# ON THE CHARACTER OF THE MERAPI ERUPTION IN CENTRAL JAVA

BY

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(with plates 7 and 8).

## I. The two paintings of Raden Saleh.

The two paintings which we here reproduce in colour are the work of RADEN SALEH, the first Javanese to receive a Western education as painter, and are dated 1865. They represent the Merapi, by day and by night, obviously during the eruption of 1865.

RADEN SALEH SARIEF BASTAMAN was born about 1814 at Semarang. At an early age he gave signs of an unusual artistic talent, which draw the attention of PAYEN [1]).

There are few specimens of RADEN SALEH's landscapes in public collections in Holland; his name is principally known as a painter of animals and many of his works in this field may be found in the National Museum and Zoological Gardens both in Amsterdam. A number of his important works were lost in the desastrious fire in the first Dutch Pavilion of the Colonial Exhibition at Vincennes on June 28 1931. The two paintings here reproduced were secured by the National Geological and Mineralogical Museum in Leiden in Jan. 1931.

It is a matter of interest to determine where the painter was standing as he made this pictorial record of the remarkable character of the eruption in 1865. Dr. G. L. L. KEMMERLING, who saw the two pictures in our museum and who possessed a thorough knowledge of the topography of the Merapi, was of opinion that they were painted from the Goenoeng Plawangan (1276 m.) on the southern slope of the volcano, above Kalioerang. The shoulder visible to the right of the peak would then represent point 2490, belonging to the Goenoeng Poesoenglondon (2698 m) which itself lies behind the silhouette of the volcano.

[1]) PAYEN, who was born at Brussels in 1792, went to the Indies in 1817, where he was attached as draughtsman to the „Director of affairs for Agriculture, Art and Science in Java and the surrounding islands", Prof. Reinwardt. Returning to Europe in 1828 he worked at numerous paintings designed for the projected „Indian Gallery" in the Hague, which, however, was never instituted. In the National and Ethnological Museum in Leiden, there are some thirty of these paintings by PAYEN, while there is on loan a portrait by RADEN SALEH of his teacher PAYEN.

A second question is whether these paintings carry conviction. May they actually be regarded as characteristic of the Merapi?

Writing of the latest eruption in Nov.-Dec. 1930, Dr. NEUMANN VAN PADANG says (bibl. 3, p. 20) amongst other things:

„Nov. 25th. The entire western slope of Merapi was one great mass „of fire" and further: „The falling lumps of lava descended with great „bounds along the Blonkeng slide, which consisted of sand and ash „throwing up clouds of ash where they struck. But even during their „fall it could clearly be seen, especially at night, that the lava blocks „burst asunder. A shower of sparks was spread in every direction."

Both our pictures correspond to this description of the latest eruption. If we wish to compare them with descriptions of other eruptions we can consult ARRIËNS (bibl. 16) and VERSTEEG (bibl. 17). In July 1863 the Merapi was active and subsequently from Oct. to Dec. 1865. In the „Natuurkundig Tijdschrift" (Physical Magazine) of 1864 it was pointed out that the activity of the volcano had been gradually increasing from before July 20th 1863 until on July 28th, the whole mountain was set on fire. And ARRIËNS writes of this eruption: „There was no old crater „wall left to obscure the view, so that at night the masses of glowing rock „rolling down the mountain could be seen from all sides." „During the „eruption the lumps of glowing rock could be clearly seen rolling down, „many broke into smaller pieces as they struck against one another and „then continued to roll for some time further" (bibl. 16, p. 97).

When on May 26th 1864 ARRIËNS climbed the Merapi, the volcano was inactive and he was able to ascertain that in place of a crater there was a plug of solidified lava on the top.

On Oct. 24th 1865, however, the Merapi became active again. On this subject W. F. VERSTEEG (biblt. 17) writes:

„On Nov. 10th the Resident went to Djengger, which is the highest „accessible point of the mountain (5000 ft) [1]) in order to observe the „working of the volcano from near by. The activity was terrific and „baffles all description; at night especially the mountain offered a striking „picture. Streams of fire were ejected from the crater on all sides, while „gigantic, white hot blocks were thrown out, which rolled about 3000 ft „downwards from the crater precipitating themselves into the Blongkeng „valley."

This momentous eruption lasted from Oct. 24th to Dec. 28th 1865.

These earlier descriptions indicate that the character of eruption was the same.

This seems to me sufficient evidence that the two pictures are fundamentally correct and that they clearly reproduce the characteristics of a Merapi eruption.

It is, however, a different question whether they may be regarded as instantaneous pictures of the eruption. Probably this is not the case. It seems to me more likely that the artist, after watching the eruption for some time, painted consecutive occurences as if they had taken place simultaneously. It does not seem to me likely that in 1865 the incandescent

[1]) The Goenoeng Djengger lies above Maron to the west of the summit.

avalanches would have descended over a section of nearly 180° all at the same time.

Both of these reproductions have been published in „Tropisch Nederland" (bibl. 18 and 19) and I am glad to take this opportunity for expressing my thanks to the N. V. Drukkerij en Uitgeverij J. H. de Bussy, Amsterdam, for their permission to include their very successful repoduction in this periodical.

## II. Incandescent Avalanches and Glowing Clouds.

The chief authority on the subject of glowing clouds is still undoubtedly A. LACROIX, who made known this volcanic phenomenon of which no one had previously been aware. After the destruction of St. Pierre on Martinique on May 8th 1902 and especially after the publication of his great work „La Montagne Pelée et ses éruptions" in 1904 (bibl. 20) this phenomenon was repeatedly observed in other volcanoes.

Later eruptions and the descriptions of them have gradually brought a differentiation into the conception of glowing clouds, so that we now have a more extensive view of the phenomenon than previously. LACROIX has not been behind hand in deepening our insight and in 1930 he gave a clear statement of his standpoint (bibl. 22).

Immediately after the eruption of Mt. Pelée in May 1902 the origin of glowing clouds became a point of dissension in volcano literature. KEMMERLING (bibl. 14, p. A. 130) refers to this in his last publication, but does not mention the reason for it. In my opinion it is due to the fact that in 1902 in the West-Indies two important eruptions took place almost simultaneously from Mt. Pelée and from the Soufrière on St. Vincent. ANDERSON and FLETT (bibl. 23 and 24) made a study of the catastrophe on St. Vincent, using the material on Martinique as comparison, while LACROIX did just the opposite.

It is true that ANDERSON and FLETT on the night of July 9th 1902 saw an incandescent avalanche with a glowing cloud from Mt. Pelée advancing straight towards them and interpreted it in connection with their observations on St. Vincent, but LACROIX had observed some 16 notable glowing clouds from Mt. Pelée between Nov. 1902 and Febr. 1903, some of which he had photographed. There can be no doubt that LACROIX had the greatest experience in the observation of glowing clouds from Mt. Pelée.

KEMMERLING personally observed the glowing cloud in the eruption of the Merapi in 1920, and considered that LACROIX had given a wrong interpretation to them at Mt. Pelée. He himself saw very clearly the difference between the glowing clouds of the Soufrière and St. Vincent in 1902 and the Kloet in 1919 on the one hand and of the Merapi on the other. But he could not see any difference between those of the Merapi and of Mt. Pelée.

It is, therefore, still a question whether there are two types of glowing cloud or three.

I believe that there are three and I have called them (bibl. 1, 8 and 26) St. Vincent type, Merapi type and Pelée type, while LACROIX (bibl. 22) calls them *„nuées ardentes d'explosions vulcaniennes"*, *„nuées ardentes d'avalanche"* and *„nuées péléennes d'explosion dirigée"*. The effect of

the St. Vincent type is known from the Soufrière of St. Vincent on May 7th and 18th 1902 and from the Kloet in the night of May 19th to 20th 1919. Both volcanoes have a crater lake which was first explosively emptied and it was not until after this that the glowing cloud phenomenon appeared. Both in the Soufrière and in the Kloet the phenomenon must have consisted in a brief, not violent explosion, by which glowing hot rocks were ejected just over the rim of the crater and then rolled down the slope.

In 1901 the Kloet not only formed mud flows by throwing the water out of the crater, but ejected incandescent avalanche material as well, which charred the woods on the summit (bibl. 25, plates opposite p. 66, 68 and 70).

The two other types of glowing cloud formation which I called Merapi type and Mt. Pelée type are both called Mt. Pelée type by LACROIX in his latest publication (bibl. 22). Both are connected with the presence of a plug of fresh lava which projects above the top of the crater of the volcano.

If with a comparatively low gas pressure the fresh lava simply crumbles, an avalanche of glowing rocks is formed which burst asunder as they bump and roll downwards and are partially turned into glowing sand forming a sort of suspension of glowing particles of rock in hot air, which moves like a liquid of fairly high specific gravity but having the peculiarity of more or less floating over the surface. Of these incandescent avalanches it is known that they pay little attention to the curves of a valley, they have a strong tendency to follow the original direction taken and float as it were over obstacles, can even spring from one valley to another when their direction demands it, while the coarser material mainly follows the ravines. The hotter the rock originally is the longer the „quasi suspension'' will last, because while rolling down fresh hot particles of rock form hot air cushions around themselves. An incandescent avalanche possesses a peculiar mechanism of movement from the fact that the action of gravity upon the rock particles is partially neutralised by the upward movement of the air cushions. These are the incandescent avalanches from which glowing clouds arise during the descent something like a trail of smoke.

The remarkable nature of the incandescent avalanches is clearly drawn in a communication by NEUMANN VAN PADANG (bibl. 3, p. 23). On Dec. 18th 1930 a huge incandescent avalanche descended the Blongkeng ravine. 50 m. above the bottom of the ravine, at 6 km. to the west of the summit of the Merapi stood the observation post of Maron. The incandescent avalanche overflowed its 50 m deep bed, engulfed and destroyed the observation post. But the extraordinary thing is that in the afternoon the surface of the avalanche had again sunk 20 meters. This shows the remarkable mobility of these avalanches, which must be accounted for by the hot gas which escaped from the splitting lava blocks expanding and forming gas cushions. It was glowing hot quicksand of very great porosity, which after the gas had escaped settled into a closer mass. The actual glowing cloud in this case consisted of a hot descending mass of gas combined with triturated avalanche material, powdered lava.

In RADEN SALEH's picture of the Merapi by day the glowing clouds follow the rolling blocks of glowing lava like a trail of smoke.

KEMMERLING's opinion is that the glowing clouds from Mt. Pelée do not differ in character from those just described. LACROIX, on the other hand, who witnessed the glowing clouds on Mt. Pelée personally, writes, describing the „nuées péléennes d'explosion dirigée": „Subitement, une „nuée partait du dôme; le phénomène était comparable à un coup de canon, „qui n'aurait été suivit d'aucun autre" (bibl. 22, p. 459).

In his earlier work of 1904 (bibl. 20, p. 350—368) LACROIX carefully considered the point of whether he could account for the phenomena of Mt. Pelée without an „explosion initiale". He did not think it possible to arrive at an acceptable conclusion without this directed shot, a conviction which he retained in his latest study (bibl. 22, p. 459).

KEMMERLING in his last study (bibl. 14) minutely criticised LACROIX's arguments and again insisted upon all the glowing clouds of Mt. Pelée being caused by crumbling of the lava plug and in every respect being comparable to the glowing clouds which arose from the incandescent avalanche on the Merapi. It is of course not possible to prove here which is wright, LACROIX or KEMMERLING. Now that the point at issue has been made clear, the phenomena will have to be very sharply observed in future eruptions. It seems to me also of great importance in this discussion that LACROIX considers himself justified in assuming a fundamental connection between the extrusion and crumbling of the rock needle of Mt. Pelée and the occurence of vast glowing clouds (bibl. 20, p. 354—355 and fig. 35, p. 131).

Finally it should be stated that GRANDJEAN, who lived in Djokja and who witnessed the Merapi eruption in 1930, came to a conclusion in direct opposition to KEMMERLING, namely, that in this eruption two kinds of glowing clouds were formed, those following upon incandescent avalanches caused by the crumbling of the lava plug and a second kind, which were shot out (bibl. 11). GRANDJEAN, thus, arrives at the same conclusion regarding the Merapi as LACROIX does with regard to Mt. Pelée. At the Merapi eruption in 1930, there were therefore: „nuées péléennes d'explosion dirigée" and „nuées ardentes", or in other words, on the Merapi in 1930 there arose glowing clouds both of the Merapi type and of the Mt. Pelée type.

This seems to me a very likely hypothesis, seeing that the destruction wrought by the glowing clouds in 1930 on the western sector of the Merapi extended much further than in 1920 for instance, even reaching as far as 9 km. from the summit. (The distance from Mt. Pelée to St. Pierre is about 6 km.).

NEUMANN VAN PADANG expresses a different opinion on the mechanism of the latest Merapi eruption, of which he says (bibl. 9, p. 141—142):

„De alte Ansicht, dass die Anwesenheit eines Propfes, der den Ausweg „verstopft, zu stärkerer eruptiver Tätigkeit Anlass gibt, hat sich hier nicht „bestätigt. Die erste eruptive Tätigkeit des Magmas in November war ein „ruhiges langsames Hochkommen und ein Wegdrücken eines kleinen Teils „vom Vulkanmantel. Als der Weg frei war, ging das ruhige Ausfliessen „gleichmässig fort. Kein äusserer Umstand führte zu grösserer Kraft-„entwicklung. Die erhöhte eruptive Tätigkeit vom 18. und 19. Dezember

„hatte daher ihre Ursache im Magma selbst und zwar in seinem grösseren „Gehalt an Gasen. Die ungleiche Gasverteilung im Magma war die Ursache, „dass einen Monat nach Beginn der Eruption plötzlich eine erhöhte Magma-„bewegung einsetzte."

It seems to me quite possible, that the magma is not uniformly rich in gas and that the variations in the composition will influence the nature of the eruption. But this does not alter the fact that a rapidly congealing magma will sooner close the way out than one which congeals more slowly, so that obstruction may have added to the pressure of the gasses confined in the magma and thus helped to determine the character of the eruption.

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Merapi in 1865.
By night. After the painting by Raden Saleh at the Geological Museum, Leiden.


Merapi in 1865.
By day. After the painting by Raden Saleh at the Geological Museum, Leiden.