

AERIAL OBSERVATIONS OF GUNUNG MERAPI CENTRAL JAVA

BY

H. D. TJIA *)

ICHTISAR.

Pengamatan udara pada bulan Nopember 1961 dari Gunung Merapi di Djawa Tengah memberi kesimpulan bahwa kedua „break in slope” (tekuk pada lereng) yang terdapat disana djuga merupakan batas-batas penggunaan tanah tanah atau vegetasi yang djelas. Ketiga djalur vegetasi itu ialah : Sawah dibawah garistinggi rata-rata 400 meter, ladang antara 400 dan 1500 meter dan tanah tandus diatas 1500 meter. Daerah yang paling banyak tergolong dataran aluvium ; daerah ladang terdiri dari endapan-endapan lahar, sedangkan puntjak terdiri dari pyroklastika. Sungai-sungai besar mempunyai tebing tegak didjalur vegetasi yang kedua. Tebing-tebing tegak itu mungkin disebabkan oleh ketidakpadatan dari endapan-endapan lahar. Bentuk-bentuk sawah dapat dipakai untuk mendapatkan kesan mengenai besar lereng, jaitu galangan-galangan sawah dengan djelas mengikuti garistinggi. Depresi yang terdjadi ditempat lidah lava 1961 berbentuk segitiga dengan puntjak yang memuntjak kehilir, berlainan dengan depresi-depresi berbentuk segitiga sebagai hasil tanah longsor yang menjempit kearah puntjak.

INTRODUCTION.

With the purpose of obtaining an over all picture of the activity of Gunung Merapi, Central Java, and to study the possibilities of preventing or minimizing the dangers of nuées ardentes and mud streams (lahars), two single engined airplanes, respectively from the Angkatan Darat Republik Indonesia and from the Kepolisian Negara Republik Indonesia, participated in photographing the volcano and its surroundings. The military and police crew were commanded by Major WIDODO SAS-TROAMIDJOJO. Among the civil members were Drs. GOEI TJOE HOW of the Geological Survey and also present author from the Institute of Technology Bandung. The flights took place between November 20th until November 30th, 1961. Thanks to the eruption on November 27th the party

*) Dept. of Geology, Institute of Technology Bandung.

could make several comparisons of the summit conditions before and after the eruption. A technical report has been made and submitted to the Geological Survey. However, there are still a number of noteworthy observations of less technical value which have not yet or only partly been mentioned

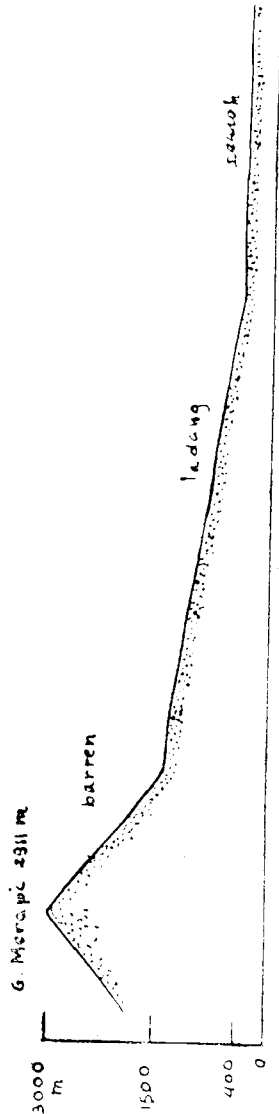


Fig 7

in the former report. The author is aware that some of these observations have probably already been made in the same or other areas in Indonesia, but as yet he is not familiar with any published data on the features to be described.

MERAPI VOLCANO.

The Merapi volcano of Central Java has been active since at least the year 1006 A.D. when it destroyed the Hindulands of the Cailendras' and Borobudur. Since about 1800 the Geological Survey has records of its activity. In May 1961 increased activity resulted in the formation of a tongue of lava approximately 1400 meters long and 200 meters wide. This tongue extended southwestward in the direction of Kali Batang. Nuées ardentes were also formed at that time. On November 27th of the same year a heavy rain fall seemed to have reacted with the — presumably still hot — "insides" of the lava tongue, caused the pulverization of the lava mass, the formation of nuées ardentes, ash rains, and some mud flows (lahars).

The Merapi presents two dangers. First, because of its viscosity the lava forms a plug in the crater vent. This lava plug is constantly being pushed out, either partially or completely, and through subsequent partial or complete crustal crumbling its hot internal mass expands, explodes, and forms nuées ardentes d'avalanche with recorded speeds of 30-40 meters per second. To prevent casualties from these glowing ash clouds the Volcanogical Section of the Geological Survey has imposed a prohibited area around the summit. The prohibited zone extends farthest toward the west, southwest, and south, attaining a maximal radius of ca. 12 kilometers in the direction of Kali Batang. Merapi's second danger lies in the loose pyroclastics, particularly ash and huge blocks, plus heavy showers. Excess of water transforms showers. Excess of water transforms the loose pyroclastics into fast flowing mud streams, the huge remains of solidified lava being easily transported by the high density of the medium. These mud streams or lahars endanger bridges across the major rivers. On account of the above mentioned threats and the dense population Gunung Merapi has been classified as being extremely dangerous.

GUNUNG MERAPI FROM THE AIR.

Drs. GOEI TJOE HOW, (personal communication) has attracted the author's interest to be breaks in slope on volcanic bodies. On Gunung Merapi two breaks in slope are found, one at approximately the 1500 m contour and the other at the 400 m contour line (fig. 1). The uppermost portion of

the volcano, the one bounded by the 1500 m contour at the lower side, has a steep slope of $36^\circ - 42^\circ$, which conforms to the angle of repose of loose material. The fine texture of the terrain gives another evidence of the cohesiveness of the material. This summit area seems to be barren vegetation or is probably only sparsely covered by grass and Edelweiss (*Anaphalis javanica*). Between the two breaks in slope the gradient of the volcanic body is $9^\circ - 12^\circ$ and this zone is built of lahar, as could be established during a short field trip. This belt is used for ladang (dry fields). Beyond and lower than the 400 m contour we have reached the alluvial plain with a very gentle gradient of less than 1° and is characterized by sawahs (wet rice fields). Where streams are crossing these breaks in slope one may expect, after heavy rain falls, floods by the sudden change in gradient.

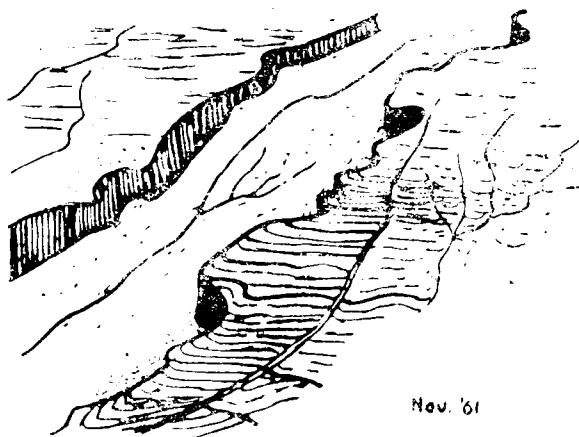
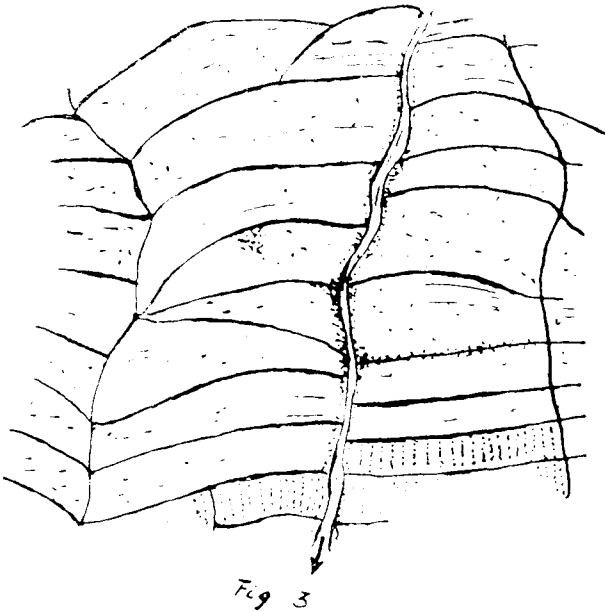


Fig. 2

The valley walls in the belt of dry fields are vertical as can be seen on figure 2. This fact may indicate that the underlying material (viz. lahar) is not sufficiently compacted. The softness of the lahar is distinctly shown by the deep valleys, e.g. the one of the middle reaches of Kali Woro. In the same belt the river sometimes follows a tortuous course including meander cut offs.

Many geomorphologists have noted that the small sawah dikes follow contour lines very closely. This fact is clearly discernible on the Merapi (fig. 3). In addition the shape of the sawahs proper is indicative of the shape of the terrain. Straight sided rectangular patches indicate a flat surface which at the most is gently sloping. The longer sides of the rectangles



are always perpendicular to the slope. Sinuous like dikes indicate dissected surfaces, the degree of sinuosity being a measure for the local relief. In plan most of these dikes are convex upslope. This fact probably indicates that the sawah patches are built in the local lowest location in order to receive water most efficiently.

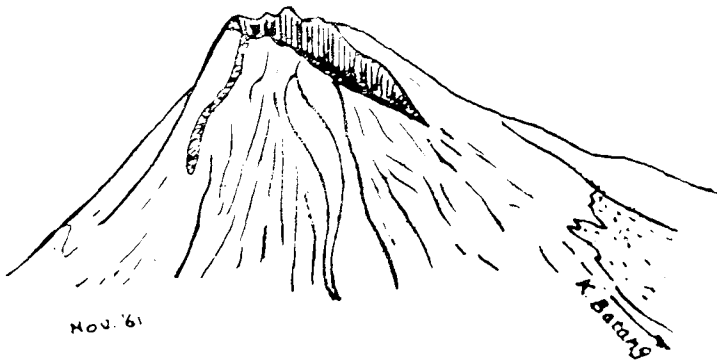


Fig. 4

After the activity of November 27th, 1961, a depression was seen where the tongue of lava of May 1961 was situated before. This wedge shaped depression reaches the actual crater and narrows down slope, its length being ca. 1.5 km and its maximal width being 700 m (fig. 4.). On other volcanic bodies wedge shaped depressions are also seen, like on the southwest slope of Gunung Raung in East Java, and on Gunung Api in the Banda Sea. In these cases the triangular depressions have their bases at lower levels while they narrow toward the summits. According to the investigators these latter examples are the result of landslides. The present author nurses the idea that the shape of such wedge like scars on volcanoes may have a genetical meaning. So a wedge pointing upslope is the result of a landslide whereas a wedge pointing downslope indicates a volcanic origin. The author hopes to present a more detailed discussion on this subject.

Bandung, February 1962