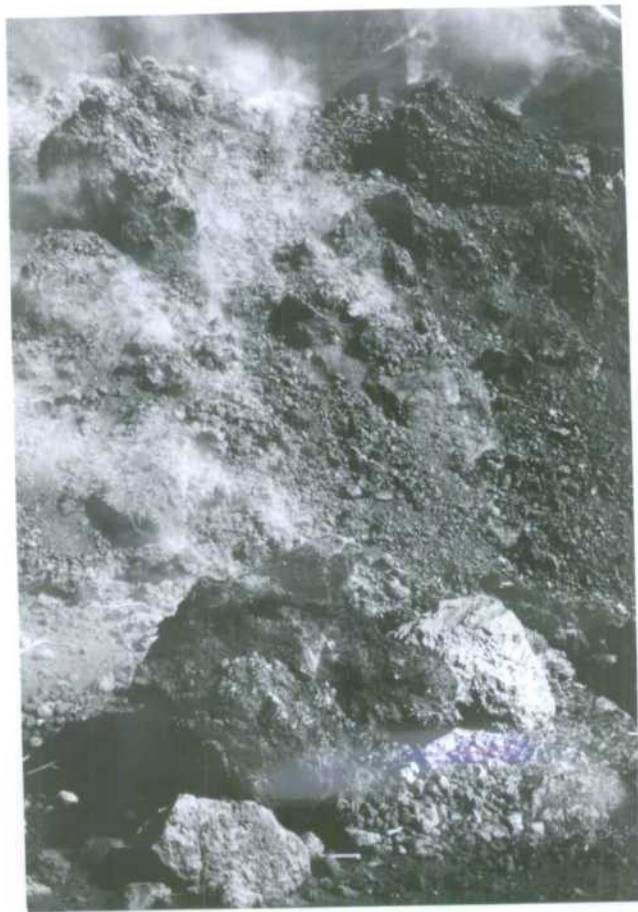
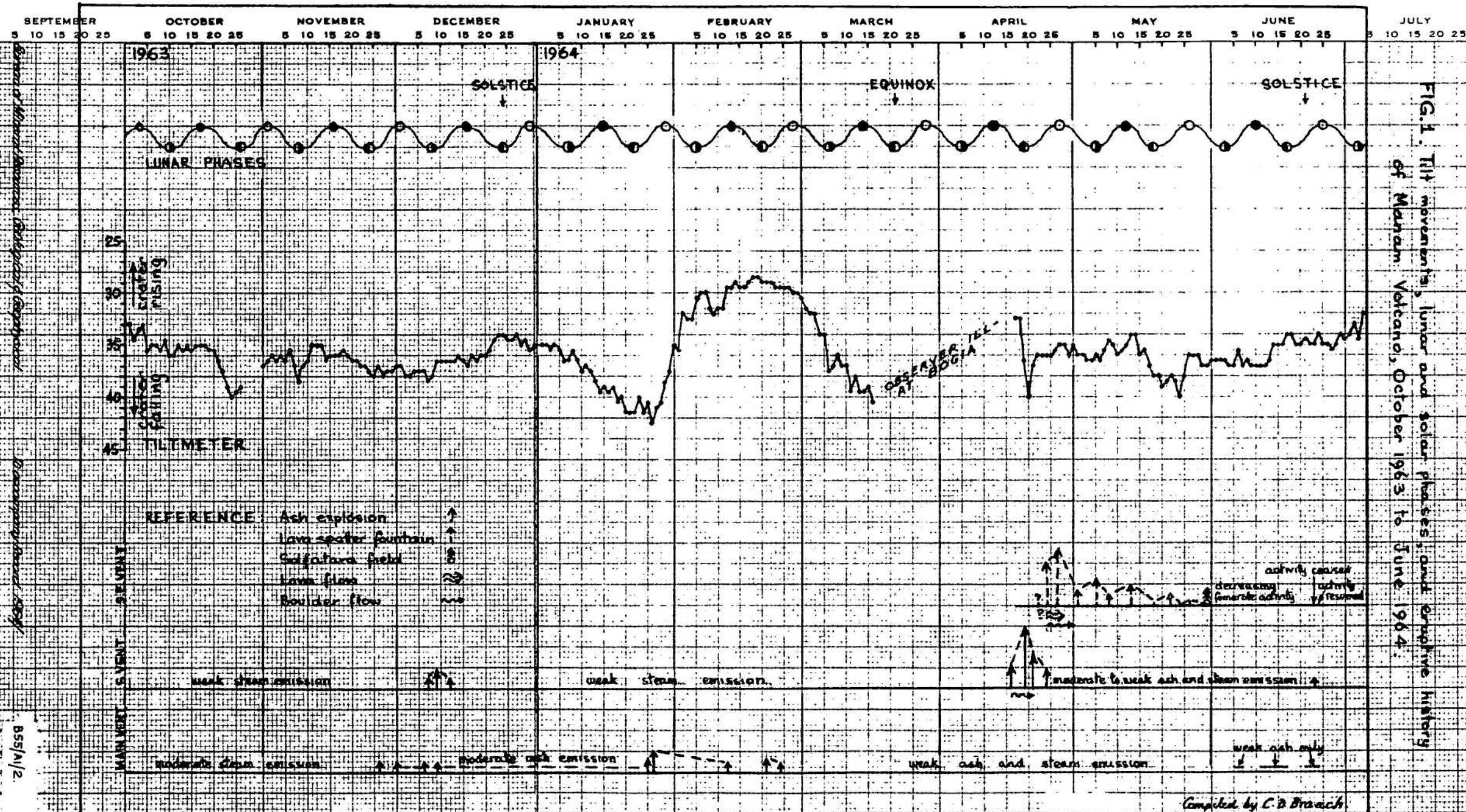


Plate 3: Snout of the new olivine basalt blocky lava flow  
in the south-east valley on 27th April, 1964.  
Neg.G/7153.





Source: Mount Volcans, Smithsonian Institution

Dissemination and Use

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