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THE AD 1600 ERUPTION OF HUAYNAPUTINA AS DESCRIBED IN EARLY SPANISH CHRONICLES

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RESUMEN

La descripción de la erupción de 1600 D.C. del volcán Huaynaputina (volcán de mal agüero en Quechua) efectuada por Roy Navarro está basada en las crónicas españolas, escritas por sacerdotes, congregaciones religiosas (Compañía de Jesús) y en los relatos de sobrevivientes que presenciaron la erupción.

Precedida de cinco días de intensa actividad sísmica (más de 200 sismos por día), el sábado 19 de febrero de 1600 a las 5:00 pm se inició la erupción del volcán Huaynaputina, acompañada de fuertes ruídos similares a piezas de artillería. En Arequipa desde el 18 de febrero se sintieron temblores en forma continua, dando lugar a que los pobladores salieran a las calles y no retornaran a sus casas por temor a que colapsaran. A esto se sumo la oscuridad total debido a la abundante caída de cenizas que se prolongó durante 15 días (en una distancia de ~40-50 km alrededor del volcán). El 19 de febrero a las 6:00 pm de la tarde se oscureció toda la región de Arequipa, comenzó a caer cenizas y pómez en gran cantidad, acompañado de truenos y relámpagos los cuales aterrorizaron a la población, prolongándose hasta el domingo 20 por la mañana. Los movimientos sísmicos se produjeron durante siete días. Sin embargo, dos movimientos más fuertes fueron sentidos el sábado 19 (grado IX de Mercalli).

El lunes 21 por la mañana continuó la caída de cenizas y luego se aclaró al mediodía. Hasta este día se prolongaron los sonidos fuertes (tiros de artillería). Los gases y cenizas emitidos formaban grandes globos de fuego que ascendían a la atmósfera. Al mismo tiempo, por la cima del volcán eran emitidas gran cantidad de cenizas y bloques de rocas que arrasaban y sepultaban todo lo que encontraban a su paso. Las cenizas y rocas que cayeron al río Tambo saturaron su caudal por espacio de 28 horas formando dos lagunas temporales, y posteriormente generaron corrientes de agua de grandes velocidades que destruyeron los valles situados alrededor del volcán, incluídos terrenos de cultivos, casas y ganados que fueron transportados con dirección al mar.

Desde el día martes 22 al viernes 26 de marzo los días eran parcial y totalmente nublados debido a la abundante cantidad de caída de cenizas, igualmente los temblores eran contínuos. Durante este tiempo la gente caminaba en las calles con sus lámparas. El lunes 28 hubo un temblor de fuerte intensidad, el día era nublado y se aclaró un poco a mediodía. A partir de ese día hasta el 6 de marzo continuó la caída de cenizas.

La erupción causó graves consecuencias humanas, geográficas y económicas, en efecto ella ocasionó: (1) la muerte de aproximadamente 1500 pobladores y ganados que vivían en áreas pobladas aledaños al volcán; (2) la transformación del medio geográfico, provocando la destrucción de terrenos de cultivos, sembríos y canales de irrigación, y la desaparición de las fuentes de agua; (3) la aparición de epidemias, hambruna y una elevada pobreza de los pobladores; una de las regiones más productivas de alimentos fue transformada radicalmente; (4) la desaparición de 17 poblados, sepultados por una espesa capa de cenizas y pómez. Entre ellos el pueblo de Quinistaquillas (ubicado a 14 km al sur del volcán), el cual fue el más afectado y donde murieron más de 100 habitantes; (5) la destrucción de casas y las catedrales de Arequipa y Moquegua debido a los fuertes movimientos sísmicos y a la gran acumulación de cenizas sobre los techos de las casas.

INTRODUCCION

El presente texto es una traducción original del capítulo II "La reventazón del volcán Huaynaputina 1600 D.C." (p. 26-56) del libro "Antología del valle de Omate" (Navarro O., 1994, 1) efectuada por Lidia Jara Romero. Además es un resumen de la "Ampliación de investigación sobre la erupción y estragos del volcán Huaynaputina en 1600 y 1667"

Translated from: "La reventazón del Huaynaputina en 1600" (in "Antología del valle de Omate") por Roy NAVARRO Oviedo[1]
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tambien escrito por Roy Navarro. Estos últimos artículos son el resultado de las investigaciones patrocinadas por el IFEA (Instituto Francés de Estudios Andinos), obtenidos a partir de los "Archivos Generales de la Nación", la "Biblioteca Nacional de Lima", los "Archivos departamentales de Arequipa" y los "Archivos subregionales de Moquegua". Además algunos datos han sido obtenidos del "Archivo histórico de La Paz", el "Archivo histórico" y la Biblioteca de Potosí (Casa de la Moneda). Así como la «Biblioteca Municipal», la Biblioteca del «Observatorio de San Calixto» y la «Biblioteca Central» de la Universidad de San Andrés (La Paz, Bolivia). El presente texto y las recientes investigaciones obtenidas concernientes a las crónicas españolas proveen una mayor información histórica a las investigaciones vulcanológicas (Thouret et al, 1999; 2). Además forman parte de la reconstrucción de una serie de eventos ocurridos durante la erupción del volcán Huaynaputina (tabla 1).

THE AD 1600 ERUPTION OF HUAYNAPUTINA. ANTECEDENTS

The antecedents of the AD 1600 cataclysm have been confused between myths, superstition, and facts with a surprising realism. Southern Peru has abundant volcanoes which likely showed activity in prehispanic times. People who lived in this region were alarmed and intimidated, and for this reason they started to worship the volcanoes adoring to the fire called Con. From this "derived the word CONTESUYO"(3), which means "country of fire". Incas, during their expansion period, arrived to these territories and observed the numerous volcanoes.Therefore, they named them CONTISUYO.

Specifically, there are two volcanoes in the geographic area under study: Huaynaputina and Ubinas. Their presence preoccupied the inhabitants of nearby villages. According to accounts and to historians, Huaynaputina was the more feared. In the villages around, such as Coporaque, Tassata and Quinistacas people believed that the hills grew and became volcanoes, so that they had to do something to control them. Between Coporaque and Tassata is a hill called "Juín", which has the shape of a volcano. For sure, it was considered as a growing volcano and as an additional danger. All that increased their preoccupation, so people consulted to their wizards and bewitchers who advised "to tie the hill" for stopping its growth. They built a circular wall, using stones (pirca) at the top of the Juín. The offering was placed in the center of the circle (4). In doing that, they "avoided the change of the Juín into a volcano".

Huaynaputina, as a dreadful volcano, received a special cult. Indian people offered "sacrifice of sheep, birds, chicha and clothes" to the volcano(5). It was also known that some Indians talked with the demon: "in the Tambo river, he had a human head and a body of a snake"(6). Indians called this snake PICHINIQUE, which means: "what do you have that belongs to you"(7). Thus, when the Spanish conquerors arrived, the Catholic priests separated Indians from the cult to Pichinique. Indians were baptized and received the Christ's law and forgot the sacrifices offered to Huaynaputina. According to chronicles of that time, the "demon became infuriated" for that change.

There are two versions around the facts that were forthcoming. The first version was given by the priest Torres: "Some days before the eruption, the demon told his wizards that a frightful storm was coming to punish the disloyal villages". That penalty will be given by the Guaina Putina hill, so people had to offer sacrifices as they used to do before"(8). The second version, taken from a document of the Compañía de Jesús says that "one day of the year 1600 an Apu told them: Stop your absurdity and surrendering to the Spaniards, who are opposed to our Gods... Do not allow the Gods to turn out the lights of the sky and the days to become nights. Hills will burn... Before it is too late, go to the Quinistacas volcano and offer living beings as you did in better days"(9).

Then, to stop the irascibility of the "Gods" and Pichinique volcano which was showing an extraordinary activity "doing a loud noise" and shaking the earth, the wizards did a petition: "Natives should find the most beautiful virgins, crowning them with flowers. Also natives should get the best flowers and animals". A numerous procession went to Huaynaputina. Travada y Córdova wrote that the whole town went to the top of the hill between songs of ayllas and dancing excessive huaynos"(10). At the top of the volcano, they offered the sacrifices while a dark cloud covered all the surrounding space and suddenly the volcano erupted throwing out fire, ash and lava, burying all people there.

Apparently people from nearby towns did not practice good habits before the eruption. During the first days of December 1599, the priest Alonso Ruíz preached at the Plaza de Armas of Arequipa, recriminating the vice and giving this prophecy: "Look, citizens of Arequipa, that I am seeing at God punishing you: a hard chastisement is coming from the heaven. I will not see it"(10). The posterior events seemed to prove his prophecy. Therefore, the Huaynaputina eruption was considered more as a divine punishment than a natural convulsion. An interesting fact about the seismic activity preceding the 1600's is reported by José T. Polo (1897, 11) who wrote that on the 2nd of July 1582 "a strong earthquake occured in Arequipa at 05:30 a.m., which caused much damage. Related to this, the Quinistaquilla(12) threw so much ash that it destroyed many vineyards and oliveyards, and ash also went as far as Lima. The roars of the volcano were heard as far as 150 leagues (one league =~4 km).

Regarding that date, the priest Rodrigo Cabredo wrote a chronicle in 1601(13), reporting that the earthquake happened on the 22nd of January 1582, contradicting José T. Polo who stated that it occurred on the 2nd of July. That frightful earthquake destroyed most of the city and was

the strongest in comparison with other earthquakes felt before in Arequipa. After 19 years, the city had not been rebuilt completely. Apparently, José T. Polo stated that Quinistaquillas or Huaynaputina threw ash on that day because he confused the earthquake with the 1600 AD eruption. We have to consider that, because frequent earthquakes happened in the town of Arequipa during the late 1500's, the Emperor Charles V ordered through a Royal Cédula that the walls should not be raised more than '6 varas' high (i.e. ca. 5 m).

These are the main facts, mixed with myths and legends, that preceded the large eruption of February 19 AD 1600.

THE FEBRUARY 19 AD 1600

Luis de Velasco was governing the Vice-Kingdom of Peru. Carnival parties were coming in but people from the districts of Quinistacas and Omate would have to forget the celebrations. On February 15 AD 1600, the quakes started. On Friday the 18th, a stronger earthquake woke up all people. Then the quakes continued, as much as 3 or 4 per 15 minutes. The earth shook strongly until the next Saturday at 18:00 p.m. The people were afraid that house walls could fall on them (14). These movements preceded the catastrophe of Saturday the 19th of February AD 1600, when the Huaynaputina erupted at around 17:00 p.m. Simón Pérez de Torres related how the eruption started. He was going from Arequipa to Moquegua: "... At around 5 p.m., I began to hear many shots, like gunfire from an artillery"(15).

There was a crash joined to high flare-ups. At 6 p.m., a dark cloud covered the heaven and a strong rain of small sand started. Pérez de Torres reported the "shots" continued until Monday at noon...."During 24 hours, more than 200 quakes and crashes were counted. Before Sunday the 20th of February (first Sunday of Lent), the heaven was dark looking like midnight at 2 p.m. We thought that this was the day of the Last Judgement"(16-17).

The volcano threw out tongues of fire and sulphurous gas. Felipe Guamán Poma de Ayala wrote: "From the volcano rose fire and a smoke of ash and sand(18). The sulphurous matter formed some "globes", whose flight threatened to burn all things. At the same time, plentiful "lava" started to flow, dragging, burning and burying all it found. "Rivers of lava" filled up ravines and, in some places it was 5 meters in thickness. In Arequipa, on Sunday the 20th of February, the ground was covered by a *cuarta* (ca. 21 cm) of white and brown sand with ash.

That night, there were large thunders and lightnings, and the Indians, Spaniards, women, children and old men cried and claimed mercy to God. Travada writes that "when the ash went down to the rivers, their volume increased, and together with the smaller rivers formed some lakes".

The rivers grew very much and water formed a stream, which dragged large rocks, uprooted trees, and swallowed houses and cattle, carrying them away to the sea"(19). People were hungry and thirsty. Those who lived in the field were buried by sand and ash or injured by incandescent stones... The ash from Huaynaputina vanquished also the thought"(20). Quakes continued for 7 days. Sieberg (*in* Barriga 1951) reported that the strongest earthquake occurred on the 28th of February. In contrast, Barriga wrote that "the witness declared that the strongest earthquake occurred on Saturday the 19th of February" and that there were 2 earthquakes between "11:00 a.m. and 1:00 p.m." that day, estimated to be at "level IX on the Mercalli scale within a range of 100 km"(21).

More information on the 1600 AD eruption stems from the fact that priests and monks wrote detailed accounts. The "Compañía de Jesús" as a religious organization, strong and charismatic, was responsible to write and hand down the chronicle of the volcanic catastrophe to posterity. The General of the Order, P. Claudio Acuaviva ordered to the Provincial Rodrigo Cabredo to write down all what happened in Arequipa. This chronicle, written in 1601, was found for unknown reason in the San Calixto Observatory in La Paz, Bolivia(22).

The main paragraphs which describe the eruption are the following:

"In the middle of February 1600, some quakes were felt in Arequipa. They were neither frequent nor strong but they started during the season of rains, a fact which had never happened before. On the 18th of February, quakes started in the night. Between 9 and 10 p.m. a strong earthquake woke up all people, then quakes were as frequent as two or three each 15 minutes. People ran out of their houses, and to parks or free areas. At midnight, quakes were very strong and frequent. Nobody slept that night. On the 19th of February, the storm got worse, and people went to church to prepare their soul, but the priest neither could held the mass nor people were able to listen. The movement of the ground was continuous, walls moved, roofs creaked, and people cried and were disturbed... The quakes continued the whole Friday from morning to night. People counted 200 tremors since Friday evening until Saturday at the same hour. The ground was not quiet at that time and everyone heard a perpetual quake.

This day, almost 30 minutes before sunset, the sky turned dark, and people heard strong thunders and were expecting rain fall. But clouds started to unload a white and thick sand". The priest Bernabé Cobo wrote that this sand was "like mustard grains in size, and people started to fear it more than earthquakes(23). The sand covered hills, flat lands, trees, houses and animals. All noises were mixed: roars, quakes, and rain of ash... The 21st of February everything was covered by a horrible red and pale color. Also a white dust turned the hair and beard into crushed pumice stone".

DATE	TIME	SEISMIC AND VOLCANIC EVENTS	TIME	RELATED EVENTS		REFERENCES
AD 1600	onset / end	mostly felt in Arequipa	onset / end	at and around Arequipa		
15 February		weak seismic events are perceptible				Barriga, 1951*
to 17 February		west(?) of Arequipa				(report of S. Perez de Torres)
	07:00 p.m.	frequent seismic events are recorded		a few walls collapse in the city of Arequipa		Ocana, 1963
	09:00 p.m.	Strong seismic events are continuously felt				Barriga, 1951*
18 February		Seismic shakes so strong that nobody can				Murua, 1925
		enters his house, all people woken up				
	11am to 1pm	As much as 200 seismic events recorded all day long		Houses fall apart		Cartas Anuas, 1899
		two very strong earthquakes	10 pm to 2 am	thunder and lights		Barriga, 1951
19 February	5 to 6 pm	Eruption begins at 5 pm. Ash begins to fall at 6 pm		people see 'fireballs as large a street'		
	06:00 p.m.	Abundant, small white and brownish pumice		The city of Arequipa in darkness	Vasquez de Espinosa, 1942**	
		begin to fall. Frequent and strong events			(report of Pedro de Vivar)	
		every 15 minutes or so			Cartas Anuas, 1899	
	5 to 11 pm			a few houses collapse in Arequipa		Murua, 1925
	06:00 p.m.	Pumice lapilli fall decrease by much,	06:00 p.m.	Sky gets dark as far as the Pacific coast		
		while 'black grain' ash fall occurs		Frightful thunder and lights are heard		
	11 to 1 pm	People feel at least 150 seismic events all	5 to 6 pm	Sky is cloudy. Thunder heard like artillery's		Ocana, 1969
		day long; two major quakes		canonade. Darkness all the day long. Fireballs		
		Frequent ash falls		are seen in the city of Arequipa		
	05:00 p.m.	quakes continuously felt; eruption began,	11:00 p.m.	Incrasing bad weather and darkness. Thunder sounds		Murua, 1925
		ash fall		like artillery canonade" in Lima, Chuquiabo, and		Travada y Cordova, 1923
				Arica. Thunder and lights in Arequipa. Fireballs		
				crossing the sky, seen from Arequipa		
20 February	02:00 a.m.	Pumice lapilli stop falling. Ash keeps on	02:00 a.m.	Bad weather, thunder and lights stopped		Murua, 1925
		falling; earthquakes felt				
	06:00 a.m.	Ash fall decreases	1 to 2 am	Fireball street-sized is seen		Barriga, 1951*
	08:00 a.m.	Ash fall; 15-20 cm of ash measured in Arequipa	08:00 a.m.	Sun appears and day gets clear		Murua, 1925
			10:00 a.m.	morning gets dark		
				ash-covered roofs collapse at morning time		Barriga, 1951*
	01:00 p.m.	seismic events continue	01:00 p.m.	afternoon gets dark; '2 pm was like midnight'		
		ash fall continues; pulsing eruption				
	03:00 p.m.	Increasing fine ash fall	03:00 p.m.	day gets clearer again		Murua, 1925
		ash fall continuous and more intense	1:30 to 3:30 pm	Evening gets darker		Vasquez de Espinosa, 1942
		until morning of 21	03:30 p.m.	Evening gets clearer again		
				Thunder and lights at night		
			05:00 p.m.	seismic events continue		
	05:00 p.m.	ash fall		Evening gets darker, then clearer		
				Darkness all day long		
				a few houses collaps due to ash cover and		
				fireball' is seen in Arequipa		
		ash fall finer-grained but continuous	09:00 a.m.	Daybreak a little clearer		Ocana, 1969
21 February	04:00 p.m.	seismic events at a time		again darkness later		Barriga, 1951
		ash keeps on falling		Daybreak clearer		Vasquez de Espinosa, 1942**
		ash fall until night, then clearer, not much ash fall				
	04:00 p.m.	seismic events at a time		some houses collapse again		Barriga, 1951*
				darkness permanent		Vasquez de Espinosa, 1942**
22 February	6 to 7 pm	Numerous light seismic events and one		Daybreak clearer than previous days		Murua, 1925
		stronger; renewed ash fall all day long				
		Numerous seismic events		Daybreak a little clearer and all day long		Ocana, 1969
		Fall of fine ash decreases				
	04:00 p.m.	Intermittent seismic events		A few houses collapsed in Arequipa		Barriga, 1951*
		No ash fall observed		Day was clear		Vasquez de Espinosa, 1942**
		Ash fall during 2 hours leaving one palm		Daybreak dark, then clearer, but sun not seen		
		thick (about 10 cm)		A few houses collapse. The Tambo river and all		Murua, 1925
				streams nearby volcano dried up. The dis-		
				charge of the Tambo river decreases during 3 days		
				and the entire valley is devastated		
		Weak seismic events are felt		Day gets clearer, but sun hidden		Ocana, 1969
	04:00 p.m.	Intermittent seismic events		A few houses keep collapsing		Barriga, 1951*
		Ash fall decreases		Moon and stars are seen		Murua, 1925

23 February		apparent lull in the seismic and volcanic activity				
24 February		A few seismic events are felt		Sky gets clearer and sun is seen		Ocana, 1969
		No ash fall?		Day stays cloudy and sun does not show up		Vasquez de Espinosa, 1942**
	04:00 p.m.	Intermittent seismic events		A few houses keep collapsing		Barriga, 1951*
		Strong seismic events and ash fall goes on		Morning gets dark		Murua, 1925
25 February		Abundant ashfall		Day stays cloudy and dark		Vasquez de Espenosa, 1942**
		Very fine-grained ashfall		Day stays cloudy		Ocana, 1969
		Abundant ashfall		No daybreak, complete darkness		Vasquez de Espinosa, 1942**
	03:00 a.m.	Abundant, 'colored' ash fall until Sunday 27-02	03:00 a.m.	Daybreak clearer but morning darker than ever		Murua, 1925
26 February	08:00 a.m.					
		renewed ash fall		Complete darkness in the city of Arequipa		Barriga, 1951*
		Ash fall deposit reaches '2 varas' ?		Complete darkness		Ocana, 1969
	08:00 a.m.	Ash fall stops		Day gets clearer when ashfall stopped (40		Murua, 1925
				hours of darkness since Friday at 6 pm). Day		
				slightly clear		
27 February		Abundant ash fall	08:00 a.m.	Complete darkness		Barriga, 1951*
				Houses collapse		
	10:00 a.m.	Ash fall stops				Vasquez de Espinosa, 1942**
				Day gets clear		Ocana, 1969
		A strong explosion is heard from Huaynaputina	12:00 a.m.	Daybreak at noon only		Vasquez de Espinosa, 1942**
28 February			04:00 p.m.	Day gets dark for about 2 hours		Vasquez de Espinosa, 1942**
		Renewed ash fall and major seismic event		Daybreak clear		
			03:00 p.m.	Evening darker		Murua, 1925
			05:00 p.m.	Evening clearer		
29 February		Ash keeps falling		Sun is seen nut hazy		Vasquez de Espeinosa, 1942**
1 March		Earthquake, ash fall				
1 to 5-6 March		Ash keeps falling. Ash fall finally stops apparently		Sun is seen but hazyy ; dust and ash are observed		Vasquez de Espinosa, 1942**
		on 6 March		in the air		
15 March		Ash fall and seismic events are felt until		Sun is seen but hazy ; dust and ash are observed		Vasquez de Espinosa, 1942**
		6 or 15? or 21? March		in the air		
2 April 1600				Air eventually cleared		eye-witness in Arequipa,
26 March 1601				Daylight returns to normal, atmosphere cleared, but		in Barriga, 1951
				sun is barely seen clear a few days only'		
* Simon Perez de Torres, who traveled on 19 February 1600 and eye-witnessed the eruption at about 5 pm on his way from Arequipa to Moquegua						
** Pedro de Vivar: Relación de la erupción del Huaynaputina en 1600 (Report on the Huaynaputina eruption in 1600), published by Vasquez de Espinosa						

Table 1. Chronology of the AD 1600 eruption of Huaynaputina based on six different chronicles.
Table 1. Cronología de la erupción de 1600 DC del Huaynaputina en base a seis crónicas diferentes.

THE HAVOC IN THE TOWN OF AREQUIPA

The city of Arequipa lies 16 leagues away from Huaynaputina. The zone is volcanic and earthquakes are frequent. Despite this fact, when on February 18 AD 1600 the tremors did not stop, people were afraid and walked in procession to Santa María. Pedro de Vivar reported that on Saturday the 19th of February, "at 6 p.m., a dark cloud covered the heaven, raining white and gray sand until Sunday morning... the ground was covered with a hand of sand and ash..."(14). People cried and claimed for mercy. On the morning of Sunday the 20th, people started to remove the ash accumulated on the roofs with the aid of torches. From 1:30 p.m. to 3:30 p.m., it was completely dark.

People from Arequipa did not know what was happening. On Monday the 21st of February, as Pedro de Vivar reported "when the day broke just at midday, ash continued raining, it was known that Omate volcano or Huaynaputina, located at 6 or 10 leagues from the city, had burst into eruption. That day grew dark at 4 p.m., the darkness continued for 2 hours and then the light came once again"(32). On Tuesday the 22nd of February, the sun appeared while sand and ash kept on raining. On Wednesday the 23rd, the day was clear and ash did not fall. On Thursday the 24th, there were darkness, crashes, and an earthquake"(33). On Friday the 25th, the day was dark and people had to burn lights in order to see... On Saturday the 26th, daybreak did not occur, the obscurity was complete since Friday evening until Sunday at 10:00 a.m. During all this time, a great quantity of ash rained... V. Travada y Córdova wrote that "there were storms threatening to destroy all the city, and clouds shot frightful storms"(10).

On Monday the 28th of February, there was a strong quake, it was dark until midday. At around 4:00 p.m., the night resumed and sand started to fall along with storms. On Tuesday the 1st of March AD 1600, the sun was covered by fog while ash continued raining. On Wednesday the 2nd, there was a strong quake. The rest of the day was clearer, but no one could see the sun because ash kept on falling. On Saturday the 5th, "the heaven was dark again and a great quantity of ash rained until Sunday the 6th, when the day was clear. Only on April the 2nd, the heaven was completely clear"(34).

THE SITUATION IN ANOTHER CITIES: MOQUEGUA, LIMA AND CALLAO

Not only Arequipa suffered havoc from the volcano, but it was also felt in other cities and latitudes. Historians reported that the sound of the volcanic explosions spread out more than 200 leagues of distance, and that "ashfall reached more than 600 leagues because it fell also in Nicaragua"(35). This is also stated by V. Travada y Córdova: The echoes of the explosions "resounded as far as Chuquiabo (La Paz) and Lima which is located 200 leagues away" and "the ash fell out in the sea as far as Panama and the coast of Nicaragua...". In Moquegua, people were astonished looking at ash raining as if it were water". On Tuesday the 22nd of February, a priest and 80 Indians arrived to Moquegua. He reported that a volcano had split within half a league from his village"(36).

The Corregidor of Moquegua, looking at the quantity of sand and ash, ordered that neighbors cleaned the roofs of their houses. In the book "The first new chronicle and good government" published by Felipe Huamán Poma de Ayala(18), there is a drawing showing ashfall on Arica (Chile). In Arequipa, sand rained also and the sky was covered by "tongues of fire". In the Quilca valley, people died suffocated and buried by ash and sand.

Quakes were felt also in Lima where the explosions were heard. Only a small amount of ash fell there. Luis de Velazco, Viceroy of Perú, thought that Callao was being attacked because shots like artillery(37), actually produced by the explosions of Huaynaputina, were heard.

THE IMPACT OF THE CATASTROPHE IN THE SPANISH LITERATURE AND POPULAR TRADITION

The eruption of Huaynaputina is an unique event of that magnitude in the History of Peru. For that reason it has been immortalized in an "*Egloga*"(38). During the first half of the 17th century, Diego Mexía y Fernagil wrote the egloga "El Pan Bueno" (The Good Bread), where he describes the events of February AD 1600. The most important verses are:

"In Arequipa, whose history is lamentable, the earth shakes, Baco was frightened seeing his dreadful kingdom. - People were afraid looking at the buried farm. - Did it stop here? No, the ash of the Omate clouded, darkened, embraced and cauterized. - I know that in Sicilia the fearful Etna pours ash in the wind with fury. - The ash covered the hills, ran on the earth and filled up even a tower". - The events occuring in Arequipa have been incredible, the ash conquered also the thought. - The sun was eclipsed by the ash, the rich rivers destroyed many towns".

Not only the literature but also the popular tradition immortalized this event. While years went by, the volcano acquired a legendary character "because what happened with Quinistacas became a tale, although it was observed". Hence, the narration of the catastrophe transmitted by generations was covered by a legendary cloth until it gave rise to the "Legend of Cahua Pampa", considered as a divine penalty to punish the evil consciences.

Following is a transcription(39) of the legend transmitted orally:

"In 1600, when Luis de Velasco governed the Vice-Kingdom of Peru, there were unexpected and amazing

events. The devil, more powerful and vain, challenged our Lord Jesus Christ to know which of them would be best received by people. The devil was sure to get the victory. So, they both went to walk the world, explaining their doctrines to the towns. Our Lord was well received and listened to with attention. After walking so much, the infuriated devil dressed with gold and rode a beautiful white horse. They arrived in Omate on the 19th of February, which was located in the "Cahua Pampa". That day a marriage was celebrated. The party was at the house of the wife, where the devil arrived and was invited in by the owners, where he saw the nice and elegant young bride. When everyone was dancing, a ragged old man appeared and the owners threw him out of the house. The old man went to the kitchen where the cook cleaned his face and offered him a jar with *chicha*, but the old man did not drink and only thanked her. He asked her: "Where are your husband, sons and family"? Then he said: "Follow me, we should go out of this town because it will be soon buried". The cook, despite being pregnant, accepted the invitation and taking her son by the hand, she followed the old man, our Lord Jesus Christ who gave her the order "do not turn to look back". They walked up hills, through pampas, and down gorges. When they came up to the "Coylanto" hill, she turned back and saw a rain of sand burying the town, then she was converted into a stone. Then, our Lord made a stair of gold and ascended to the heaven, he buried the devil with a mantle of sand and ash. Now, there is a stone block with the figure of a pregnant woman, which is the place of the disobedience, as a reference for the present generations.

A similar version of the legend is also told in Quinistaquillas, and the facts occurred in the "Pampa of Calicanto" where we can observe now the ruins of a village.

CONSEQUENCES. HUMAN CONSEQUENCES

Historians report that seven villages were buried by the Huaynaputina eruption(40): Omate (Chiquiomate?), Coporaque or Cojraque, Tassata, Calicanto, Lloque, Colana, and Checa, see Fig. 1 (41). Also hamlets like Santa Cruz and Muilón were buried. People of these villages died burnt by the incandescent lava, sand and pumice. They died together with their cattle, as well as the animals and wild birds.

The priest of Puquina "found that the inhabitants of Omate were dead, cooked by the fire of stones"(42). Then he went to the town of Ubinas and found that there were still a few people in the villages of Chiquillaque, Zazallaque and Cacahuara... According to Travada y Córdova, only two of the buried towns showed vestiges of their existence: a shoot of a willow and the top of a high tower"(43). Sieberg reported in "The earthquakes in Perú" that there were approximately 100 victims in Quinistacas(44). Epidemies, famine and poverty were added to the general ruin. Thus, autorithies decided to cope with this problem. For example, the Arequipa's *Cabildo* appealed to the Cuzco's *Cabildo* who sent "100 loads of corn and dry meat"(45)... The *Virrey* ordered the Collagua's *Corregidor* to send 500 Indians from the *mita* to help repair the city because almost all houses were in ruins... The *corregidor* of Caylloma also collaborated...

Arequipa suffered the least because the town was far enough (75 km) from Huaynaputina, hence it was rebuilt quickly. The villages located nearby the volcano were rebuilt over many years, whereas other villages could not be rebuilt. Quinistacas, despite being located only 13 km away from the volcano, was less affected, because the village was protected by the ridges and valleys of Paylogen, Mayoc, Chumure, Collayoc and Pucará... In contrast, the nearby town of Omate "was destroyed, buried by a mantle of incandescent ash"(46). It was not before 1605 that people talked about "cleaning the town"(47). Also in Moquegua some provisions were taken to help the famine. The Corregidor bought wheat to "be distributed to the villages (Omate, Quinistacas and Ubinas) and to the Indians of Carumas"(48). Since many towns were not rebuilt, they were known only by their names. Coporaque, the first of them, belonged to the *Encomienda* of Quinistacas. The ruins of this village (housing and cultivated terraces) are located in the Pampa of "*Cojraque*". Another buried village is located south of Escobaya at the foot of the Santa Cruz hill. To the west of Santa Cruz, in the Omate valley, now "*Cagua*" Pampa, there are also archeological vestiges of the old town of Omate(49). In the Quinistaquillas district, there are more buried villages: Muilón, Tassata and Calicanto...

The Puquina district contains vestiges of a village called "*Charfón*"(50)... There are today so many signs of cultivated terraces, paved trails, irrigation canals, tombs and one aqueduct in the Omate valley... Omate suffered very much from the eruption and was "buried together with 200 persons, most of them Indians"(51). Incandescents rocks affected Quinistacas, Coporaque, Tassata, Calicanto, Escobaya, and Santa Cruz which belonged to the Anansaya partiality(52). Their Cacique was Cristóbal Esquiagola (Segola). In the Urinsaya partiality including the town of Omate, the following villages were buried: Yahabaha, Sibaya, Istacha, Cometa, Guanas, Yuayga, Arapa, Yoca, Taratau, Chuchuyata, and Pachari(53). Many of them are still buried and their location remains unknown. In that partiality, the village of Cupilaque (old Coalaque) was also buried: the ruins can be found in a site termed "*Gentilpata*" nearby the Pampa Dolores of the Coalaque district. The masonry used for constructing the houses and public buildings, the irrigation canals, farm yards and tanks indicate that Gentilpata was probably an important town.

People from Omate and Quinistacas, the nearest towns to the volcano, evacuated when faced with the dangerous situation. Only few persons trusted their good fate and did not escape. For this reason, not all died buried, since some of them abandoned their villages to save their lives. Almost all who left their villages and fields on the 19th of February were guided by their *caciques* and mayors.

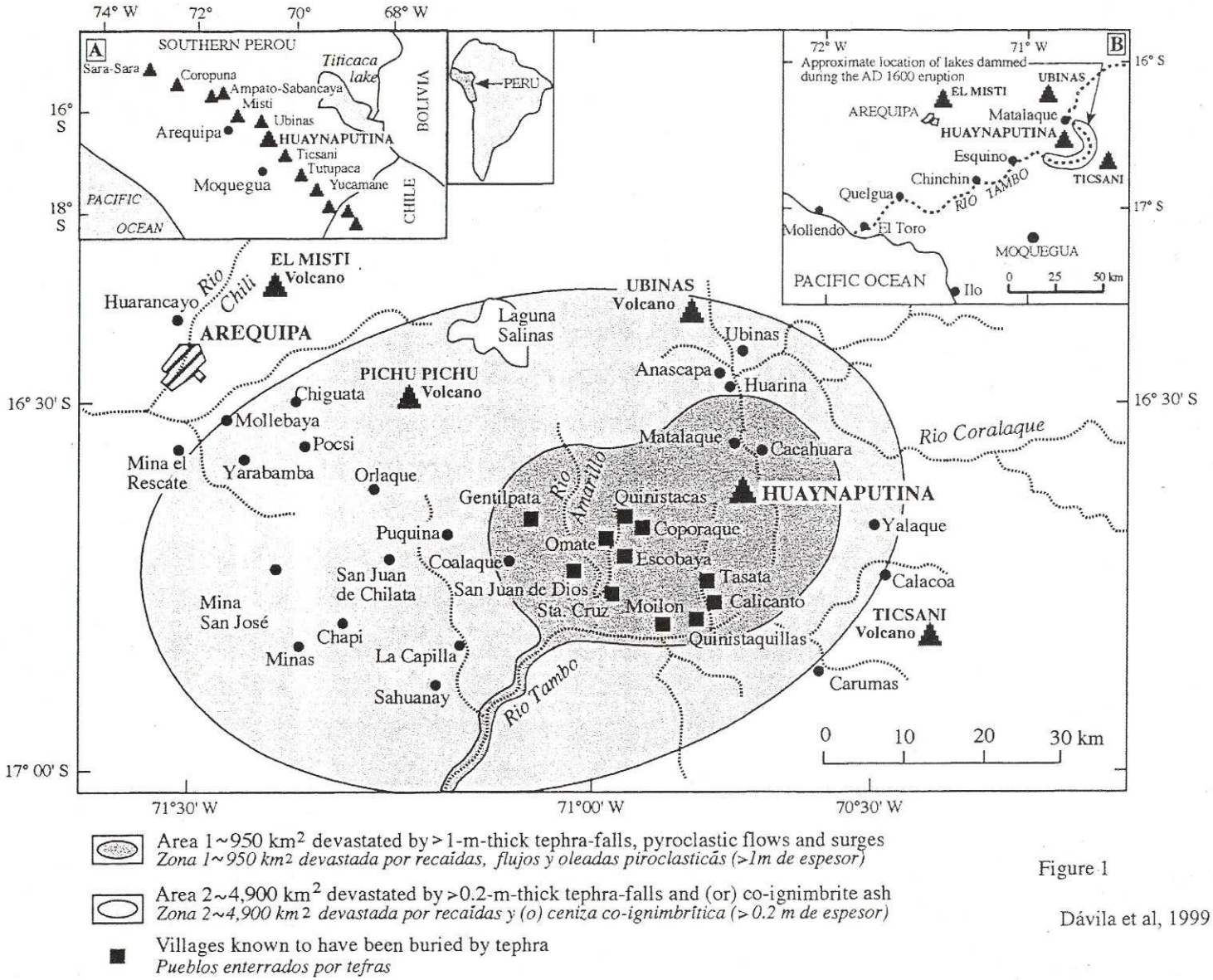

Figure 1

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Fig. 1: Sketch Map of the Arequipa - Moquegua region showing two areas devastated or directly affected by the Huaynaputina AD 1600 eruption. A. Sketch map of southern Perú showing the most recent volcanoes of the northern Central Andes. B. Inset: Map of the Rio Tambo valley showing the path of the AD 1600 lahars and localities cited in the text.
Mapa esquemático mostrando las dos áreas devastadas o directamente afectadas por la erupción de 1600 DC del Huaynaputina. A. (Izquierda) Mapa esquemático del sur del Perú mostrando los volcanes más recientes del norte de los Andes centrales. B.(Derecha) Mapa del RíoTambo mostrando el camino de los lahares de 1600 DC y las localidades citadas en el texto.

People from Omate with their cacique Francisco Cayla, and people from Quinistacas with their cacique Cristóbal Segola (Esquiagola) left accompanied by their women and children toward the valley of Moquegua. They settled at in two sites named "*Carapampa*" and *Estuquiña* near the village of San Sebastián de Escapagua, where they remained until 1602-1603, and some of them as late as 1619. On the 17th of July 1601, Cristóbal de Aranda, priest and vicar of the Moquegua valley wrote that, because of the eruption and ruin caused by the volcano, Indians from Omate and Quinistacas were welcome to "live in this valley with their women and children"(54). The priest Aranda and the treasurer Francisco Voso Vizconde were responsible to converting and giving them the Holy Sacraments until 1605 when the priest died. Since 1605, "the majority of the Indians from Omate and Quinistacas lived in the Moquegua valley since the eruption of the volcano"... After arriving to the Moquegua valley, they worked in agriculture and domestic service. Some of them lived there only until 1602, when they returned to their village to rebuild their houses and cultivate their land. In 1605, they already had a new priest, Pedro Gerónimo de Horta, who was responsible for the town and district of Omate...

GEOGRAPHICAL CONSEQUENCES

Pedro de Vivar wrote that the Huaynaputina eruption "devastated all the earth"(55). That was true because the volcanic catastrophe changed radically the landscape and environment. The whole territory was covered by a mantle of ash and pumice, turning the land barren. There was desolation 15 leagues (~60 km) around the volcano, the ash disabled many farm land, and inundated the ravines, valleys, plateaus, hills, and plains. Springs had disappeared, the Quinistaquillas river had practically vanished because its sources were located at the foot of the volcano and, as the Governor Intendant Antonio Alvarez y Jiménez wrote, "the river was absorbed by the ground and covered by ash"(56). Something similar happened with the Escobaya and Paylogén rivers, whose discharge decreased to such an extent that the water was insufficient to irrigate the cultivated land. This has been confirmed by the discovery of many terraces (some still buried, other uncovered) such as Calicanto, Santa Rosa, Muilón (Quinistaquillas), Santa Cruz, Pampa de la Cahua, Cojraque, Chichilín, Coalaque, Puquina, etc. The Paylogén stream, whose narrow channel plunges down the Paylogén hill, may have also disappeared like other nearby streams. Initially, its channel was blocked by tephra from Huaynaputina and by material from landslides induced by earthquakes. The small stream opened a new channel but the new drainage did not succeed in the thick sand covering the channel beds.

The wise Antonio Raimondi wrote: "You cannot believe that all these towns, Omate, Coalaque, Huatacache, Quinistacas, Quinistaquillas, and so on, have been covered by a mantle of pumice stones and sand thrown by the volcano. But your doubt disappears when you examine the enormous crater of Huaynaputina and consider the high wall of pumice surrounding it"(57). Antonio Vásquez de Espinosa, 18 years after the cataclysm, said that "the dry and deserted land was extensive and more than 150 leagues were sand and ash"(58).

A disturbed ecology was added to the disturbed geography: fauna and flora disappeared, buried and burnt by the high temperature, only a few birds could escape. After the volcanic explosions, an immense cloud of dust continued in the sky during some months and people emigrated to another land. A year after the eruption at March 26 1601, when the Procurator Antonio de Paz ordered a report on the situation in Arequipa, seven witnesses reported that "dust and fine ash are still falling and the sun appears clear only on a few days"(59)... In 1750, i.e. 150 years after the catastrophe, "people inhabited again the mountain that had buried seven villages many years before, and they cultivated the fields and also had cattle".

ECONOMIC CONSEQUENCES

The economical loss was enormous although there is no inventory that would allow to evaluate the loss. Some historians wrote that damages and loss exceeded 10 million of pesos(60) in the 1600's. The economic consequences derived from the disorder, the total ruin of cereals and loss of crops covered by thick layers of sand, pumice, and ash, generating poverty. That year nobody harvested fruits... Pedro de Vivar reported that "a great quantity of cattle died and those that escaped also died because there was no food"(61). Almost all the valleys of Tambo, Majes, Vitor, Camaná and Moquegua were affected by the catastrophe. In Arequipa, cereals were lost, as well as vineyards, chili and other produce.

In additon to the misfortune, the famine suffered by Spaniards and Indians was general. Many Indians left Arequipa, and the Cabildo asked the Cabildos of Cusco and Condesuyo for food assistance. They distributed corn to the Indians "so that they can sow because they have no corn seed left"(62).

Trying to avoid the escape or extinction of Indians, the Viceroy Luis de Velasco recommended to the Corregidor of Collesuyo and Moquegua, Pedro de Vergara y Muñatones, to take care of the Indians "giving them cereals without collecting too much taxes, so that Indians would be able to maintain their houses and families"(63).

The Huaynaputina eruption ruined the villages and their folks. The holders of *encomiendas* asked them the due payment of taxes and tributes on Saint John and Christmas days... The poor Indians had accumulated debts because they had loaned money... But Quinistacas continued suffering, people had no money and it was almost impossible to pay the requested taxes. In their

original places most of their seeds were still buried, the rehabilitation was slow, and they did not get any income. Then, they had only one resource: the guano from the Corocinto islands... As they were forced to pay the tributes, they decided to rent these islands to Martín de Quintanilla who lived in the Moquegua valley...

Living in the Moquegua valley was not favourable for the people from Quinistacas because there were interests opposed to their return to their villages. Were they actually needed as labour force? In addition there was the fear that Huaynaputina would erupt again. Since 1602, they were negotiating their return. Taking the opportunity of the travel of Martín de Sayn to the *Ciudad de los Reyes*, the Indians met him on the 26th of November 1619 and asked him to go to see the Viceroy as well as the King or the Real Audience and request the authorization to "return, inhabit, live and stay in our old reduction in the town of Omate and the land of Quinistaca"(64)... The recovery of the fields was slow and difficult. A large part of the formerly cultivated terraces in the Omate valley remained buried. The havoc of volcanic ash was felt in all the valleys of the Arequipa region. In the valley of the Río Vitor, more than 100,000 jugs of wine were produced usually each year. In contrast, 6 years after the eruption, no jug was produced. The raisin trade also disminished. Before the eruption, as much as 600 quintals of raisins were sold each year, whereas in 1603 only 200 were sold(65). The trade of sugar faced the same difficulty owing to the ruined sugar plantation in the Río Tambo valley... The valley of Moquegua suffered similar consequences.

The mining center of Potosi also suffered because the above-mentioned valleys used to supply the city with food. Martínez Arzanz says that the Villa of Potosi was supplied with more than 100,000 jugs of wine, spirits, and delicious olives, among other things, from the valleys Sinti, Arancota, Turuchipa, Ica, Moquegua, and Arequipa. These valleys also produced "winebags with a clear and delicious oil"(66). All the commerce was interrupted temporarily because of the Huaynaputina eruption and its consequences: long sections of dirt roads and trails that joined the valleys of Arequipa and Moquegua with the city of Potosi were disrupted, forcing the merchants to stop their trade... Fine ash also fell on the city of Potosi... 1600 was a sad year for Potosi because additional natural phenomena like droughts, which affected the life and disminished the production of silver occurred. Moreover, "awful storms of wind and snow lashed the city. Life conditions were unhealthy giving birth to many epidemies"(67). In addition and as a consequence, a social and political riot stained with blood the Villa Rica...

The capacity of the people to challenge nature with work and faith was remarkable. The survivors were determined to start the reconstruction of houses and the rehabilitation of the cultivated land. In 1750, thanks to the efforts initiated in 1618, as Vásquez de Espinoza reported, 150 villages were relocated to sites which had been covered by ash. In addition to Arequipa, seven villages which had been covered with ash in the mountains were reoccupied by new people"(68). But in Quinistacas, Omate and other nearby villages, the reconstruction proved to be more difficult. Related to this, Governor Antonio Alvarez y Jiménez stated in 1791 that there was "many land yet to be rehabilitated despite the hard work to clean them"(69). Many terraces, previously cultivated on hillslopes, which are still being discovered at present by arqueological work and also by serendivity, witness to the damage caused by the AD 1600 eruption.

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(3) CABRERA VALDÉS M.L. (1924).- "Documentos primitivos del Cabildo", Tip. Caritg and Rivera, Arequipa, p. 34.

(4) Now, there is that circular *pirca*, whose linear measure is approximately one meter. The circle inside the pirca is covered by pumice and sand. Tradition says "witches dance in Juín every Tuesday and Friday". Actually, following a belief, old Coporaque's inhabitants "tied the hill and stopped it growing" putting a circle of stones.

(5) Datum given by P. Torres who continued writing the "Crónica Agustina" written by Father Antonio de la Calancha. In "Documentos primitivos del Cabildo", by Ladislao Cabrera V., Arequipa, 1924, p. 33.

(6) In 1804, the news was given by the Archdeacon Francisco Echevarría y M., who wrote an Ensayo Monográfico del Obispado de Arequipa. This text was published by P. Víctor M. Barriga in "Memorias para la Historia de Arequipa", Imprenta Portugal, Arequipa, 1952, pp. 48-53.

(7) CABRERA VALDÉS L., op. cit., p. 33.

(8) CABRERA VALDÉS L., op. cit., p. 33-34

(9) GALLEGOS SANZ M.: "Los horrores de Quinistacas" published in El Correo dominical supplement, March 29, 1987. Gallegos took these data from a Jesuit document (a letter of a Spaniard published in "El Perú" by Antonio

Raimondi) and a version of Inocencio Tirado. Note that Gallegos uses the name 'volcán Quinistacas' instead of Huaynaputina.

(10) TRAVADA Y CÓRDOVA V. (1923).- Historia General de Arequipa (Libro primero), Folletín de 'El Deber', Arequipa, pp. 22-24 and 17-18, respectively. The priest Alonso Ruíz was born in Córdova, Andalucía, Spain, and died on December 18 1599, three weeks after offering his prophecy.

(11) POLO J.T. (1897).- "Sinopsis de sismos y volcanes del Perú", printed by the Libreria San Pedro, Lima, p. 6. José T. Polo was one of the founders of the Geographical Society of Lima.

(12) The Huaynaputina was also called Quinistaquilla, Chiqui Putina, Morro Putina, Chiqui Omate, Guayta, Omate, and Quinistacas.

(13) San Calixto Observatory. "Historia de la Compañía de Jesús en Arequipa y relato de la erupción del volcán de Omate". This manuscript is a literal copy of Alonso Osorio's letter related to Arequipa and written in February 1583.

(14) VÁSQUEZ DE ESPINOZA A. (1942).- Compendium and description of the West Indies (translated by CU Clark). Smithsonian Misc Collect 102, pp. 470-474. The author published the "Relato de la erupción del Huaynaputina y del sismo en 1600", written by the soldier Pedro de Vivar, who lived in Arequipa and survived a collapse of his house".

(15) BARRIGA V.M., op.cit., pp. 140-142. According to Antonio Raimondi, Simón Péres de Torres was a traveler who left Sevilla in 1586. The interesting report of his travel yields important data regarding Peruvian places and events of the end of the 16th century.

(16-17) BARRIGA V.M., op.cit., pp. 140 and 48-53, respectively.

(18) GUAMÁN POMA DE AYALA F.: "La primera nueva crónica y el Gobierno bueno", Edition published by the *Institut d'éthnologie de l'Université de Paris,* 1936. We have consulted the Instituto Tiahuanacu Edition, La Paz, 1944, p. 1054. The chronicle was written in 1613.

(19) TRAVADA Y CÓRDOVA V., op. cit., p. 18.

(20) Eclogua "El Dios Pan" written by D. Diego Mexia.and Fernangil (see below note 38).

(21) BARRIGA V. M.: "Terremotos en Arequipa 1582-1868", Edición La Colmena, Arequipa, 1951, p. 184.

(22) This Observatory belongs to the Compañía de Jesús, directed by S.J.P. Lawrence Drake. One member of the order might have carried the manuscript there, until it was discovered by scientists in 1909, and transcribed by the geophysicist Montessus de Ballore, first director of the Servicio Sismológico of the Universidad de Chile.

(23) COBO B. S.J.: "Trabajos del Padre Bernabé Cobo de la Compañía de Jesús", Tomo I, Edición Atlas, Madrid, 1964, pp. 96-97.

(24) BARRIGA V.M. "Memorias para la historia de Arequipa", 1951, pp. 48-53.

(25) BARRIGA V.M., op. cit., pp. 126-142.

(26) VÁSQUEZ DE ESPINOSA A., op. cit., p. 469. According to other reporters like Pedro de Vivar, this night continued without light for 15 days. According to Guamán Poma de Ayala "Darkness lasted for 30 days and 30 nights".

(27) Ibidem, p. 473. In the eighth book of the Acuerdos del Calbildo de Arequipa in the Archivo Municipal de Arequipa, to the reverse of folio 312, and finishing the agreements of February 1600, a paragraph reads: "The eruption of the Ubinas volcano occured on 19 February AD 1600". The date is precise but the name of the volcano is wrong because Huaynaputina was the volcano that erupted.

(28) "El Mapa político y literario", newspaper from Lima, No. 14, July 27, 1843, written by José María Córdova Urrutia, p. 115. P. Cobo, in his book, corroborates that because "we all listened to them".

(29) GONZÁLES FERRAN O.: "Volcanes de Chile", Instituto Geográfico Militar, Santiago de Chile, 1995, p. 95.

(30) BARRIGA V.M., "Memorias para la Historia de Arequipa", 1951, pp. 48-53.

(31) COBO B., S.J., op. cit., p. 100.

(32) VÁSQUEZ DE ESPINOSA A., op. cit., p. 470. The author wrote down what Pedro de Vivar witnessed.

(33) BARRIGA V.M., "Memorias para la Historia de Arequipa", 1951, pp. 48-49.

(34) VÁSQUEZ DE ESPINOSA A., op. cit., p. 473.

(35) Ibidem, p. 474.

(36) BARRIGA V.M., "Memorias para la Historia de Arequipa", 1951, pp. 126-142.

(37) TRAVADA Y CÓRDOVA V., op. cit., p. 19.

(38) The present Egloga was published by Ruben Vargas Ugarte in "Manuscritos Peruanos", t.1, Lima, 1935, p. 83. V. M. Barriga published it also in "Terremotos en Arequipa 1582-1868", Edición La Colmena, Arequipa, 1951, pp. 234-236.

(39) The versión of this legend was first published by R. Navarro O. in the Revista Horizonte No.3, June, 1982, edited by the "Centro de estudios históricos Juan Pablo Vizcardo y Guzmán" of the Programa Académico de Historia at the Universidad Nacional San Agustín, Arequipa.

(40) For example see "Historia General de Arequipa" by V. Travada y Córdova. Also, read "Diario del viaje a Moquegua y Tacna, por el Dr. Pedro J. Chávez de la Rosa, obispo de Arequipa", in 1879, published in "El Deber", October 14, 1937.

(41) DÁVILA J & THOURET J-C. (1999).- Volcán Huaynaputina (Sur del Perú): Erupción pliniana e ignimbrítica de gran magnitud en 1600 D.C., Volumen Jubilar N° 5 "75 Aniversario Soiciedad Geológica del Perú" Lima, 141-166.

(42) TRAVADA Y CÓRDOVA V., op. cit., p. 24. The author does not specify which villages of the municipality of Omate.

(43) BARRIGA V.M., Memorias para la Historia de Arequipa, 1951, p. 51.

(44) BARRIGA V. M., "Terremotos en Arequipa 1582-1868, 1952, p. 184. The Sieberg's report is included in Barriga's book.

(45) Archivo Municipal de Arequipa, "Libros de los acuerdos del Cabildo", Octavo Libro from 1593 to 1602, fol. 323, Meeting of May 30, 1600.
(46) RAIMONDI A. "Notas de viaje" for his book "El Peru", 4th volume, Imprenta Torres Aguirre S.A., Lima, 1948, pp. 218-220.
(47) Archivo Municipal de Arequipa, Decimo libro de los acuerdos del Cabildo, fol. 81 (1593-1602).
(48) Archivo Departamental de Moquegua, Libro de 1600, written by the notary Diego Dávila, fol. 440 (sale letter given to Capitán Lope de Aguero, signed in Moquegua on September 3, 1600).
(49) DE LEÓN Y MENDOZA L. made useless efforts to occupy and clean the town of Omate because the survivors preferred to move toward the site occupied at present by the town of Omate, previously called "Amsi" (which means village).
(50) "Diario de viaje...", "El Deber", 14 August 1937. The bishop passed the site on June 23, 1789.
(51) GONZÁLES FERRÁN wrote in 1990 that 1200 persons died in Omate (Huaynaputina volcano: the biggest historical dacitic eruption in the Central Andes of South America, on February 19, 1600. IAVCEI Volcanological Congress, Mainz (FRG), 3-8 September 1990, Abstract p. 40). This is wrong because only 478 Indians were counted during the 1578 census. These 478 individuals were distributed in 11 villages or hamlets.
(52) Archivo General de la Nación. Letter from the Virrey Manuel Amat who ordered that Indians from the Omate district be reevaluated for taxes, March 25, 1767. Derecho Indigena, Leg. XIV, cuaderno 326.
(53) According to the investigations of T. Bouysse-Cassagne (1988, Lluvias y cenizas. Dos Pachacuti en la Historia. Imp. Alcegraf, La Paz, p. 153) regarding the General Archive of Indias-Sevilla-España-Justicia 448, all these villages are listed as inhabited in the year 1578 (with the number of their inhabitants) and belong to the Omate district.
(54) Archivo Subregional de Moquegua: Libro notarial 1602-1604, fol. 84v., belonging to the Notary Diego Dávila. Power letter of P. Cristóval de Aranda to the Cap. Cristoval Jayme, Moquegua, July 17, 1601.
(55) VÁSQUEZ DE ESPINOSA A., op. cit., p. 474.
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(57) RAIMONDI A., op. cit., p. 231.
(58) VÁSQUEZ DE ESPINOSA A., op. cit. p. 468.
(59) BARRIGA V. M., "Terremotos en Arequipa 1582-1868", 1952, p. 236.
(60) COBO BERNABÉ S.J., op. cit., p. 101.
(61) VASQUEZ DE ESPINOSA A., op. cit. p. 474.
(62) Archivo Municipal de Arequipa, Libro Octavo, fol. 326 (reverse).
(63) Archivo Municipal de Arequipa, Libro Octavo, fol. 347 (reverse).
(64) Archivo SubRegional de Moquegua, Diego Dávila, Protocole of 1619, Fol. 584v.
(65) JIMÉNEZ DE LA ESPADA M. "Descripción de la Villa Potosí y de las Minas, año 1603" in: "Relaciones geográficas Indias-Perú", T. CLXXXIII. Spanish authors Library, Madrid, 1965, p. 380. Laura Escolari caught valious information to write her book "Production and Commerce in the South Andean Space, S. XVIII", where she shows a list and the price of goods consumed in Potosi in 1603. It is important to set a comparative table with the consumption and costs before 1600, and check how much the Arequipa and Moquegua commerce (wine, raisins, figs, vinager, oil, etc) was affected by the eruption of Huaynaputina.
(66) MARTINEZ ARZANZ Y VELA N.: "Historia de la ciudad imperial de Potosí", Imprentas Unidas S.A., La Paz, 1975, pp. 42-43. This history was written in 1705.
(67) BALLENTINE COFF G:, "Potosí and Huancavelica, base económica 1545-1640", Imprentas Unidas S.A., La Paz, 1977, p. 152.
(68) TRAVADA Y CÓRDOVA V., op.cit. p. 39
(69) BARRIGA V.M., "Memorias para la Historia de Arequipa", T.II, 1951, p. 252.

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NUEVOS SOCIOS HONORARIOS

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La Sociedad Geológica del Perú se complace en presentar, a continuación, las reseñas biográficas de los cuatro nuevos Socios Honorarios, elegidos en el año 2000.

James Birbeck, Jaime Fernández Concha, Rosalvina Rivera, Blanca Huaco y Alberto Benavides de la Quintana, durante la ceremonia realizada en el Auditorio SGP