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TERRITORY OF PAPUA AND NEW GUINEA

PRELIMINARY REPORT - ON AN INVESTIGATION OF MOUNT LANGLA VOLCANO.

by

G.A. Taylor

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PRELIMINARY REPORT - ON AN INVESTIGATION OF MOUNT LANGLA VOLCANO.

Mount Langla is one of a group of volcanoes which lies on the western end of the island of NEW BRITAIN. The 3,800 feet cone is on the eastern flank of the ancient volcano, Mount TALAWE and is almost due south of the wartime Gloucester airstrip.

THE ORIGINAL REPORT:

The original report concerning the signs of increasing activity was made by Father McSweeney of the Kalingi Roman Catholic Mission. Farther McSweeney was returning from a trip along the north coast on 12th May, when he noticed condensed steam rising from a new location on the summit of Mount Langla. On a visit to Borgen Bay on 30th May he saw gas bubbles in the sea close to the shoreline adjacent to the small conical hill which lies on the western side of the Bay. About the same time, he observed that the vegetation on the slopes below the new active centre had begun to die off.

Having no radio, he was unable to get the report away until Mr. Stokey called into the mission early in June. Mr. Stokey passed the message on to Rabaul.

THE INVESTIGATION:

Mr. Best attempted to investigate this report but unfortunately suffered an accident, en route, and had to return to Rabaul for medical attention.

At the request of the Government Secretary the writer left Popondetta and flew to LAE on 18th June, and left by trawler the same day to arrive at KALINGI on 20th June. He was met by A.D.O. Single who had come from Kandrian at the request of the District Commissioner.

An inspection of the volcano confirmed the recent nature of the increase in gas emission and revealed a number of phenomena which are usually identified as pre-eruption conditions.

High pressure gas was being emitted from three vents in the secondary crater within the major north-east crater of Langla. High concentrations of sulphur dioxide were responsible for the killing off of the vegetation. Turbulence caused by gale force winds filled the crater almost continuously with acid gas. As a result the vents were unapproachable for several days. On the 26th June the wind dropped sufficiently, in the early morning, to make a descent into the crater practicable. Charring effects on wood exposed in the vents for five-minute periods indicated temperatures of the order 200 - 300° Centigrade.

Having established the existence of abnormal temperatures the important thing was to discover what trend prevailed. This was not possible without additional equipment. Gas masks and high temperature recording apparatus were required.

The temperatures did not appear to have reached a critical level; there was little evidence of an increase in total gas emission and tests for earthtremors by means of a mercury pool had been negative. Hence the writer had little misgivings about leaving the area while equipment was being obtained from Australia.

A.D.O. Single remained in the area to check village locations and carry out a census so that the information would be available should movement of peoples be necessary. At his suggestion the local people volunteered to clear the Claucester airstrip so that it would be ready in the event of an emergency.

Returning to the area on the 11th July it was found that A.D.O. Single had returned to Kandrian the previous day. He left a note to say that two reliable reports of earthtremors had been received from the villages on the south side of Langla.

The tremors had not been felt in the goup of coastal villages around the Kalingi Mission.

Carriers were not made available by the local Luluai until the 16th July, when an ascent was made and a base camp set up about 550 feet below the crater. This site was selected to facilitate the daily inspections of the crater and for better observation of subterranean phenomena, should they occur.

Six natives were employed to carry water to the camp and equipment to and from the crater. This local labour stayed one week, at the end of which they returned to their villages as several of them were sick from the effects of bad weather conditions.

Initial work on temperature observations made it obvious that the recording of temperature data by means of the pyrometer was not a practical proposition without European assistance. Two of the vents were located on the floor of a vertical-sided fissure crater which was thirty feet wide, over a hundred feet long and had a floor sloping from thirty to eighty feet below the level of the inner wall. Concentration of the corrosive acid gases was very high in this fissure. If temperatures were to be recorded in these important vents it was necessary that the s naitive galvanometer should be left outside the fissure and read by one observer while the other applied the thermocouple to the vents.

In answer to a request for assistance, Mr. Best came from Rabaul, bringing with him native labour, additional equipment and rations. He arrivedat Kalingi on 26th July.

During the following week temperature records were maintained for the accessible vents while a forty-foot ladder was being prefabricated at the base camp for gaining access to the vents on the floor of the fissure crater. The ladder was carried up to the crater on Saturday 2nd August, assembled on the inner crater rim and lowered into position.

Over the following fortnight temperature data was collected at all the main vents: Condensates of the vent gases were collected and chemical tests carried out for the presence of halogens; a crude recording pendulum was constructed; a tape and compass of the summit area was carried out and hot ground areas south of the mountain were examined for indications of recent chagge.

The Observers left the area on 17th August to make a survey of Long Island and Sakar Island volcanoes and to investigate a report that earth tremors had been felt near Ritter Island and smoke had been seen rising from the cone. Native stories indicated an association between past activity of Langla and Ritter.

Returning to Kalingi on the 26th August crater conditions were checked once again before returning to LAE.

STRUCTURE AND PETROLOGY:

The structure and petrology of the volcano are a valuable index of past activities, and may be helpful in indicating a future pattern of activity, should it occur.

Field observations suggest Mount Langla to be an easterly migration of Mount Talawe crater. An east-west alignment of these two centres with two minor cones extending down to the shores of Borgan Bay could indicate the presence of a deepseated fracture or a zone of weakness; a zone which favoured the formation of parasitic cones and upon which Langla was eventually established as the main centre of activity. Superimposed on this east-west structure there appears to be a secondary alignment of minor cones with a north-easterly orientation. The latter structure seems confirmed by a parallel pseudo-summa formation apparent in the disposition of Langla summit craters.

The original and largest of Langla craters lay south-west of the present centres. Subsequent activity migrated to the north-east, breaching the wall of the older crater and forming a smaller crater at a lower level. Thus there appears to be a series of three major craters which decline in size and elevation as the activity moves to the north-east. Either the south-west or western wall of each crater is the dominant physiographic feature. It is perhaps significant that the present centre of increased activity occurs in the north-easterly crater.

Extensive lava flows from these centres have, at some earlier date, covered the country to the north of Langla, almost down to the coast. This great apron of flow material rises in gentle slopes of 5^{o} to 10^{o} to the base of the terminal cone, which appears to be composed of flow and fragmental material. The flows are covered with grass and tree vegetation, without a great thickness of soil cover. Flow structures are still apparent in some of the grass covered areas and rock towers of plastic deformation and gas blow holes, typical of Aa lavas, can be seen on the road up to the mountain. The condition of the later lava flows is not unlike that of the 1888 flows of Ambrym volcano in the New Hebrides, but they are probably of earlier origin.

Megascopic examination of the laval types suggests that the petrological trend has been towards a more acid lava. Earlier flows are porphyritic in olivine, later material contains augite and appears andesitic in composition.

Such a trend in volcanoes is not uncommon and it can be associated with a change in its eruptive pattern. The more fluid basic lavas favour open conduit conditions with continuous activity and the extrusion of lava. Acid lavas are more conducive to explosive conditions and the ejection of fragmental material.

Examination of the ejectamenta in Langla crater suggests that its most recent activity has been Vulcanian in character. The temperatures were below the melting point of the ejected laval The numerous bombs thrown out from the vent are angular blocks showing little evidence of plastic deformation and true breadcrusting is rare. The last activity might almost be classified a low-grade Vulcanian tending towards pure steam explosion. Long periods of dormancy and major outbursts are typical of this eruptive mode.

In the event of eruption one can fairly confidently expect a repetition of the Vulcanian pattern of activity from this centre. This would involve a high degree of explosibility with the ejection of solidified lava in the form of bombs, lapilli and dust. Under normal conditions the danger area around the crater should not exceed two miles. Ash and dust, however, would be deposited over a much wider area. Its distribution would be largely determined by the direction and velocity of the winds prevailing at that time.

THE ACTIVE CENTRES:

Apart from the rather extensive areas of hot ground, there were three main active centres in the summit area.

The least active was a small steam explosion crater formed just below the rim of the northern wall of the south-west corner. Actively solfataric in character, its walls had been partially converted into mounds of low temperature products by the slow emission of gases which had no sensible acid content. Temperatures of 98° C were recorded.

On the adjacent sides of the major crater rim a more active centre was located. Explosive activity had blown through a thick flow of lava to form a sheer-sided chasm more than 250 feet in depth. Its shape suggested the name, Chimney Crater. Active vents at the bottom of this crater produced a fluctuating vapour cloud which always hid the lower levels from view. It was obviously a low pressure emission because the noise of escaping gas was barely audible at the crater rim. Only during high humidity conditions did a visible vapour cloud from this centre drift over the crater rim. Although the presence of sulphur dioxide in the emitted gases was quite appreciable, the concentration was not high. As evidence of this fact, a bird of the cliff dwelling family had built a nest in the upper part of the crater wall, which was frequently enveloped in the vapour cloud. On one occasion the odour of sulphuretted hydrogen was quite strongly detected in the vicinity of this crater.

By far the most active centre was located in the main north-east crater from which the recent increase in activity was reported. Here the activity originated from a secondary crater roughly 300 feet in diameter and 120 feet deep A medial wall divided the base of the crater into two sections, a large funnel-shaped depression on the eastern side, and west of it, a smaller elongate cavity, fissure-like in its dimensions. In the southern end of the fissure crater three powerful vents emitted high pressure gas with loud and continuous roar . On the walls above the vents sulphur and other materials had been deposited from the cooling gases, and the rising cloud of white condensates was swept by the prevailing winds over the outer crater rim, leaving in its wake a bleached landscape of skeleton trees, crumbling grasses and whitened stones.

Systematic observations were concentrated on this most active centre during the period of the investigation. These observations will now be considered in detail.

TEMPERATURES:

For the sake of convenience the three major vents have been labelled A, B. and C. The A vent lay at the southern end of the medial wall beneath an overhanging ledge of rock. Less than fifty feet away the B. vent opened out at the base of the western wall of the fissure crater and the oblique C vent lay roughly ten feet to the east of B veht, thus occupying a more or less medial position on the sloping floor of the crater.

DATE	TEMPERATURE ° CENTIGRADE		
1952	A vent	B vent	C vent
July 29	203	-	184
30	209	-	217
31	207	-	-
Aug. 1	199	-	-
2	192	-	-
3	204	194	218
6	215	226	228
7	215	220	228
8	220	224	226
9	220	220	226
10	212	222	222
11	212	222	222
14	215	22	227
15	222	225	228
16	216	223	231
26	216	225	237

The above temperatures are the most reliable recorded during the period of observation. These are at best an estimate of correct temperatures as the instrument used was 200° maximum recording thermometer. Some of these figures represent an average of eight readings which may have varied by as much as 30° C.

Results obtained from the electrical pyrometer have been excluded on the score of unreliability. Heat dispersal effects from the structure of the vents and turbulent wind conditions so affected this sensitive instrument that the readings have been rejected as inconclusive. Deterioration of the thermocouple also took place as a result of the corrosive effect of the vent gases. Although it was shielded from direct contact with the gas by glass tubing, the iron element virtually fell to pieces after two weeks of use.

In considering the significance of these temperatures, their magnitude immediately suggests that abnormal conditions exist. The presence of superheated steam implies high pressure gas accumulations and/or a rising magma column. After the temperatures of Tavurvur volcano at Rabaul began to rise they reached such a level in two months and further increases took place during the ensuing six months prior to the eruption of June 1941.

With Langla however, the period of observation has not brought to light a major rising trend in the temperature conditions. There does appear to be a rise of some 20° centigrade with C vent without a noticeable rise in A and B vents. This development appears anomalous because the close proximity of the vents suggests that they are fed from a common conduit. It can possibly be explained by taking into account individual vent structures and changes which occurred during the period of observation.

A and B vents send out vertical blasts of gas from orifices which are from four to six feet in diameter. C vent on the other hand, has an elongate orifice of dimensions roughly 18 inches by six inches. From it emerges an oblique jet of hot gas of such force, that, unless special care was taken, measuring instruments attached to a twenty foot pole were thrown out by the powerful blast. Higher temperatures from this obviously higher pressure centre are not unexpected.

During the latter part of the period of observation, constructive processes changed the shape of the C vent. Materials brought up by the gases were deposited at the mouth, extending the thin walled process which formed the containing wall of the orifice and consequently deepening the lateral extent of the vent. The attendent constriction of the gas at this point may have had the effect of increasing the pressure sufficiently to affect the temperatures.

The overall impression of the temperature records is one of instability and further checking of this important index of internal conditions appears necessary.

THE GAS COMPOSITION:

Aside from the basic emission of steam, the most common of all volcanic emanations, the main constituent of the gas appeared to be sulphur dioxide. This characteristically choking gas is unmistakable and its lethal effect on vegetation is well known. Concentrations were always high, the vents being rarely approachable without a gas mask. During turbulent conditions in the fissure crater, the filtering medium in the gas mask was quite unable to cope with the existing concentrations. The filters are made to eliminate concentrations up to 2%.

One fluctuating constituent of the gas caused a stinging sensation in the eyes. It was at first thought to be hydrogen chloride but a silver nitrate test proved negative. Physiological effects may supply a clue to its composition. It was noted while collecting temperature data that should the Observer, without a mask, become inadvertantly enveloped with warm gas the most acute physiological discomfort was experienced. Even with eyes tightly closed and breath held an intense burning sensation in the membranes of the nose and eyes was experienced. Condensation on any exposed skin also produced severe irritation. It was concluded from these observations that a higher unstable oxide of sulphur was present in the freshly emitted gases; a conclusion which seemed to be confirmed by the fact that copper wire exposed in the vents was often converted to a blue product, which was presumably the sulphate.

The odour of sulphuretted hydrogen was not often detected close to the vents but was detected quite frequently at a distance from the crater. This could be explained by assuming either the presence of higher sulphides of hydrogen or could be attributed to a paralysis of the olfactory centres, a recognised physiological reaction to exposure to H_2S gas. When it was observed that stainless steel articles were blackened in the crater atmosphere it seemed more likely that the higher sulphides were present.

The fact that the observers did not experience any lasting physiological effects from exposure to the gases suggests that concentrations of the very poisonous higher sulphides were low. The extreme irritableness and nervous depression experienced after a prolonged period of work in the crater was probably due more to a deficiency in oxygen than to the effects of poisonous gas. The ineffectiveness of the filtering medium in the gas masks may have been a contributary factor.

Analysis of the condensates collected from the vents should supply a more accurate picture of the gas compositions.

CHANGES AT THE TWIN CRATER:

Changes in the actual volume of emission were difficult to gauge owing to the great variation in weather conditions. Humidity, winds and light conditions all affect the appearance of a vapour cloud. It is not practical to allow for all these variables when weather conditions are unsettled. It must suffice to say that there was no obvious change in its total volume during the period of observation.

Minor changes occurred at B and C vents. The diameter of B vent increased by more than a foot at the end of July. Dust ejected during the process covered the bright yellow deposit of sulphur on the crater floor. About the same time a small fissure opened beside C vent and began to emit boiling water and grey mud.

A fortnight later the thin-walled process forming the aperture of C vent began to grow as the result of deposition of emission products. The growth of the wall doubled the horizontal depth of this oblique aperture. At the same time the small adjacent fissure began expelling a yellow-brown mud with its gas.

In the second week of August the brilliant yellow sulphur areas on the crater wall above the vents began to darken in colour. Turning to a drab yellow, no further change took place during the remaining period of observation. The change was undoubtedly caused by an alteration in the composition of the emitted gases.

SOUND EFFECTS:

(a) Surface Noises

Basically the gas escaping from the high pressure vents produced a flat continuous roar of an intensity that made speech impossible in certain parts of the crater. The pitch of the sound varies with the position of the observer, owing to acoustic effects produced by the crater walls and variation in the individual vent structures.

From the broad A vent, a low-pitched fluted roar was produced; the sound one would expect from gas passing through a long cylindrical pipe. Close to the more constricted B and C vents, the noise was flat and of great intensity. Away from them, however, high-pitched overtones could be heard - localised constriction whistlings which were drowned out near the centres.

Underlying the basic sound effects a definite beat was perceptible.. Its frequency was difficult to establish owing to waxing and waning of its intensity. It is more perceptible at a distance from the crater and could sometimes be heard at the campsites.

Close to the vents there was observed a secondary phenomenon which may have been related to sounds at depth. The rock near the vents frequently vibrated sufficiently to be felt while standing. A wooden pole held against adjacent rock always made apparent a definite percussion effect in the character of the gas emission. It suggested that the gas was supplied at depth by very numerous separate small explosions - producing at the surface a pattern of continuous sound and gas emission.

(b) Subterranean Sounds

The first experience of deep-seated sound effects was disturbing, not because of its unexpectedness so much as the hour of its occurrence. At 0230 hours on 22nd July the observer was awakened at the base camp by a noise like a muffled explosion. The sound was more of a low pitched roar than a rumble. It was accompanied by two powerful vertical bumps and a very short period ground movement. The phenomenon appeared to last little more than a second. Reoccurrence at 0730 hours caused some alarm with natives at the camp.

Subsequent occurrences of this phenomenon were observed on 2nd and 15th August. The same low-pitched muffled roar accompanied by a brief ground quiver. The vertical bumping was not observed again after thw first occurrence.

There were probably other unobserved occurrences during the period of observation. The intensity of the phenomena was such that it would not have been perceptible a mile from the crater and the perpetual noisy winds at the crater elevation were not conducive to good conditions of observation.

These sub-explosive phenomena were the only unquestionable evidence of subterranean developments to support the abnormal temperature and gas conditions in the crater. They were probably caused by readjustments in the pressure systems in the conduits beneath the volcano. The release of volumes of gas at the surface vents may destroy the equilibrium in the underlying gas reservoirs, with consequent spasmodic adjustments.

The phenomenon is significant in that it confirms the existence of high pressures at depth. Prior to eruption, a marked increase in the frequency and intensity of these adjustments could be anticipated.

The existing conditions were not regarded as critical, in that their magnitude and frequency did not appear exceptional, when compared with similar observation during phases of the activity of Lamington and Bagana.

EARTH TREMORS:

Unless the seismic intensity is extraordinary, the observation of volcanic tremors without instrumental aid is little b etter than guessing.

Mr. Single reported three tremors felt on 5th and 6th in the villages of Gie, Laut and Mangailaupa. The coincidence of regional tremors, reported from other parts of the Territory about this time, threw some doubt on their volcanic origin. It is often difficult to differentiate the typical slight volcanic tremor and a distant regional tremor.

The luluai Aisapua reported three tremors occurring on the 11th and 12th of the same month. They were allegedly felt at Nekarop, a village south-east of Langla. There was no way of checking the authenticity of this report.

Observations at the crater during the period of the investigation yielded little confirmatory evidence. Mr. Best felt a slight ground movement in the crater area on one occasion. Being an isolated observation it is therefore suspect for there is too much room for human error under such conditions.

Attempts were made to reduce their likelihood of error by firstly using a mercury pool - with negative results - and later Mr. Best constructed a recording pendulum from scraps of salvage material. This crude instrument was set up to check for ground movement during the ten days absence from the crater, 16th to 26th of August. One small tremor appeared to be recorded during that period. Since returning to Lamington, a replica of this pendulum has been constructed. Tests have not supplied reliable evidence of its effectiveness in detecting tremors, so that even this evidence at Langla is suspect.

There is no real substitute for a properly constructed seismograph for the observation of the all-important seismic data in connection with volcanic activity.

Recent landfalls in the craters may be confirmatory evidence of local earth tremors. All three craters showed evidence of recent falls. Those of the Twin Crater, however, may have been caused by undermining of the walls by the gases associated with the recent increase in activity. It is unlikely that the falls were caused by regional tremors because Brisbane seismological station reported that no unusual tectonic movement had originated from the Western New Britain area during the previous six months and the mission people at Kalingi found it difficult to recall the last earth tremor felt in the area.

It seems quite possible that occasional volcanic earth tremors are occurring but the evidence for them is by no means conclusive.

It might be argued that the ground vibrations associated with subterranean noises are volcanic earth tremors. In the strictest sense this is probably true. In the writer's opinion, the short period movement and brief duration of this phenomenon are indicative of superficial energy of a relatively low order which is not to be compared with the forces involved in producing a volcanic earth tremor of normal magnitude.

THE TIME FACTOR:

Consideration of the time factor can be important in assessing the probabilities in regard to the magnitude of an anticipated eruption and in regard to rates of change leading to the inception of such an event.

Native History.

An old native who remembered the last eruption of Langla was found in the coastal village of Onaia near the Kalingi Mission Station. His name was Avel. According to the mission records, he was born in 1875. Judging from his appearance this seemed an underestimate of his age, although his mind was remarkably clear for a man of that age.

From Avel's account Langla erupted when he was a small boy. The eruption was preceded by severe earth tremors which began several days before the initial explosion. The large stones thrown out by the volcano fell close to the crater and the south-east winds brought a light grey dust over the northern slopes. Dust falling on the gardens did not damage them to any extent. Spasmodic eruptions accompanied by further earth tremors continued for an indefinite period before the activity ended. Four years later Ritter Island erupted, the accompanying tidal waves drowning most of the coastal people of the western end of New Britain.

From this account it is estimated that Langla erupted around the year 1880. A period of dormancy of roughly 70 years is conceivably long enough for the accumulation of sufficient energy to support an eruption of major proportions, but most unlikely to produce an outburst of catastrophic violence unless external additions to the magmatic reservoir were indicated by extraordinary seismic phenomena.

Caria, a native of Saumoi village, supplied information on more recent conditions of Langla crater. He accompanied some American troops to the crater in 1944. At that time, he stated, the present vents in the Twin Crater were less active than at present, and the vapour from the vents was only visible from the coast during wet weather conditions. Even at that time sulphur dioxide was being emitted and trees in the immediate vicinity of the crater were dead. This suggests that a change in quantity rather than quality of the gas emission has taken place; an observation that reduces the significance of the high concentration of acid gases in the present emission.

Destruction of Vegetation

A study of the affected vegetation pattern seems to confirm the native's story. Trees in and around the active centre appear to have been dead for several years. They are bare trunks, practically devoid of bark and small limbs. Even with the assistance of sulphur dioxide, it is considered that disintegration from weathering would not produce this effect in less than ten years. Dead trees of a comparable age can be seen on the slopes of Tavurvur volcano at Rabaul.

The effects of the most recent increase in gas emission are very obvious . The first plant type to be affected is the relatively small bushy tree Cunoniaceae Weinmannia, which is common on the upper slopes of the mountain. The leaves rapidly wither and fall off to give the impression of wintering. The sap gradually dries out and the limbs become brittle as the process of disintegration sets in. A tongue of this recently affected vegetation extends down the northern slopes as far as a mile from the crater.

As the gas concentration increases, closer to the crater grasses are killed off, and then the more acid resistent plant types. One of the last to die is the fern Gleichenia Dichotoma, and finally the highly resistent broad leafed sedge, Gahnia. Gahnia is almost the exlusive vegetation types over the greater part of the summit area. This plant resists spasmodic exposure to the acid gases even on the rim of the Twin Crater. Only on the floor of the crater and the immediate leeward area has this plant been completely destroyed.

Many of the trees on the nearer slopes south of the crater appear to have been affected by gas. The zone, however, is not nearly so extensive and many of them have reached such an advanced stage of disintegration that the questions arise:- Have there been earlier unreported fluctuations in the volume of activity at this centre? Are periodic fluctuations a normal pattern of the activity?

Admitting the possibility of earlier fluctuations, overall observations suggest that nothing comparable with the present increase has occurred over the last twenty years. The evidence of the vegetation pattern does say that sulphurous gases have been characteristically emitted for more than ten years and that at some earlier date, no activity or, at least, no sulphur dioxide was emitted from this centre.

<u>CONCLUSIONS</u>:

There are at Langla a number of phenomena which are usually recognised as premonitory symptons of eruption:

i. Increase in volume of gas emission.
ii. High concentrations of sulphur dioxide.
iii. Abnormally high temperatures.
iv. Subterranean noises.

At the other end of the scale there is the negative evidence of an absence of definite seismic phenomena, an absence of an unquestionable rise in the temperature trend and an absence of halogens in the emitted gases.

Admitting that the data is incomplete in that there is no substitute for reliable seismic recording, a diagnosis of the present condition of the volcano must be as far as possible based on established facts.

The importance of the presence in the gases of high concentrations of sulphur dioxide as a critcal indicator appears questionable for two reasons. Firstly, it has been reliably established that this gas was characteristic of the emanations nearly ten years ago and secondly, surveys of volcanoes in other areas have suggested that the emission of sulphur dioxide may be a normal feature of individual volcanoes. It is possible that the negative evidence of an absence of halogens could be eliminated for a similar reason.

For the remainder of the positive evidence, the nature of the gas emission and temperature levels are an unquestionable indication that high pressure accumulations of gas have taken place in the reservoirs beneath the volcano. The native of the adjustments in these reservoirs, indicated by the sub-explosive sound phenomena, suggests that changes are at present confined to shallow-focus gas accumulation immediately beneath the mountain. The intensity and frequency of the adjustments appears to be of too low an order to suggest critical conditions. A marked increase in such phenomena could be anticipated before the inception of an eruption.

It is conceivable that under the above conditions relatively superficial gas accumulation could continue to a critical point whereupon a steam explosion would occur and expel the old conduit lavas. Such an eruption would not necessarily be preceded or accompanied by appreciable seismic disturbance. The time factor suggests that its effect on the surrounding country would be limited to a relatively small area.

Alternatively the existing conditions could be the beginnings of a slow increase of activity which will eventually culminate in strong seismic disturbance, as a prelude to a powerful vulcanian eruption involving the rise of fresh lava from deepseated sources.

It is hoped that observations to be undertaken in October will yield information which will clarify these questions.

Settlement.

No movement of native people is at present considered necessary. North of the volcano settlement is confined to a group of coastal villages lying about seven miles north-west of the crater. They contain roughly 600 people. These people are unlikely to be seriously affected by any normal eruption of Langla. South of Langla settlement is closer, but none of the villages appears to be less than three miles from the active centre. Should an eruption occur during the north-west season temporary evacuation of the nearer villages south-east of the crater may be necessary, as the area may be heavily dusted. Mr. Copely, A.D.O. of Talsea sub-district, has undertaken to check village locations in this area in case such a movement should become necessary.

Communications

The Kalingi area is under the control of Talasea Government station which is more than 100 miles away. There is no wireless transmitter at Kalingi and the work boat owned by the Mission appears to be frequently out of order.

Should any sudden development of the volcano take place, it may be several days before the official Local observer, Father McSweeney, could get news out. It seems advisable that the Administration should make a transmitting set available to Father McSweeney for a nominal period of six months. It is understood that the Church of England mission at Sag Sag is installing a transmitter early next year.

Access to the area is at present gained by trawler from Lae. Provided that weather conditions are favourable for navigating the Siassi reefs, the journey take approximately twenty hours.

According to a recent news broadcast an Airforce aeroplane made an emergency landing at Gloucester strip. The fortuitous clearing of the strip has at least served one good purpose. Presumably in the event of a volcanic emergency it will provide a rapid means of access to the area.

(G.A. Taylor)
Vulcanologist.