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**RECORDS.**

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NOTES ON THE CURRENT ERUPTION AT MANAM

BY

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# NOTES ON THE CURRENT ERUPTION AT MANAM

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Manam an island volcano off the north coast of New Guinea, began a new cycle of activity in December, 1956, thus ending a dormant period of nine years. This basaltic volcano has produced numerous eruptions during the last eighty years; not much detail is known of the magnitude or duration of these early events. The native inhabitants, who number 3,200, claim that none of the early eruptions were severe enough to warrant movement from the island. The activity of 1957 took the form of intermittent explosive and effusive phases which gradually increased in intensity. In December of that year major outbursts extensively damaged native gardens on the island. This fact in combination with the observations that the volcano was capable of producing nueés ardentes and that more powerful activity was yet to come, led the Administration to move all the inhabitants to the mainland. Six weeks after the evacuation an eruption of unprecedented magnitude covered most of the western side of the island with a heavy deposit of cinder and produced nueés ardentes which wiped out part of the empty villages and destroyed forest areas on various sectors of the mountain.

Two major eruptions followed this outburst. The February event increased the cinder deposits to a minimum thickness of twelve inches for much of the western slopes and nueés ardentes devastated further areas of forest on the southern slopes. The March eruption devastated a narrow zone on the eastern slopes with a heavy cinder fall and poured lava down to the sea on the southern flank of the volcano. An hiatus of more than three months ended in June with a new phase of explosive activity which still continues.

## INTRODUCTION

Manam is an island volcano situated about eight miles off the northern coast of New Guinea. (Lat.  $4^{\circ}$  S, Long.  $145^{\circ}$  E). The symmetrical cone rises to a height of approximately 5,900 feet and covers an area of more than 33 square miles. It owes its symmetry to numerous lava flows and dykes which strongly buttress the fragmental material of the structure against erosion. In four sectors, however, the cone is breached by four great chasms or radial valleys which approximately bisect the sectors of the island lying between the cardinal points of the compass.

Two of these valleys, in the south-west and the north-east sectors, end hard against the central core or nucleus of the volcano in sheer walls whose bases are concealed by an apron of ejecta from the summit vents. In the other two valleys, significantly lying in the plane of the prevailing south-east and north-west winds, the apron of ejecta has reached major proportions and has completely concealed the end walls. Thus one has the impression of looking at a terminal cone erected in an old breached crater. It is believed that all four valleys are due to normal erosion and not to explosive destruction of the cone.

The conduits of the two chief vents therefore rise through a central nucleus of the old cone and form "the main crater" and the much smaller "southern crater" on the north and south sides of the summit area. The diameter of the craters is estimated to be little more than 1,500 feet for the main crater and less than 300 feet for the southern crater.

The slopes of the volcano are normally covered by rain forest, grassland and native gardens. In the summit area and at the head of the valleys the vegetation is usually sparse or absent. The island supports a native population of 3,200 which is distributed around the margins of the island in fourteen villages. No village is farther than  $3\frac{1}{2}$  miles from, or closer than 2 miles to, the summit craters.

### HISTORY

Manam, with the possible exception of Bagana or Bougainville, is the most active volcano in the Territory of New Guinea. It has produced many explosive and effusive eruptions during the short time it's history is known. Fisher (1957) lists the following years and observes that the record is incomplete: 1877, 1887, 1888, 1889, 1902, 1910, 1917, 1919, 1921, 1936, 1937, and 1946-47.

Little is known of the nature or magnitude of these outbursts. Two people are said to have been killed during the 1902 eruption, and the 1919 event destroyed arable land and damaged Iassa village on the west coast. Since the natives of the island have no story of large scale loss of life or movement of people from the island it is possible that these early events did not reach the intensity of the current eruption. The disposition of settlements gives some support to this idea. It is believed that the villages are located in areas which they know from past experience are immune from serious volcanic effects. During the current eruption, however, part of one village was annihilated.

### THE COURSE OF THE ERUPTION

Unlike a closed conduit volcano with its early climax and eruptive activity of declining power Manam began its new cycle with mild intermittent phases of explosive and effusive activity which gradually increased in magnitude and intensity. A period of calm followed the initial phase of activity which began in December, 1956, and ended in February, 1957. The following mid-year period ushered in a new phase of more vigorous activity which reached a peak in July and then declined. With renewed activity in October came a strong outburst and the first destructive effects on local settlement. Although marked fluctuation in emission occurred, the volcano did not settle down after this outburst. Thus vigorous explosive activity throughout November climaxed in early December with an eruption which covered most of the island with ash and scoria and seriously damaged the native gardens. This was the first of a series of extraordinarily powerful eruptions which took place during each of the months from December 1957, to March 1958. A very marked decrease in visible activity followed the March eruption and this calm period came to an end in June with the resumption of explosive activity.

### THE NATURE OF THE ACTIVITY

The initial activity was predominantly explosive in character and consisted of rhythmical jet-like explosions which projected showers of incandescent lava fragments a thousand feet above the southern vent. During January, 1957, the explosions were estimated to be occurring at the rate of 6 or 7 per minute.

A conspicuous feature of this activity was the very small proportion of ash in the total ejecta. This type of emission probably belongs to the so-called Strombolian category. In some respects it resembles the activity of Tanna volcano in the New Hebrides except that there was no clear evidence of figured projectiles.

Concurrent with the explosive activity short viscous lava flows were poured over the rim of the southern vent to descend a short way down the south-eastern flank. It is probable that one lava flow descended to the foot of the debris apron which formed the terminal slopes in the head of the south-eastern valley.

Lateral movement of material also took two other forms: boulders derived from falling ejecta or disintegration of the lava flows moved down slopes either individually or en masse as noisy slow moving streams which left deposits superficially resembling lava flows: nueés ardentes of the block-ash-flow type swept down the flanks of the cone. The existence of the latter phenomenon at that time is deducible from the descriptions by Reynolds (1957) of the activity during January.

The new phase of activity in the mid-year period was almost identical in nature with that described above. It seems to have been a more intense form of activity with a marked increase in ash discharged. Falls were reported on the south-eastern and north-western slopes and, shortly afterwards, the first mudflows descended these sectors of the mountain.

During July the activity reached a new peak of intensity with heavy detonations and lava flows which descended more than 1,000 feet below the southern vent. The most notable event of this period was an extension of the activity to the main crater. Incandescent lava appeared at this focus and greatly increased vapour and some ash emission was observed. Towards the end of the month the southern crater became calm and activity was confined to vapour emission from the main crater.

The next major phase in the eruption began early in October with rapidly fluctuating spasms of explosive activity which quickly culminated on the 18th in a strong eruption. Heavy nueés ardentes swept down the southern flanks and falls of fine ash on the northern slopes destroyed houses in one village and damaged a broad zone of cultivated land.

Vigorous activity followed this outburst as the eruptive potential of the volcano continued to rise. Gas and ash emission greatly increased, coarse cinder fragments fell on coastal areas for the first time and a more mobile lava flow descended the southern slopes. A rise in temperature was apparent in the increasing brilliance of the incandescent ejecta, and an increase in gas content in the lava was evident in a change in the texture of the explosive jets.

On 4th December the volcano began to rumble continuously and the sounds were louder than any heard before. Two days later villages on the eastern coast received a heavy fall of ash and cinder blocks. The largest blocks measured 2" by 3": some of them penetrated the roofs of houses. More powerful activity occurred on the next day, 7th December, when a number of nuees ardentes descended the south-eastern valley, and dust and lapilli fell over the northern and western sectors of the island.

The eruption reached a peak on the next day, 8th December. The early morning rumbling and ash emission changed at 10AM to spasms of continuous roaring and the voluminous ejection of ash and cinders. For the greater part of the afternoon the northern and western sectors of the island were blacked out by heavy clouds of ash. The ash rain reached its greatest at Iassa where the forest was stripped of its branches, gardens were covered by not less than three inches of ash and some houses collapsed. On this day further nuees descended the south-eastern valley and extended the devastation in that sector of the mountain. A large proportion of the extensive lava field of the 1946-47 eruption was covered by a hot layer of fragmental material which in places was more than 40 feet in thickness. Some of the rapidly descending avalanches of fragmental material cut great swathes through the forest and one of them entered the sea.

Between the 10th and 13th December the whole population of the island was evacuated to the mainland.

Although activity was greatly reduced after the outburst of the 8th, rhythmical explosive jets continued from the summit vents until the 13th, and nuees continued to be expelled from the southern vent. The last of these occurred on Christmas eve. Noisy explosive activity was resumed towards the end of December with a heavy low-pitched booming which caused strong vibration effects on buildings. The summit once again became luminous at night.

#### THE MAJOR ERUPTIONS

Marked fluctuations occurred in Manam's activity during January leading progressively to eruptions of greater magnitude. The outburst of January 25th reached such an intensity that all previous eruptions observed on the island were dwarfed in comparison.

The build-up to this event began with<sup>a</sup> series of major gas and ash releases on the 6th and 7th of the month. Increased fluidity and increasing temperatures in the conduit lava were indicated by the ejection of unusual forms of gas-dilated scoria and greatly increased luminous effects.

On the night of January 9th, brilliant lava fountaining originated from the main crater and the glow of incandescent lava illuminated clouds five thousand feet above the summit. At 1600 hours on the 10th of January an enormous cloud rose more than 20,000 feet above the summit with loud roaring and rumbling. This outburst expelled a heavy nuee ardente into the north-east valley and devastated an area which, up to this time, had been immune from serious effects. The nuee swept down the valley and stopped within a mile of the sea. A lava flow then poured over the north-eastern rim and covered much of the fresh nuee deposit.

Heavy ash emission followed this eruption and during the next few days crater noises became louder. On the 14th a more powerful eruption poured a much larger lava flow into the north-western valley. This flow destroyed a considerable area of grassland and forest and reached the limit of its mobility within half a mile of the coast.

Again heavy ash emission followed this eruption and further falls of scoria occurred. Then on the 19th the activity declined to a mild emission of vapour as a prelude to the culminating outburst.



At 0605 hours on 25th January, the inactive southern vent started silently emitting ash and vapour. An hour and a half later the main crater opened up. At 0800 hours nuees ardentes were expelled onto the south-eastern flank and within a few minutes the roar of the full scale eruption could be heard all over the island. A towering column of vapour rose to more than 30,000 feet and began to drift towards the west. For the next five hours the column was fed by incessant explosions roaring and rumbling from the summit vents.

Fluctuations in the activity occurred yet always the total activity was on a gigantic scale. Near mid-day the emission reached a new peak of intensity when the main crater began roaring like an enormous blow-lamp and huge blocks were ejected as far as the forest margins on the northern slopes. So great was the pressure of this emission that flashing arcs were seen for more than half an hour and barometric readings on the island were impossible.

Heavy nuees ardentes were expelled during the course of this eruption. Although most of the ejecta was thrown to great heights a large volume of material was merely discharged onto adjacent slopes to descend as avalanches of hot fragmental material. These nuees were gravity-controlled and thus channelled into the four large valleys which dissect the cone. These fortuitous valleys were responsible for limiting the devastating effects of the nuees to mostly unsettled land. Only on the south-western slopes was settlement seriously effected. The northern sector of an empty village here was completely wiped out.

Much more extensive damage to the arable land was caused by the heavy falls of scoria. Most of the western side of the island received a deposit of coarse scoria which was 5 to 6 inches thick along the coast. This deposit was subsequently thickened to 12 inches by the eruption in February.

The February event on the 3rd took place under conditions of poor visibility with heavy rain falling on parts of the island. The peak period of this outburst occurred between 0430 and 0730 hours when loud roaring was heard from the cloud covered summit.

Voluminous quantities of fragmental and molten material were discharged and powerful nuees swept down the south-eastern flanks. Some observations suggest that this eruption was more intense than its predecessor. The nuees on this occasion over-rode the lower flanks of the south-eastern valley and destroyed additional areas of forest, and incandescent blocks were seen from the mainland falling into the sea. However, the scoria deposit from the February eruption was less extensive and no evidence was found to suggest that nuees had descended into the other three radial valleys of the cone.

The March eruption which began at 1415 hours on the 4th was the most sustained event on record. It lasted for more than 24 hours. It began with the same roaring emission of voluminous ash and vapour and similar phenomena were produced in the course of the outburst. On this occasion however, effusive activity was greatly emphasised and explosive phenomena were correspondingly reduced.

Some nuees descended the south-eastern flanks during the initial stages of the eruption. They were blocky avalanches less mobile than the previous examples. Although they came down close to the coast none of them entered the sea. The scoria falls were distributed over the eastern slopes and a narrow zone of country was severely effected. Thicknesses up to six inches were recorded.

The most prominent feature of the activity was a heavy lava flow which descended from the southern crater. Reaching the foot of the debris apron at the upper end of the valley it fanned into a broad advancing front about half a mile wide. For a time it moved down as a broad lava field and then more mobile tongues broke away from the main body and descended towards the sea. On the 6th of March a lava flow entered the sea for the first time in the current cycle of activity.

The volcano's activity was greatly reduced after this eruption. The great banner of vapour which had been present at the summit during most of the previous activity was reduced to a thin cloud which rarely passed over the margins of the island. Some fluctuations in emission have occurred from time to time and very mild explosive activity was observed towards the end of April. Light dust emissions occurred during May. It was not until the end of June that discreet explosive noises again became prominent and the familiar jet-type, luminous ejections began again from the southern crater.

### CONCLUSION

The study of Manam's activity has supplied good supporting evidence for certain theories which emerged from the work on Lamington, Ambrym, Langila, and other volcanoes in this region of the Pacific. The idea that a volcanic energy system responds to the application of external stress from regional and tidal sources seems adequately demonstrated.

The occurrence of Peléan phenomena in the course of this eruption strongly supports the view that nuees ardentes can be produced from a magma of any chemical composition - given the requisite physical conditions. It is believed that the literature on volcanic events contains many examples in which Peléan phenomena have remained unidentified.

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