

WORLD DATA CENTER A
for
Solid Earth Geophysics



CATALOG OF SUBMARINE VOLCANOES AND HYDROLOGICAL PHENOMENA

ASSOCIATED WITH VOLCANIC EVENTS

JANUARY 1, 1900 TO DECEMBER 31, 1959

October 1986

NATIONAL GEOPHYSICAL DATA CENTER



COVER PHOTOGRAPHS

Left: Nuee' ardente flow on Mt. Lamington, Papua Island, 1951.

Center: Lava fountain, Kilauea Iki, Hawaii, 1960.

Right: Eruption cloud, Mt. Ngauruhoe, New Zealand, May 1972.

(all photographs, University of Colorado)

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REPORT SE-42

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ASSOCIATED WITH VOLCANIC EVENTS JANUARY 1, 1900 TO DECEMBER 31, 1959

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DESCRIPTION OF WORLD DATA CENTERS

World Data Centers conduct international exchange of geophysical observations in accordance with the principles set forth by the International Council of Scientific Unions (ICSU). They were established in 1957 by the International Geophysical Year Committee (CSAGI) as part of the fundamental international planning for the IGY program to collect data from the numerous and widespread IGY observational programs and to make such data readily accessible to interested scientists and scholars for an indefinite period of time. WDC-A was established in the U.S.A.; WDC-B in the U.S.S.R.; and WDC-C in Western Europe, Australia, and Japan. This new system for exchanging geophysical data was found to be very effective, and the operations of the World Data Centers were extended by ICSU on a continuing basis to other international programs; the WDC's were under the supervision of the Comité International de Géophysique (CIG) for the period 1960 to 1967 and are now supervised by the ICSU Panel on World Data Centres.

The current plans for continued international exchange of geophysical data through the World Data Centers are set forth in the *Fourth Consolidated Guide to International Data Exchange through the World Data Centres*, issued by the ICSU Panel on World Data Centres. These plans are broadly similar to those adopted under ICSU auspices for the IGY and subsequent international programs.

Functions and Responsibilities of WDC's

The World Data Centers collect data and publications for the following disciplines: Meteorology; Oceanography; Rockets and Satellites; Solar-Terrestrial Physics disciplines (Solar and Interplanetary Phenomena, Ionospheric Phenomena, Flare-Associated Events, Geomagnetic Phenomena, Aurora, Cosmic Rays, Airglow); Solid Earth Geophysics disciplines (Seismology, Tsunamis, Gravimetry, Earth Tides, Recent Movements of the Earth's Crust, Rotation of the Earth, Magnetic Measurements, Paleomagnetism and Archemagnetism, Volcanology, Geothermics), and Marine Geology and Geophysics. In planning for the various scientific programs, decisions on data exchange were made by the scientific community through the international scientific unions and committees. In each discipline, the specialists themselves determined the nature and form of data exchange, based on their needs as research workers. Thus, the type and amount of data in the WDC's differ from discipline to discipline.

The objects of establishing several World Data Centers for collecting observational data were: (1) to insure against loss of data by the catastrophic destruction of a single center, (2) to meet the geographical convenience of, and provide easy communication for workers in different parts of the world. Each WDC is responsible for: (1) endeavoring to collect a complete set of data in the field or discipline for which it is responsible, (2) safe-keeping of the incoming data, (3) correct copying and reproduction of data, maintaining adequate standards of clarity and durability, (4) supplying copies to other WDC's of data not received directly, (5) preparation of catalogs of all data in its charge, and (6) making data in the WDC's available to the scientific community. The WDC's conduct their operation at no expense to ICSU or to the ICSU family of unions and committees.

World Data Center A

World Data Center A, for which the National Academy of Sciences through the Geophysics Research Forum and its Committee on Geophysical Data has overall responsibility, consists of the WDC-A Coordination Office and seven subcenters at scientific institutions in various parts of the United States. The GRF periodically reviews the activities of WDC-A and has conducted several studies on the effectiveness of the WDC system. As a result of these reviews and studies, some of the subcenters of WDC-A have been relocated so that they could more effectively serve the scientific community. The addresses of the WDC-A subcenters and Coordination Office are given inside the front cover.

The data received by WDC-A have been made available to the scientific community in various ways: (1) reports containing data and results of experiments have been compiled, published, and widely distributed; (2) synoptic-type data on cards, microfilm, or tables are available for use at the subcenters and for loan to scientists; (3) copies of data and reports are provided upon request.

PREFACE

This volume is the second part of a comprehensive catalog of hydrological phenomena associated with volcanoes. The first volume (Hedervari 1984) consisted of the submarine eruptions, new volcanic islands, tsunamis, seiches, and base surges related to volcanic activity from antiquity to the end of 1899. The first event discussed was the famous Santorini eruption, which occurred about 1500 B.C., that altered the history of Crete and the surrounding islands and buried by volcanic ash and pumice a really wonderful Minoan settlement on the volcanic island itself. The number of events treated in Hedervari (1984) totaled 302, including questionable and uncertain cases. Here, in the second volume, I discuss phenomena that occurred from January 1, 1900, to December 31, 1959. The same methods are applied.

As in Hedervari (1984), this volume not only treats well-understood events, but also discusses those that are more doubtful. The latter are denoted by a question mark beside the conventional volcanological symbols. In certain cases the author expresses his own view: these should be regarded as personal opinions only; they can be accepted or rejected on the basis of the results of further research.

ACKNOWLEDGMENTS

The author is much indebted to those scholars who kindly helped him in the collection and elaboration of data. He remembers with the greatest esteem the late Mr. Gustav Hantke, who gave him invaluable information on the volcanic events of the Alaska-Aleutian belt, as well as the late Professor Rein W. van Bemmelen and his late wife, Lucy Clara van Bemmelen. Their personal friendship, their true enthusiasm and belief in Science and in Humanity are unforgettable. This second volume is dedicated to the memory of Mr. Hantke and to the van Bemmelens.

The author is particularly grateful to William H. Berninghausen (U.S.A.), John H. Latter (New Zealand), Frederico Machado (Portugal), Maur Neumann van Padang (The Netherlands), George Pararas-Carayannis (U.S.A.), Tom Simkin (U.S.A.), the late Sigurdur Thorarinsson (Iceland), and Daniel Shackelford (U.S.A.).

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During preparation of the text the author has received some materials and photos concerning volcanic eruptions. The author expresses his sincere thanks for them to Yasuhiro Tanaka and Yoshio Katsui (Japan), and P. M. Otway and J. C. Grower (New Zealand).

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Peter Hedervari*

*Deceased 1984

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CATALOG OF SUBMARINE VOLCANOES AND HYDROLOGICAL PHENOMENA
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INTRODUCTION

On the suggestion of M. Neumann van Padang, the International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI) has accepted some symbols for the short description of certain volcanic phenomena. Those symbols are used in this catalog, but it has been necessary to add a few more to them. The symbols used are as follows:

Conventional Symbols

- eruption in the central crater
- eruption in a parasitic crater
- ⊖ eruption in a radial fissure
- = eruption in a regional fissure
- ▲ subglacial eruption
- ↑ normal explosions
- eruptions producing nuees ardentes
- ↘ lava flow
- ∪ eruption in a crater lake
- ∩ eruption in a lava lake
- △ extrusion of a lava dome
- ▲ extrusion of a spine
- ↑ phreatic explosions
- ↘ mud flows
- ⊗ submarine eruption, sublake eruption
- ★ volcanic island
- ∩ tsunami

New Symbols

- ∩ tornadoes, water spouts, high (vertical) water columns
- ∩ seiche
- ∩ base surge
- ↘ submarine lava flow
- ★ submergence or denihilation of a volcanic island (generally used only where exact date is known)

- ? doubtful event
- S supplement to a former item

At the end of this volume (p. 27) the reader will find a "List of Locations" in which all the volcanoes (including the unnamed ones) are listed in alphabetical order according to the name of the volcano or, if unnamed, in terms of the name of the area in which the eruptive center can be found. The event numbers used in this catalog continue those used in Hedervari (1984). Accordingly, the first event discussed is number 303. Names and coordinates generally follow *Volcanoes of the World* by Simkin et al. (1981). These are almost identical to those used in the volumes of *Catalogues of Active Volcanoes of the World Including Solfatara Fields*, published by IAVCEI.

At the time of preparation of the present volume, the volumes for Iceland and for the Aleutian-Alaska belt had not yet been published by IAVCEI. Therefore, the data referring to these regions are taken from those of Berninghausen (1969), Hantke (1979), and Latter (1971), as well as those of Shackelford (1981), respectively.

In the *Catalogues of Active Volcanoes...* and in Simkin et al. (1981), each volcano has a serial number that gives information about the region, about the district within the region, and about the special nature of the volcano in question within the district. In the IAVCEI-Catalogue, volcano Tangkuban Prahū (or Parahu) has the number 6,3-9. In the Simkin volume the same serial number is written 0603-09. The latter form is used in this catalog. Here, 06 refers to Indonesia, 03 means Java, and 09 refers to the volcano itself. For easy identification of the individual volcanoes, the same system has been adopted for the "List of Locations" on p. 27. For Iceland and the Aleutian-Alaska belt, the serial numbers given by Simkin et al. (1981) were used, because those IAVCEI volumes were not available.

D. EVENTS BETWEEN JAN. 1, 1900, and DEC. 31, 1959

303. 1900--Falcon Island, Tonga Islands, SW Pacific

A shoal was seen on the site of the former new volcanic island. The shoal in question was 2.7 m high at its northern end (Richard 1962).

★

304. 1901 December 30--Cook Inlet, Alaska

Doubtful. A volcanic eruption on Cook Inlet was reported by a few authors. The event was allegedly accompanied by an earthquake and a tsunami; the latter

consisted of more than one wave. We have no data or details on the eruption, however. Shishaldin Volcano in the Aleutian Chain showed certain activity in 1901 but no further data are available (Simkin et al. 1981). Redoubt Volcano erupted in 1902 (Gutenberg and Richter 1954) and the same is true for St. Augustine (Cox et al. 1976): "Manuscript notes of Reid's on file with the Coast and Geodetic Survey (now NOAA National Ocean Service), Rockville, Md. (R.E. Eppley, personal communication) have four pertinent entries: 1) a volcanic eruption 30 - 31 December 1901, covering Kenai with ash; 2) a volcanic eruption late in 1901 or early in 1902 accompanied by a severe quake; 3) an eruption and quake as in 2) with 'several tidal waves doing much damage' accompanying the quake; and 4) an eruption not far from Kenai on Cook Inlet, about 70 miles above English Bay, reported in Juneau as occurring about 2 months before 7 March 1902, with strong earthquakes recorded in Baltimore on 30-31 December 1901. Redoubt Volcano, across Cook Inlet from Kenai (and about 70 miles from English Bay) was in eruption on 18 January 1902 (Coats 1950). However, Redoubt is about 20 miles from the Cook Inlet coast. Augustine Volcano, on Augustine Island near the mouth of Cook Inlet, which was the source of the 1883 tsunami (see item No. 220, Hedervari 1984) was also in eruption in 1902. The date of the 1901-1902 tsunami seems to be in doubt, and it seems possible even that the tsunami report is erroneous and resulted from confusion with the 1883 event" (p. 14).

○ ? ≡ ?

305. 1901--Karua, New Hebrides Islands, SW Pacific

A new island emerged from the sea at the end of a long cycle of activity that began as early as 1897. See also item No. 257, Hedervari (1984). The island had a length of 1 km and a height of 15 m. After half a year it gradually disappeared (Fisher 1957).

∧ ★★∇

306. 1902 May 5--Mont Pelee, West Indies

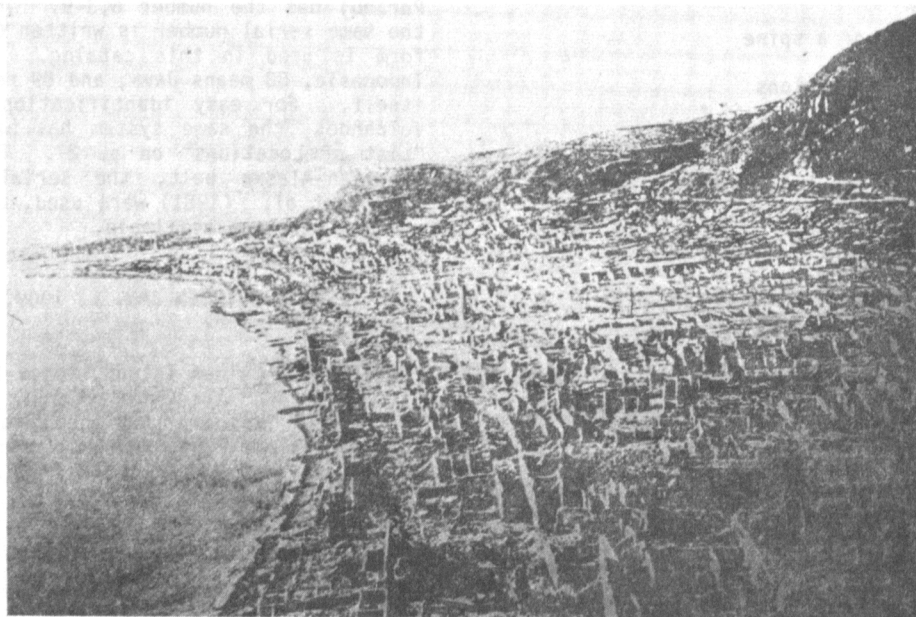
The lahar that crashed down along the valley of River Blanche on the island of Martinique created a small tsunami in the sea. One yacht sank and a mill was destroyed. The number of dead was estimated at 30 to 150 (Bullard 1968).

○ a ↑ ≡ ≡

307. 1902 May 7 - May 8--Unnamed submarine volcano, San Jorge region

The coordinates of the submarine eruption point, according to the Catalogue of Active Volcanoes..., are 38° 30' N, 27° 25' W. The eruption was not observed directly, as the vent opened at a point deeply situated on the ocean floor; the activity is known because a submarine telegraphic cable was burned at this time. Volcanic ash and cinder were found on the ridge after the outbreak. The same place showed signs of activity as early as 1800 (see item No. 82, Hedervari 1984). It is probably a fissure-volcano (Neumann van Padang 1967). Note that this submarine eruption in 1902 took place just simultaneously with the Mount Pelee eruption. It is, however, only accidental; no geological or geophysical correlation can be supposed between the Azores and the Lesser Antilles. One is unlikely not only because of the very great distance between the submarine eruptive center in question and Mont Pelee, but, in addition, because of the structural (tectonic) difference of the two localities and their environs. The submarine volcano belongs to the mid-Atlantic Rift System, a belt of creation of new oceanic lithosphere, while Mont Pelee belongs to a typical island arc, the zone of subduction of old lithosphere. The simultaneous activity of these volcanoes is, at any rate, very interesting and remarkable.

= ∟



Town of St. Pierre, Island of Martinique, West Indies, destroyed by eruption of Mt. Pelee on May 8, 1902. See Event No. 308. (From Howell Williams).

308. 1902 May 8--Mont Pelee, West Indies

The glowing avalanche that destroyed the town of St. Pierre and killed more than 30,000 people, initiated a tsunami in the sea which was strong enough to produce extensive damage as far as Fort de France at a distance of about 19 km off St. Pierre (Bullard 1968).

○ △ ↑ → ≃ △

309. 1902 May 9--Hodder's Volcano, West Indies

According to Simkin et al. (1981), no volcano is to be found here and the observed phenomena (see below) were not of volcanic origin. Therefore we regard the event as very doubtful. In the Catalogue of Active Volcanoes (Robson and Tomblin 1966) the following events are described:

The white patches on the sea were seen from 0830 to 1330 local time at about 14° 02' N, 61° 04' W. After 1330 they disappeared completely. They were irregular in shape, but approximately oval. The larger one was 137 x 91 m in extent, while the smaller spot measured 91 x 55 m. They appeared about 0.8 km apart. They gave the appearance of bubblings. Note that these white patches appeared just halfway between Mont Pelee of Martinique and Soufriere of St. Vincent. Mont Pelee had its paroxysmal outburst of a very similar character on the same day.

The physical correlation between these two great eruptions appears to be almost certain, but as regards Hodder's "volcano", there is no proof of its physical existence.

π ? ?

310. 1902 August 7 - August 24--Tori-sima, Izu Islands, Japan

Simultaneously with the subaerial eruption, a submarine outbreak also took place 1.5 km southwest of the island (Kuno 1962).

○ ↑ π

311. 1902--Ometepe, Nicaragua

An eruption took place within Lake Nicaragua, on the island of Ometepe (Mooser et al. 1958). Whether there was any sublake component of this outbreak or not, is not known exactly; the event, therefore, is doubtful.

☪ ?

312. 1903 October 5 (or October 6 or 8?)--Hawaii

The unusual disturbance, observed in the ocean, might have been a submarine eruption, but was not a tsunami (Pararas-Carayannis and Calebaugh 1977). Note that an eruption of Mauna Loa volcano commenced from the summit on 1903 October 6 (MacDonald 1955). No

(tectonic) earthquakes were observed on those days (Furumoto et al. 1973).

π ? ≃ ? ○ ≃

313. 1904 April 17 - April 18--Banua Wuhu, Sangihe Islands, Indonesia

Submarine eruption (Neumann van Padang 1951), temporary island (van Bemmelen 1970). Van Bemmelen gives the following date for the activity: 1904 April 16 - August 27. The eruption on August 27 is treated by the Catalogue of Active Volcanoes as an independent event (Neumann van Padang 1951).

○ ↑ π ★

314. 1904 May 14 - May 15--Kiwu Lake, Central African Volcanic Region

Not mentioned by the Catalogue of Active Volcanoes and similarly absent from Simkin et al. (1981). Sublake eruption at 1° 40' S, 9° 08' E, in the north-western part of the lake. Strong subterranean noise accompanied the event (Sapper 1927). Doubtful.

☪ ?

315. 1904 August 27--Banua Wuhu, Sangihe Islands, Indonesia

The submarine volcano erupted (Neumann van Padang 1951; see item No. 313 as well).

○ ↑ π

316. 1904 November 14 - 1905 June--Sin-Iwo-zima, Bonin Islands, Japan

On November 14 sounds like cannon firing were heard. On the 28th the amount of smoke increased and on December 5 a small island came into being. The outbreak continued, and in 1905 January a pumice- and obsidian-fragment cone was built up. On 1905 February 1 the circumference of the island was 5 km; it reached the height of 150 m. It soon declined, however. In 1905 June its circumference was only 150 m and still later it disappeared due to collapse around the crater on the cone, and to wave erosion (Kuno 1962).

π ★ ★ ↘

317. 1904 December - 1905 January--Nushima, Ryukyu Islands

Not mentioned by Simkin et al. (1981). According to Neumann van Padang (1938), a submarine eruption led

to the formation of a temporary island that was destroyed soon after. No exact location is given.

π ★ ★ ↗

318. 1904--Fukutoku-Okanoba, Bonin Islands, Japan

According to SEAN (1980), a submarine eruption led to the formation of a new island.

π ★

319. 1905 August 4 - 1911 November--Matavanu, Samoa, SW Pacific

Great eruption on 1905 August 4, followed by an unusually long period of activity. The outburst was accompanied by a lava flow of some 1 km³. Small tsunamis were caused by material avalanching into the ocean. Several tsunamis were observed when the crater was more than usually active (Richard 1962).

○ ↑ ○ ⇒ ↘

320. 1905--Bogoslof, Aleutian Islands

Bogoslof was active during this year (Latter 1979).

π or ○ ↑

321. 1906 February--Bogoslof, Aleutian Islands

Birth of Metcalf Cone (the month is not quite certain, but probably in or around February). Half of it was blown away by an explosion before McCulloch dome arose in 1907 (Bullard 1968). The Metcalf Cone or Perry Island emerged from the sea midway between Castle Rock and Fire Island (Latter 1979).

π ↑ △ ★

322. 1906 April 7 - April 14--Bayonnaise Rocks, Izu Islands, Japan

In the Myojin Sho area, at a point 9 to 15 km southeast of the Rocks, an eruption took place that ejected much pumice (Kuno 1962).

π

323. 1906 August--Perry Island, Aleutian Islands

At 54° N, 168° W, a new island originated by submarine eruption. It is interesting to note that this event is not mentioned in the different volcanological catalogs; it was, however, observed by the staff

of an American vessel, Albatross. We accept the event as valid (Supan 1910).

π ★

324. 1906 October 4--Fiji Islands

A submarine outburst is mentioned by Sapper (1927). As no further data are available and the event is not mentioned elsewhere, the case is regarded as doubtful.

π ?

325. 1907 January - September--Bogoslof, Aleutian Islands

Birth of McCulloch Peak--a volcanic dome (Sapper 1927). Early in 1907 a violent eruption took place, and the south part of Metcalf Cone was destroyed (Latter 1979).

π ↑ △ ★ ★ ↗

326. 1907 April 1--Nameless submarine volcano at Monaco Bank, Azores

The outbreak was detected only as a result of the rupture of a telegraph cable. Hence, the eruption is regarded as somewhat doubtful (Neumann van Padang et al. 1967).

= ? π ?

327. 1907 July--Unnamed volcano, Tonga Islands, SW Pacific

Submarine activity, no details (Richard 1962). Doubtful.

π ?

328. 1907 September 1--Bogoslof, Aleutian Islands

Dense black cloud rose from Bogoslof, ash fell at Unalaska, rumblings, explosion of McCulloch Peak (Jaggard, see: Bullard 1968). This peak was wrecked by these explosions (Bullard 1968). McCulloch Peak was destroyed by the violent eruption (Latter 1979).

π ↑ ★ ↗

329. 1907 - 1908--Bogoslof, Aleutian Islands

During the winter of 1907/1908, explosions occurred at Bogoslof (Bullard 1968).

π ↑

330. 1908 February 6--Dempo, Sumatra

π ?

A tsunami occurred, caused by an earthquake at 5° S, 100° E (Berninghausen 1966), observed at Sikakap, Pageh Isles (Visser 1922). The current name is Kepulauan Mentawai, Mentawai Island Group. Explosive outbreak of Dempo (mudflow and ash; Sapper 1927) on February 16 and 17 (Neumann van Padang 1951), after a 3-year interval of quiescence. May it be that the eruption was triggered by the shock that caused, at the same time, the tsunami as well? Note that Dempo is located near the earthquake epicenter, namely at 4.03° S, 103.13° E. In this case we have an indirect correlation between the quake and the eruption.

≈ ○ ↑ ~ ?

331. 1908 June - 1910 September--Bogoslof, Aleutian Islands

Eruptions in the Bogoslof Group led to the formation of two (later coalesced) small lava-islands with a maximum height of 53 m. This is known by the name Tahoma (Neumann van Padang 1938). Origin: Oct. 1, 1909.

π ★

332. 1908 July--Bogoslof, Aleutian Islands

The remains of Metcalf Cone (of Bogoslof) subsided (Jaggar; see Bullard 1968).

★ ↓

333. 1910 January 25--Poas, Costa Rica

A very strange volcano-hydrological event occurred on this day. A phreatic eruption took place and it produced a probably unique phenomenon: it sent a geyser of water upward more than 4000 m into the air (Mooser et al. 1958).

↑ ↑ ∩

334. 1910 September 18 - 19--Bogoslof, Aleutian Islands

Violent eruption of Bogoslof, strong explosions, and a new crater formed at the summit of Tahoma Peak (Latter 1979, Bullard 1968).

π ↑

335. 1910--Canal d' Orleans area near Antarctica

Between Trinity Island and Palmerland, in Canal d' Orleans, allegedly a submarine outbreak took place (Sapper 1927). Doubtful.

★ ↓

336. 1911 January 27 - February 8--Taal, Philippine Islands

Phreatic eruptions and normal explosions, devastation of arable land. According to Neumann van Padang (1953), a tsunami took place; Berninghausen (1969), however, is of the opinion that it was a seiche. A seiche is accepted here, as seiches are frequent phenomena in Taal's crater lake.

○ ↑ ↑ ~

337. 1911 March 7--Monaco Bank, Azores

A submarine eruption occurred. It consisted of a phreatic (?) explosion with a few water jets (Neumann van Padang et al. 1967).

= π ↑ ? ∩

338. 1911 August--Unnamed volcano, Tonga Islands, SW Pacific

Submarine eruption, no further data exist (Richard 1962, Sapper 1927). According to Simkin et al. (1981) the area is non-volcanic. Therefore, we regard the event to be doubtful.

π ?

339. 1911 September 30--Pinne Marine Bank, Sicily Sea

Emission of gases and submarine activity was accompanied by earth shocks, probably of volcanic origin (Imbo 1965).

π

340. 1912 April 29--Unnamed Volcano, Tonga Islands, SW Pacific

This is a reef on which the seawater breaks. On the day mentioned, steam and smoke was seen (Richard 1962).

π ↑

341. 1913--Falcon Island, Tonga Islands, SW Pacific

The island--as a matter of fact a shoal, see item No. 303--has disappeared (Richard 1962).

342. 1914 January 12 - April--Sakura-zima, Kyushu, Japan

π ↑

Great explosive eruption from a lateral crater, accompanied by lava flow. The volcano originally was an island in the northern part of Kagoshima Bay, but it has been connected with the mainland by a narrow isthmus formed by the 1914 lava (Kuno 1962). The eruption caused a tsunami, however probably indirectly, because a (volcanic) shock with a magnitude of 6.1 on the Richter scale (Usami 1966) took place, and this shock was followed by the seismic sea wave having a tsunami magnitude of -1 (Iida et al. 1972).

∞ ↑ ⇒ ㄉ ⇒

343. 1914 January 23 - February 12--Sin-Iwo-zima, Bonin Islands, Japan

The volcano is identical with Fukutoku-oka-noba. For the eruption Neumann van Padang (1938) gave the date January 13, only one day after the great eruption of Sakura-zima, see item No. 342. New submarine eruption on the site of the former one (see item No. 316). Smoke rose up to 3 km above the sea, explosions occurred 26 times during 1 hour. A new island emerged during January. It was formed from pumice and obsidian fragments. It had a summit crater 250 m across. On February 12 the island was 0.7--1 km across, 3.5 km in circumference, and had a height of 120 m. The island disappeared in 1916 (Kuno 1962).

π ↑ ★

344. 1915 February--Bayonnaise Rocks, Izu Islands, Japan

Submarine activity occurred in the Myojin Sho area, at a point 11 km east of the Rocks (Kuno 1962).

π

345. 1915 April--Bayonnaise Rocks, Izu Islands, Japan

Another submarine outbreak on the place mentioned in item No. 344 (Kuno 1962).

π

346. 1915 June--Bayonnaise Rocks, Izu Islands, Japan

Submarine explosions took place at points 19 km northeast and 4 km southwest of the Rocks (Kuno 1962).

π ↑

347. 1915 July--Bayonnaise Rocks, Izu Islands, Japan

Submarine explosions occurred at points 19 km northeast and 4 km southwest of Bayonnaise Rocks, in the same places mentioned under No. 346. (Kuno 1962).

348. 1916 April 18--Unnamed Volcano North of Taiwan

A submarine eruption occurred near P'eng-Chia-Yu (Peng-Chia-Hsu). Steam eruption took place over an area of about 30 square meters. The activity stopped within 10 minutes (MacDonald 1972, Kuno 1962).

π

349. 1916 June 21--Smith Rocks, Izu Islands, Japan

Eruption below sea surface at a point just to the west of the Smith Rocks (Kuno 1962).

π

350. 1916--Sin-Iwo-zima, Bonin Islands, Japan

Disappearance of the new island that was formed in early 1914; see item No. 343 (Kuno 1962).

★ ↓

351. 1918 July 18 - 1919 May--Banua Wuhu, Sangihe Islands

A temporary island is mentioned by van Bemmelen (1970). The coordinates of this feature -- also according to van Bemmelen -- are 3° 8' 16" N, 125° 29' 26" E; and an earthquake of M = 8.25 was reported by Gutenberg and Richter (1954) from 5.5° N, 123° E, that occurred on 1918 August 15. It was accompanied by a tsunami (Iida et al. 1972) having a tsunami-magnitude of about 2.5 and a maximum height of 7 m at the coast of Mindanao. The sea wave was observed at Glan Lebak (2 m), at Kii Kushimoto (0.2 m) and at Honolulu (smaller than 0.1 m). Many people lost their lives as a consequence of this tsunami. It is not impossible that this shock might have been associated with the eruption mentioned above. The new island reached a length of 70 m and a height of 12 m. It disappeared in 1935 (Neumann van Padang 1951).

π ★ ⇒ ?

352. 1918 September 8--Simusiri (Kurile Islands)

A very doubtful event. Sapper (1927) has mentioned that the great tsunami that occurred on this day might have been connected with a submarine eruption, but other catalogs (Gorshkov 1958, Simkin et al. 1981) do not mention any eruption for this day and place. It is not clear, furthermore, which volcano was involved. Is Simusiri identical with Simusiru Fudzi (0900-19) or Goriaschaia Sopka (0900-17B)? The tsunami was the direct consequence of a great (M = 8.25) tectonic earthquake that occurred at 45.5° N, 151.5° E at a shallow depth. The tsunami reached a

maximum height of 12 m. Its magnitude was 3.6 (Iida et al. 1972).

π ? ? ≃

353. 1919 April 2--Kelut, Java

On this day an earthquake shook western Java and southern Sumatra and a tsunami was observed along the coast of southern Sumatra. This sea wave was not mentioned by Iida et al. (1972) however. Volcano Kelut erupted on May 20. Was it triggered by the quake? If so, the eruption was indirectly related to the tsunami. The physical connection between these events is, however, uncertain. No data is available about the magnitude of the shock (Visser 1922). According to Sapper (1927), the eruption caused a flood that killed 5,110 people. The water came from the Kelut's crater lake, and its volume was estimated as 3.5 million cubic meters. The eruption began after dark.

Volcano Kelut is well known by its crater-lake eruptions. As these are also volcano-hydrologic phenomena, here is a list of the known cases up to about 1950 (Neumann van Padang 1951).

Dates of crater-lake eruptions and floods

1000; 1311; 1334; 1376; 1385; 1395; 1411; 1451; 1462; 1481; 1548; 1586; 1641; 1716 July 20; 1752 May 1; 1771 January 10; 1776; 1785; 1811 June 5; 1825; 1826 October 11-14, 18 and 25; 1835; 1848 May 16; 1851 January 24; 1864 January 3-4; 1901 May 22-23; 1919 May 20; 1920 December 6-12.

For the April 2 event: ≃

For the May 20 event: ☉ ↑ ~ ☒ †

(meaning of the last two symbols: Devastation of arable lands, and casualties).

354. 1919 May 22--Stromboli, Italy

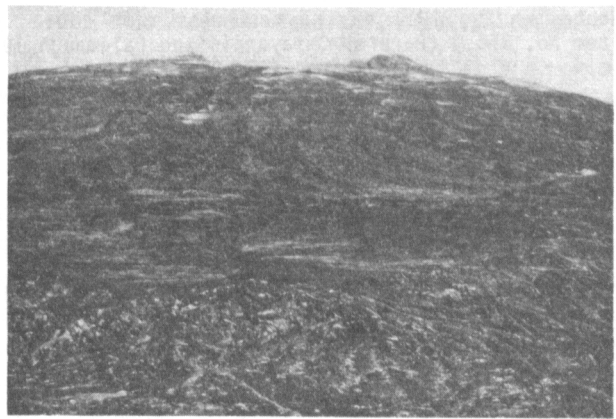
This was a very severe eruption that was followed by a tsunami (Imbo 1965, Perret 1950).

○ ↑ ≃

355. 1919 September 29--Mauna Loa, Hawaii

Eruption from the southwest rift zone, with submarine lava flow of some 153 million cubic meters (MacDonald 1955).

○ ↗



Mauna Loa, Hawaii. Collapsed lava tube in flow (1933). Looking SW to historic fissure flow from NE rift zone. See Event 355. (From Univ. of Colorado).



Mauna Loa, Hawaii. Note Lava trees. Pahoehoe flow looking W. See Event 355. (From Univ. of Colorado).



Mauna Loa, Hawaii. Shield volcano emitting fumes. See Event 355. (From University of Colorado).

356. 1919 October 2--Mauna Loa, Hawaii

Small tsunami on the Kona coast--probably associated with the outbreak on Mauna Loa that began on

September 29, 1919 at the southwest rift zone. See item No. 355. (Pararas-Carayannis and Calebaugh 1977).

○ ↗ ↘

357. 1920 January 22--Unnamed Volcano, New Hebrides Islands, SW Pacific

Submarine outburst east of Epi Island, no details (Fisher 1957).

π ★ ?

358. 1920--Nyamuragira, Africa

Probable eruption in Lake Kivu (Richard and Neumann van Padang 1957).

☐ ?

359. 1921 November--Falcon Island, Tonga Islands, SW Pacific

The island has reappeared in the form of a rock, 13.7 m across (Richard 1962).

π ↑ ★

360. 1922--Unnamed Volcano, Sangihe Islands, Indonesia

Allegedly an eruption took place during the first half of the year. Simkin et al. (1981) dated the eruption February 1 plus or minus 30 days, and for the location they gave the following coordinates: 03.97° N, 124.17° E. Van Bemmelen (1970) mentioned 3° 58' N, 124° 12' E, while MacDonald (1972) gave 3° 58' N, 128° 10' E. The outbreak of this volcano and even the existence of it is strongly questioned (see item No. 245 in Hedervari 1964).

π ? ?

361. 1922--Bogoslof, Aleutian Islands

By this time the Metcalf Cone and Tahoma Peak of Bogoslof were removed by explosions, collapse, and erosion (Latter 1979).

↑ ★ ↘

362. 1923 March 2 - May 13--Cendres (or Ile des Cendres), SE Asia

Three submarine eruption points are known; two islands and a submarine cone emerged. The first was a 34-m high and 457-m long crescent-like island, seen at first on March 15 and gone since 1927 July. The

second was a parasitic cone. It appeared on 1923 May 8. It had a length of 30 m and a height of only 0.3 m above the mean level of the ocean. The submarine cone probably came into being in the same year. Its top was 19 m below sea level (Neumann van Padang 1953).

π ★ ○ ?

363. 1923 July 1--Unnamed Volcano, Tonga Islands, SW Pacific

A submarine eruption is noted; no further data (Richard 1962).

π

364. 1924 February 15--Unnamed Volcano, Kurile Islands

A submarine eruption is indicated by Gorshkov (1958). He gave the following coordinates for the event: 48° 05' N, 153° 20' E. Sapper (1927) has mentioned a submarine outbreak on February 9 at 48° 20' N, 155° E. The identity is, however, not certain.

π

365. 1924 May 10--Kilauea, Hawaii

Start of Kilauea outbreak in the caldera, followed by collapse in the same month. Phreatic explosions, preceded by rapid sinking of magma column, accompanied by shocks (probably of volcanic origin) and faultings in the east rift zone. Possibly there was a submarine eruption east of the island (MacDonald 1955). Base surge. Tsunami on May 30 -- somewhat doubtful, it might have been perhaps a storm-surge or a tsunami due to local landslide (Pararas-Carayannis and Calebaugh 1977).

Note: It can be supposed that the disappearance of the lava-lake from the Halemaumau crater within Kilauea's caldera -- that also happened in 1924 -- was related to the phreatic eruption.

○ ↑ =! π ? ☐ ?

366. 1925 August 11 - 1926 January 14--Santorini, Aegean Sea

Explosions in the channel between Mikra Kameni, Nea Kameni, and Georgios Islands within the caldera. Submarine effusion of lava formed a small dome that rose above the water and united Mikra Kameni with Nea Kameni on the next day (Georgalas 1962). See items 367 and 370.

Note: This eruption of Santorini, like almost all other known outbreaks of this volcano, has been associated with earthquakes of tectonic origin. For details see Komlos, Hedervari, and Meszaros (1978), as well as Hedervari (1979).

↑ π ↗ △ ★

367. 1925 September 11 - September 24--Santorini, Aegean Sea

The eruption center and the dome that united Mikro and Nea Kameni Islands in the caldera shifted 140 m to the southwest from the initial point. Three lava flows were observed. During the entire activity a 96.2-m high rampart was formed around the Dafni dome. The third flow covered an area of some 25,000 m². (Georgalas 1962).

π ↗ △ ★

368. 1925 September 24--Nieuwerkerk, Banda Sea

A submarine eruption? See item No. 245 in Heder-vari (1984). See also Neumann van Padang (1951).

π ?

369. 1925 October 31--Iriomote-jima, Ryukyu Islands

Submarine activity: water domes were formed and lapilli were ejected. On the next day a field of pumice, 5.6 km long and 0.9 km wide, was seen (Kuno 1962).

π ∩

370. 1926 January 14--Santorini, Aegean Sea

At the end of the activity within the caldera the new dome had a height of 89 m, the total area covered with the new (so-called) Dafni lava was 980,000 m², and its volume reached 108,239,800 m³. (Georgalas 1962).

π ↗ △ ★

371. 1926 April 10--Mauna Loa, Hawaii

Eruption from the southwest rift belt with a submarine lava flow of about 1.2 million m³ (MacDonald 1955).

○ ↗

372. 1926 June--Eldey, Iceland

Submarine eruption northeast of Eldey. The sea was first bubbling and later spouting; finally, dead fishes floated up (Thorarinsson 1965). An ephemeral island came into being (MacDonald 1972).

π ★

373. 1926 July 17--Bogoslof, Aleutian Islands

Submarine eruptions accompanied by explosions. Lava at Bogoslof (Latter 1979). New dome (Bullard 1968).

π ↗ △ ★

374. 1926 August 12--Bogoslof, Aleutian Islands

Violent explosive outbreak at Bogoslof; ash cloud 7 km high (Latter 1979).

π ↑

375. 1926--Bogoslof, Aleutian Islands

From January until December 1927 at Bogoslof, a lava dome joined the Fire Island and Castle Rock; fumarolic activity was observed with some explosions, and pumice was seen (Latter 1979).

π ↑ △ ★

376. 1926--Askja, Iceland

A small volcanic island formed in lake Oskjavatn from 26 km long fissure (Berninghausen 1964).

= ★

377. 1927 February or March--Emperor of China, Banda Sea

Allegedly a submarine eruption took place. See item No. 245 in WDC-A Report SE-36. (Neumann van Padang 1951).

π ?

378. 1927 February or March--Nieuwerkerk, Banda Sea

Allegedly a submarine eruption took place (Neumann van Padang 1951). See item No. 245 in the first volume, WDC-A Report SE-36.

π ?

379. 1927 July 6--Bogoslof, Aleutian Islands

The new cumulo-dome was surrounded by an extensive warm lagoon, which was enclosed by a complete ring of boulder banks and sands 3 m above the level of the sea. The surviving remnants of Castle Rock and Grewing were connected by this means (Cotton 1969). An eruption was noted (Davis and Echols 1962).

π

380. 1927 July--Anak Krakatau, Indonesia

Start of the first period of activity -- the first signs of a new period of volcanic manifestations after the great eruption of 1883 -- gas bubbles appeared within the caldera of Krakatau (Neumann van Padang 1951).

Note: For the further development of Anak Krakatau see the later events as well. Neumann van Padang (1983) has recently summarized the most important stages as follows:

"The activity of Anak Krakatau...began on 29 December 1927 with submarine eruptions from a spot in the caldera sea near the steep northeastern submarine ridge in the basin. The eruption products built up a cone which rose above the sea level on 26 January 1928 as a long elongated island. ...Surf eroded this island and in February it already had disappeared.

"The eruption continued, and on 28 January 1929 a new crater rim appeared, Anak Krakatau II, which lasted until July the 3rd. Stehn made a special study of the ebullitions: the upwellings of the sea, the water cones and the water fountains that accompanied the eruptions. In the Bulletins of the Netherlands Indies Volcanological Survey of the years 1929 through 1940 the activity and the origin of Anak Krakatau III and IV since 12 August 1930 were described. A violent eruption of Anak Krakatau was observed in May 1933 by Stehn. The eruption clouds, reaching a height of 4000 m and even more, were accompanied by rumblings and electric discharges." (p. 26)

$\pi = \star \star \uparrow$

381. 1927 July - 1930 August 15--Anak Krakatau, Indonesia

First period of activity. (For details see the different phases, discussed in later items.) In 1927 and 1928 base surges were observed (Moore 1967).

$\pi \uparrow \star = \uparrow$

382. 1927 August 7--Paluweh, Lesser Sunda Islands

Heck (1947) mentioned an eruption on 1927 August 7. Berninghausen (1969) gave August 4, the same year. Iida et al. (1972) noted an eruption of Rokatinda (synonym of Paluweh) again for 1927 August 7. All these items are erroneous since no eruption on 1927 August 4 or 7 is mentioned in the Catalog of Active Volcanoes (Neumann van Padang 1951) and in Volcanoes of the World (Simkin et al. 1981). The real date is 1928 August 4; see item 390.

?

383. 1927 October 4--Falcon Island, Tonga Islands, SW Pacific

Submarine eruption, forming a new island, having a diameter of 1581 m in the north-south, and 1308 m in the east-west, direction (Richard 1962).

$\circ \uparrow \pi$

384. 1927 December 29 - 1928 February 5--Anak Krakatau, Indonesia

First phase of the first period. Smoke was seen since December 29. On January 3 six submarine vents appeared, but only one remained active on January 4. From January 26 until February 4 the crater rim emerged above the sea (height 3 m, length 175 m), but this land, Anak Krakatau I, was soon destroyed. Tremors and explosions became much stronger after January 7. On January 21 the rim emerged once again for one day. On January 28 a great amount of matter was ejected. The final result was an island, Anak Krakatau II (height 38 m, length 250 m). On February 3 and 4, 11,791 explosions were counted within 24 hours! (Neumann van Padang 1951).

$\pi \uparrow \star = \star \uparrow$

385. 1928 January 23 - March 17--Santorini, Aegean Sea

A new eruption center came into being within the caldera, 300 m south-southeast of the Dafni dome. A new dome, called Naftilos, originated due to lava effusions, having a maximum height of 15.6 m and a total volume of about 40,000 m³ (Georgalas 1962).

$\pi \uparrow \circ \star$

386. 1928 March 25 - June 2--Anak Krakatau, Indonesia

Second phase of first period. The explosive activity continued; no further details are available (Neumann van Padang 1951).

$\pi \uparrow =$

387. 1928 May--Falcon Island, Tonga Islands, SW Pacific

Violent eruption; no details (Richard 1962).

$\pi \uparrow$

388. 1928 July 3--Anak Krakatau, Indonesia

By sliding into the deep basin nearby, and as the consequence of wave erosion, the island of Anak Krakatau II that emerged on and after January 28, 1928, completely disappeared (Neumann van Padang 1951).

$\uparrow = \star \uparrow$

389. 1928 July 6 - July 13--Anak Krakatau, Indonesia

Third phase of the first period. The explosive activity continued, no further data (Neumann van Padang 1951).

$\pi \uparrow =$

390. 1928 August 4 - August 5 (or September 25)--
Paluweh, Lesser Sunda Islands

Eruption of Paluweh (identical with Rokatinda, which is, as a matter of fact, the name of the crater). Explosions, new lava dome. A tsunami has been associated with the event, magnitude about 1. Effects of the tsunami, the earthquake, and the eruption caused 226 deaths. Sieberg (1932) gave the date as 1928 August 4 or 5. Simkin et al. (1981) accepted 1928 August 4 - September 25. Thus the date given by other authors, such as 1927 August 4 or 7 is erroneous; see item No. 382. Tsunami-data are from Iida et al. (1972) and Berninghausen (1969), respectively.

$\circ \uparrow \triangle \cong$

391. 1928 August 25 - September 4--Anak Krakatau,
Indonesia

Fourth phase of the first period. Explosive activity (Neumann van Padang 1951).

$\pi \uparrow =$

392. 1928 September 19--Anak Krakatau, Indonesia

Detonations without visible phenomena. On this day 1,326 explosions were heard (Neumann van Padang 1951).

$\pi \uparrow =$

393. 1928 October 13 - 1930--Falcon Island, Tonga
Islands, SW Pacific

The island was growing slowly. On October 13 it had a height of 123.4 m, while in 1930 a height of 144.8 m was stated (Richard 1962).

Δ

394. 1928 November 4 - 26--Anak Krakatau, Indonesia

Fifth phase of the first period. Explosions (Neumann van Padang 1951).

$\pi \uparrow =$

395. 1928 December 11 - 20--Anak Krakatau, Indonesia

Sixth phase of the first period. The explosive activity continued; no further details are available (Neumann van Padang 1951).

$\pi \uparrow =$

396. 1928--Veteran, SE Asia

Discolored water was reported, suggesting a submarine eruption. The event is doubtful (Neumann van Padang 1953).

$\pi ?$

397. 1929 January 12 - February 18--Anak Krakatau,
Indonesia

Seventh phase of the first period. Explosions. (Neumann van Padang 1951).

$\pi \uparrow =$

398. 1929 March 6 - 13--Anak Krakatau, Indonesia

Eighth phase of the first period. The explosive activity continued (Neumann van Padang 1951).

$\pi \uparrow =$

399. 1929 June 8 - 20--Anak Krakatau, Indonesia

Ninth phase of the first period. Further explosions were observed (Neumann van Padang 1951).

$\pi \uparrow =$

400. 1929 July 25 - August 25--Anak Krakatau,
Indonesia

Tenth phase of the first period. Explosive activity (Neumann van Padang 1951).

$\pi \uparrow =$

401. 1929 September 19 - October 7--Anak Krakatau,
Indonesia

Eleventh phase of the first period. Explosions. (Neumann van Padang 1951).

$\pi \uparrow =$

402. 1929 December 7 - 23--Anak Krakatau, Indonesia

Twelfth phase of the first period. The center of the eruptions shifted 600 m to the southwest to a place where the depth of the caldera is 250 m (Neumann van Padang 1951).

$\pi \uparrow =$

403. 1930 January 14 - 28--Anak Krakatau, Indonesia

Thirteenth phase of the first period. The original crater became active again (Neumann van Padang 1951).

$\pi \uparrow =$

404. 1930 March 10 - April 5--Anak Krakatau, Indonesia

Fourteenth phase of the first period. Explosive activity (Neumann van Padang 1951).

$\pi \uparrow =$

405. 1930 April 30 - May 15--Anak Krakatau, Indonesia

Fifteenth phase of the first period. The explosive activity continued; no further details are available (Neumann van Padang 1951).

$\pi \uparrow =$

406. 1930 June 2 - August 8--Anak Krakatau, Indonesia

First part of the 16th phase of the first period. Between June 8 and 13 a new island emerged from the sea. This was Anak Krakatau III. By June 25 the crater rim emerged above sea level on all sides. On this day particularly strong eruptive activity was observed: 14,269 explosions were counted! At the same time flashes of lights were seen. On June 14 the height of the island was 31 m. A new phenomenon was noted: gases mixed with fine ash escaped with a great force and a roaring sound. At night they were visible as a beam of fire (Neumann van Padang 1951).

$\pi \uparrow \star =$

407. 1930 August 9 - 12--Anak Krakatau, Indonesia

Second part of the 16th phase of the first period. On August 9, the new island, Anak Krakatau III, disappeared. Its final height was 50 m, and its length reached 375 m. It is supposed that the island was destroyed by submarine explosions. There might have been four submarine centers in total. On August 12 a new island, Anak Krakatau IV, was born. It still exists.

$\pi \uparrow = \star \star \downarrow$

408. 1930 August 13 - 15--Anak Krakatau, Indonesia

Third part of the 16th phase of the first period. The explosive activity continued. On August 14 gas

and water spouts caused damage to the woods of Vertaten Island. One of the waterspouts had a height of 1400 m with a width of 100 m. Extraordinarily intense seismicity was observed until August 15 (the shocks by all likelihood were of volcanic origin). Anak Krakatau IV at this time had a height of 13.5 m, which was reduced to 8.9 m. in November. The width of the island, before this reduction took place, was 500 m and the length reached 1125 m. The crater was 750 m across (Neumann van Padang 1951).

$\pi \uparrow = \downarrow$

409. 1930 September 11--Stromboli, Italy

Very severe explosive eruption accompanied by a tsunami (Imbo 1965).

$\circ \uparrow \rightarrow \downarrow$

410. 1931 September 23 - 1932 February 17--Anak Krakatau, Indonesia

Second period of activity. Phases:

1. 1931 September 23 - 26
2. 1931 November 5 - 7
3. 1931 December 5 - 21
4. 1932 February 12 - 17

In the first phase two explosion points were active. Clouds rose up to 2400 m. Great quantities of ash and lapilli increased the island height to 47.2 m. Length and width of the island were 1150 m and 550 m, respectively. The diameter of the crater was 375 m. The activity of the other three phases was insignificant (Neumann van Padang 1951).

$\cup \uparrow \circ$

411. 1931 October--Bogoslof, Aleutian Islands

End of fumarolic activity and explosions in the area of Fire Island and Castle Rock in the Bogoslof area (Latter 1979).

π

412. 1931 November 1--Bogoslof, Aleutian Islands

Dome formation, explosions (Hantke 1979, MacDonald 1972).

$\pi \nearrow \triangle \uparrow \star$

413. 1932 November 14 - 1934 June 9--Anak Krakatau, Indonesia

Third period of activity. Phases:

1. 1932 November 14 - December 25
2. 1933 January 16 - May 25
3. 1933 June 10 - 17
4. 1933 July 5 - 6
5. 1933 September 5 - October 5
6. 1933 November 10 - December 6

7. 1934 January 6 - 26
8. 1934 March
9. 1934 May 5 - 12
10. 1934 June 7 - 9

Character of activity similar to the two previous periods. By May 25, 1933, the height of the island was measured as 96.9 m, and by the end of the period it was reduced to 88.5 m. In October 1933, three new explosion holes came into existence; each had a width of 30 - 45 m (Neumann van Padang 1951).

∩ ↑ ∅

414. 1932, end of the year--Unnamed undersea volcano, Tonga Islands, SW Pacific

Submarine activity has been reported, but no details are known (Richard 1962).

∩

415. 1933 January 8--Kharimkotan, Kurile Islands

Explosive eruption of Kharimkotan (the name is the synonym of Severgin), accompanied by tsunamis (MacDonald 1972). The tsunami-magnitude (Iida et al. 1972) was around 3; the maximum height at Kharimkotan Island reached 9 m. There were three waves in total but no significant (tectonic) earthquake took place, so the tsunamis were the direct consequences of the eruption itself.

↑ ∩

416. 1933 April--Falcon Island, Tonga Islands, SW Pacific

Explosive underwater eruption. The island at this time was longer than before (Richard 1962).

∩ ↑

417. 1933 May 1 - 2-- Anak Krakatau, Indonesia

In the second phase of the third period (see item No. 413) an exceptionally violent eruption of phreato-magmatic character (Williams and McBirney 1979) took place. It is worth separate mention. A dark base surge emerged over the crater's rim and spread laterally outward. Neumann van Padang (1951) has written about this particular eruption as follows:

"Very violent activity took place on May 1st and 2nd. Stehn...distinguished 12 gas phases, by which during 5, up to 77 minutes ash laden volcanic gases were blown into the air with great force, even to a height of more than 6800 m. The column, black at day time and ablaze at night, was uninterruptedly accompanied by booming, roaring, buzzing, cracking and thundering sounds. With a terrible crack the phenomena generally began and ended. These violent eruptions have not heightened the island but they partly demolished the SE rim. --Anak Krakatau, being 37.35 m

high in the beginning of this eruption period reached a height of 96.92 m. on May 25, 1933." (p. 59)

∩ ↑ =∩

418. 1933 November 13 - 1934 June--Alaid, Kurile Islands

Flank eruption and formation of a new lateral crater. Until 1934 May, there was Strombolain-type activity. As a result, at a certain distance from the coast a new adventive cone came into existence. Height: 145 m. (Gorshkov 1958).

∅ ↑ ∩ ∩ ★

419. 1933 December 25--Bulusan, Luzon, Philippines

Normal explosions from the central crater, accompanied by a tsunami (Neumann van Padang 1953). According to Iida et al. (1972), it can be supposed that the tsunami was the consequence of a storm since it took place on December 26; that is, one day after the start of the eruption. The relationship between the volcanic outbreak and the tsunami is, therefore, doubtful.

∅ ↑ ∩

420. 1934 May--Bayonnaise Rocks, Izu Islands, Japan

In the Myojin Sho area a submarine eruption was reported at a point 9 km east of the Bayonnaise Rocks (Kuno 1962).

∩

421. 1934 September 17 - to 1935 September 20 -- Tokara-Iwo-Jima, Ryukyu Islands

Submarine activity. Smoke and pumice were seen and detonations were heard. In 1934 November a lava-island came into being but was disintegrated by explosions on 1934 December 30. A second island was formed on 1935 January 8. It had a length of 300 m, a width of 150 m, and a height of 20 m, as measured on 1935 January 20. Its crater was 50 m across. Another island was born on 1935 February 20. On 1935 March 26 the older island was 50-60 m high and the new one was 22-23 m high (Kuno 1962).

∩ ↑ ★ ★ ∩ ★

422. 1934--Uracas, Mariana Islands, Central Pacific

Submarine activity was noted; no details are available (Kuno 1962). The name is the synonym of Farallon de Pajaros.

∅ ∩

423. 1935 January 4 - July 12--Anak Krakatau, Indonesia

Fourth period of activity. Phases:

1. 1935 January 4 - 14
2. 1935 February 6 - May 6
3. 1935 May 25 - July 12

From the 275-m long and 250-m wide oval crater lake, mud was thrown up to 125 m, but usually these mud-spouts were smaller than 50 m. These events occurred in February and the first weeks of March. From July 6 to 12 very strong explosions took place. Their detonations were heard at a distance of 360 km. After July 12 the height of the island was 63.3 m. (Neumann van Padang 1951).

π ∩ ↑↑

424. 1935 August - 1936 August-- Anak Krakatau, Indonesia

The southwest coast of the island receded in the northeast direction. Thus in August 1936 it shifted over a distance of about 400 m. The crater lake was almost completely filled up with sand (Neumann van Padang 1951).

π ? ↑

425. 1935 November 21--Mauna Loa, Hawaii

Eruption from the northeast rift belt. A tsunami did damage at Hilo (Furumoto et al. 1973). An earthquake (of tectonic origin?) was associated with the eruption and the tsunami was probably the consequence of this shock. Thus a physical correlation between the shock and the outbreak can be suggested.

426. 1935--Bogoslof, Aleutian Islands

By this year, Fire Island, as a result of erosion, separated from the larger southern island (Latter 1979).

π ?

427. 1935--Banua Wuhu, Sangihe Islands, Indonesia

Disappearance of the island that came into being between 1918 July 18 and 1919 May (see item No. 351). (Neumann van Padang 1951)

π ↓

428. 1936 June--Falcon Island, Tonga Islands, SW Pacific

Frequent explosive eruptions; explosions generally

every 15 minutes. The height of the island was 61 m (Richard 1962),

○ π ↑ ☆

429. 1936 October 13 - November--Anak Krakatau, Indonesia

Fifth period of activity. Medium-sized eruptions; the ejected solid material reached only 100, 200, or 300 m above the crater. Note that the vent was outside of the main crater (Neumann van Padang 1951).

π ? ↑

430. 1936 November 4--Kliuchevskaja Sopka, Kamchatka

The volcano erupted on this day. Note that its coordinates are as follows: 56.18° N, 160.78° E. About 10 days after the beginning of the outbreak a strong, M = 7.2 earthquake of tectonic origin took place at 55.50°N, 163.00°E at a shallow depth. These data are from Vlodavetz and Piip (1959) as well as Gutenberg and Richter (1954). Iida et al. (1972) have mentioned that at Ust' Kamchatsk, Kamchatka Peninsula, a tsunami was observed on November 14. Quoting their text: "13 m swell reported beginning at time of both earthquake and high wind. Solov'ev and Ferchev consider probably a tsunami but considering lack of distant mareographic effects this seems doubtful".

If -- nevertheless -- it was a real tsunami, then it can be supposed that the eruption triggered the earthquake, and the tsunami was the consequence of this tectonic shock. We know many cases when volcanic eruption had a triggering effect on earthquakes (e.g., Volcanoes Katmai 1912; Agung 1963; see: Hedervari 1979). However, in the present case, although such an indirect correlation among the events is not excluded, the relationship appears to be uncertain.

○ ↑ ∩ ?

431. 1937 May 29 - June 2--Vulcan, New Britain, SW Pacific

Vulcan or Raluan is one of the marginal volcanoes of the Rabaul caldera. A submarine eruption, and violently explosive, the present Vulcan Crater was built up from sea level. A tsunami accompanied the event. About 21 hours later, the nearby Matupi volcano--known also as Tavurvur and having the same code, 0502-14--also erupted into violent explosive outburst (Fisher 1957).

Note: The (almost) simultaneous eruption of two neighboring volcanoes represents a very infrequent, but not unique, interesting phenomenon. A similar case is the Katmai--Nova Rupta eruption in 1912 in Alaska. Another example is the eruption of Mont Pelee of Martinique on May 2, 1902, with the paroxysm on May 8, and the outbreak of Soufriere of St. Vincent on May 6, the same year. In the case of volcanoes that are located near one another, within a few tens of kilometers, such as the Katmai--Nova Rupta pair or with Vulcan and Matupi, a subterranean connection ("natural

tunnel" between the volcanoes in question) can be supposed. In cases where the distance is great, a hundred kilometres or more, such simultaneous eruptions can be attributed to regional stresses that act on the shallow magma chambers of the volcanoes involved rather simultaneously.

π * ↑ ○ ⇒

432. 1937 August 6 - November 23--Anak Krakatau, Indonesia

Sixth period of activity. Phases:

1. 1937 August 6 - September 21
2. 1937 November 17 - 23

Rather strong eruptions. In the first phase the maximum height of the clouds was about 2600 m. In the second, the explosions produced smaller clouds (Neumann van Padang 1951).

☪ ↑

433. 1937--Nameless undersea volcano, Tonga Islands, SW Pacific

Here a reef on which the sea breaks is known. In the year mentioned, explosive activity was noted (Richard 1962).

π ↑

434. 1937 - 1940--Falcon Island, Tonga Islands, SW Pacific

In 1937 and 1938 no further volcanic activity was observed, but measurements were made. According to the results the island was some 2400 m long and 85 m high. In 1940 November the remnants of the island consisted of black scoriae and the height was about 9 m only (Richard 1962).

A

435. 1938 July 4 - 1940 July 2--Anak Krakatau, Indonesia

Seventh period of activity. Phases:

1. 1938 July 4 - August 29
2. 1938 September 12 - 14
3. 1938 October 2
4. 1938 November 7
5. 1938 December 8 - 9
6. 1939 January 15 - 27
7. 1939 March 20
8. 1939 June 1 - August 4
9. 1939 September 23 - 25
10. 1939 December 13 - 1940 January 9
11. 1940 February 3 - 10
12. 1940 March 1 - May 15
13. 1940 June 10 - July 2

Strong outbreaks in the first phase. Two small (40- and 47-m wide) craterlets originated on March 20, 1939, and in June a new border craterlet came into being. June 17 - 18: very strong eruptions, clouds reached the height of 4000 m. At the end of the period the altitude of the island was 125 m and the crater was 680 m across and the lake within the crater was 460 m in width (Neumann van Padang 1951).

π ☪ ↑↑

436. 1939 June--Fonualei, Tonga Islands, SW Pacific

Simultaneously with the eruptions that took place from the summit crater and from a parasitic crater, respectively, spouts of water were seen some 1.6 km southeast of the island. Five separate eruptions occurred from two different sources (Richard 1962).

π ↑ ☪

437. 1939 July 24--Kick-'Em-Jenny, W. Indies

From 0800 (local time) earthquakes were felt frequently in the northern part of Grenada. Between 1202 and 1315 seven heavy shocks occurred, the most prolonged of which lasted 12 seconds and was accompanied by the discharge of a black column of smoke from a point of the sea 8 km north of David Point. The eruption cloud was a small one. It reaching 61 m at most. It contained solid, dark bodies of considerable size. At 1804 a second discharge of brown smoke emerged from the same point, reaching a height of 274 m (Robson and Tomblin 1966, Robson 1964).

π ↑

438. 1939 August 17 - end of December--Tori-Sima, Izu Islands, Japan

A submarine eruption was reported, no details (MacDonald 1972).

○ ↑↑ ☪ π

439. 1939 August 20 - 1941 first days of July--Santorini, Aegean Sea

A new eruptive cycle began that can be divided into five phases. See the following five items (Georgalas 1962).

↑ π ☪ ☪ *

440. 1939 August 20 - September 1--Santorini, Aegean Sea

Submarine explosions at the western coast of Nea Kameni. Two small domes were formed: on the west Triton A and on the east Triton B. Later on, however,

they united and reached an altitude of 13 m. The total area, covered by new lava was 9850 m². There were smaller explosions from August 26 to September 1 first phase. (Georgalas 1962).

↑ π 𐄂 Δ *

441. 1939 September 23 - November 25--Santorini, Aegean Sea

A new dome, called Ktenas, was formed west of the summit of Nea Kameni Island. The lava flow covered the Triton domes. Maximum height of Ktenas reached 77 m. Lava covered 132,500 m² of the surface second phase. (Georgalas 1962).

π 𐄂 Δ *

442. 1939 November 13 - 1940 July 9--Santorini, Aegean Sea

While the Ktenas dome was still in eruption, new activity began on November 13, due to which a new dome, known as Fouque, appeared on November 17. This exhibited a much stronger effusive and explosive activity than Ktenas. The final height of the new dome was 122 m, the total area, covered by lava was 376,250 m². In Fouque, 27 paroxysms were observed; third phase (Georgalas 1962).

↑ π 𐄂 Δ *

443. 1940 July 12 - November 15--Santorini, Aegean Sea

The new cycle began with explosions and lava flows. The latter were observed on the night of July 15/16. Due to these flows two new domes were formed: on the west, Smith A, and on the east, Smith B. On July 17 a third new dome came also into being; this is Reck. Smith A and Reck exhibited strong explosive activity. On October 11 the Reck dome was 126 m high. Its lava covered an area of 109,000 m²; fourth phase (Georgalas 1962).

↑ π 𐄂 Δ *

444. 1940 November 24 - 1941 first days of July--Santorini, Aegean Sea

The activity has begun in the eastern Fouque lava stream. Mostly effusions occurred with only small explosions. A new dome, named Niki, has been formed and reached an altitude of 125 m. With its three lava flows it covered an area of 170,000 m²; fifth phase (Georgalas 1962).

↑ π 𐄂 Δ *

445. 1941 January 28 - February 12--Anak Krakatau, Indonesia

Eighth period of activity. Eruptions in the

crater lake. No further details are available (Neumann van Padang 1951).

☉ ↑

446. 1941 March--Falcon Island, Tonga Islands, SW Pacific

Eruptions from crater lake (Neumann van Padang 1951, Kusumadinata 1979).

* ?

447. 1942 January 29 - 30--Anak Krakatau, Indonesia

Eruptions from the crater lake (Neumann van Padang 1951, Kusumadinata 1979).

☉ ↑

448. 1942 February 1--Myojin-Sho, Izu Islands, Japan

This eruption is not mentioned in the available catalogs (e.g., Kuno 1962, Simkin et al. 1981). By all likelihood there is a printed error in Morimoto's paper (Bulletin Volcanologique, II, 23) where a series of photos is presented showing Myojin-Sho-events (Morimoto 1960, see the caption of Plate II). Accordingly the correct date is 1946 February 1 instead of 1942 February 1. See 1946 February 1.

?

449. 1943 October 5 - 6--Kick-'Em-Jenny, W. Indies

Submarine eruption during the night (Robson and Tomblin 1966).

π

450. 1943--Anak Krakatau, Indonesia

The volcano was probably active in this year too; eruptions in the crater lake (Neumann van Padang 1951, Kusumadinata 1979).

☉ ↑ ?

451. 1943--Nameless submarine volcano, Tonga, SW Pacific

Allegedly a submarine eruption occurred here in 1943 (Richard 1962) but this event is extraordinarily improbable, since the place is not of volcanic origin (Simkin et al. 1981).

π ???

452. 1944 August 10 - 31--Unnamed underwater volcano,
Mariana Islands, Central Pacific

☪ ↑ ?

Near Esmeralda Bank, boiling sulfur was seen on some day between the dates mentioned above, indicating a possible submarine eruption (Kuno 1962).

π ?

453. 1944--Anak Krakatau, Indonesia

Probably active, eruptions in the crater lake (Neumann van Padang 1951).

☪ ↑ ?

454. 1945 May (probably before) 21 - September (probably before) 20--Carabobo, North of Gulf of Darien

Allegedly a new volcanic island in an unknown location off Northwest Colombia and north of the Gulf of Darien appeared in 1945 May (before the 21st) and disappeared in September (before the 20th). The events were reported on May 21 and September 20 by the New York Times (XCIV May 21 and XCV September 20). The phenomena had -- accordingly -- to occur one or two days prior to the appearance of these articles. The new island was named Carabobo.

Note: This event (and this name) are not mentioned by Simkin et al. (1981), and therefore the event is very problematical. In addition: the place mentioned is not volcanic. Perhaps we have to do with a mud-volcano, but not with a real, igneous one. We regard the event as extraordinarily doubtful.

π ★ A ? ? ?

455. 1945 November 28 - December--Ormus Islands, Gulf of Arabia

Two small islands were seen in the Gulf of Arabia, 240 km northwest of Karachi, Pakistan. No exact data are available for their location. About 4 and 2.5 km² large, they were at a distance of 5 km from each other. In December 1945 a third, 3-m high island was observed at a distance of some 500 km from the former two. The surrounding sea was still hot and lava flowed out (Neumann van Padang 1963).

Note: The site mentioned is far from the volcanic belts. In spite of this, Sapper (1927) and later on Neumann van Padang (1963) regarded this zone as a volcanic one; Sapper has referred to lava flows that occurred in the Middle Age (historical meaning, not geologic!). Therefore we can regard the event as sure.

π ★ ↗

456. 1945--Anak Krakatau, Indonesia

Probably active, eruptions in the crater lake (Neumann van Padang 1951).

457. 1945--Unnamed submarine eruptive center, New Guinea

A submarine (mud?) volcano was reported here. The existence of this underwater eruption point is, however, doubtful, although there were indications of submarine activity in 1951 November 24 as well (see the Supplement). (Fisher 1957).

π ?

458. 1946 February 1--Bayonnaise Rocks, Izu Islands, Japan

In the Moyin-Sho area a new island appeared which persisted until October 1946. The island was located at 31° 57' N, 140° 01' E. (The coordinates of the Bayonnaise Rocks themselves are: 31° 55' N, 139° 55' E.) In December 1946 on the site of the island a reef was seen that projected a little above the water. Maximum height of the new volcanic spine was 94 m above the level of the sea on February 1 between 07 and 10 o'clock (probable local time) (Morimoto 1960, Kuno 1962).

π ★ ★ ↗

459. 1946 April 1--Pavlof, Alaska Peninsula

A very severe shallow earthquake with a Richter-magnitude of 7.4 took place at 12h 29m (Universal Time) at 53.5° N, 163.0° W in the area of the Aleutian Islands. An extraordinarily strong tsunami (with a tsunami magnitude of about 5!) followed the shock. The height of the waves reached 30.5 m (!) at Unimak Island, Aleutians. Five persons lost their lives (Iida et al. 1972).

According to Hantke (1979) volcano Pavlof erupted on the same day. Ash showers and lava flows were observed on April 1, 2, and 3 as well. By all likelihood the tectonic earthquake directly triggered the outbreak.

↑ = ☪

460. 1946 July 25 - December--Anak Krakatau, Indonesia

Eruptions in the crater lake (Neumann van Padang 1951).

☪ ↑

461. 1947 January--Anak Krakatau, Indonesia

Eruption clouds were observed (Kusumadinata 1979).

↑

462. 1947 April--Anak Krakatau, Indonesia

Eruptions in the crater lake (Neumann van Padang 1951).

☪ ↑

463. 1948 September 22 - 29--Karua, New Hebrides Islands, SW Pacific

Submarine eruption (Fisher 1957).

⋈

464. 1949 February--Falcon Island, Tonga Islands, SW Pacific

The volcanic island disappeared (Richard 1962).

⋈ ↘

465. 1949 April--Karua, New Hebrides Islands, SW Pacific

Submarine eruption (Fisher 1957).

⋈

466. 1949 May 12 - June--Anak Krakatau, Indonesia

Eruption in the crater lake on May 12. In June the island showed the first signs of the development of vegetation. The southwest wall of the crater was annihilated by wave-erosion and thus the crater lake had a crescent shape (Neumann van Padang 1951). Mud eruptions as high as 120 m.

☪ ↑↑

467. 1949 November--Karua, New Hebrides Islands, SW Pacific

Severe submarine eruptions built up a new cone above the level of the sea. This island disappeared in December the same year (Fisher 1957). The cone had a diameter of 1.6 km and a height of 100 m (Center for Short-Lived Phenomena Report No. 1137).

Note: In the following listings the reports of Center for Short-Lived Phenomena of the Smithsonian Institution will be abbreviated as CSLP, No. ..., and the reports of the Scientific Event Alert Network of the same institute, as SEAN, No. ..., respectively.

⋈ ↑ ⋈ ⋈ ↘

468. 1950 January 10 - February 2--Santorini, Aegean Sea

New eruption on the eastern slope of Georgios dome

in the caldera. Explosions and lava effusions occurred. A new dome was formed, which is named Liatsikas, and two lava tongues came into being. The area covered by the lava was about 8000 m². Since then the volcano is in a solfataric and fumarolic stage (Georgalas 1962). The great tectonic shocks of 1956 (July 9, 36° 42' N, 25° 48' E, M= 7.8 and July 9, 36° 36' N, 25° 42' E, M= 6.9, Rothe 1969) did not cause any further eruptions, although the shocks were very strongly felt on Santorini (the coordinates of the volcano are: 36° 24' N, 25° 23' E).

↑ ⋈ ↘ ⋈ ⋈

469. 1950 June 1--Mauna Loa, Hawaii

Eruption of Mauna Loa from the southwest rift belt, accompanied by a submarine lava flow of about 76 million m³. (MacDonald 1955).

☉ ↘

470. 1950 July 3 - 7--Anak Krakatau, Indonesia

Ash eruptions between July 3 and 6 (Suryo 1978); eruption in the crater lake on July 7 (Neumann van Padang 1951).

☪ ↑

471. 1950 December 1 (uncertainty; plus or minus 1 month)--Kovachi, Solomon Islands, SW Pacific

Submarine eruptions were reported, perhaps an ephemeral island was also formed (Fisher 1957, Simkin et al., 1981).

⋈ ⋈ ? ☪ ↑

472. 1950 - 1963--Anak Krakatau, Indonesia

Remarkable topographical changes have taken place on the island of Anak Krakatau. For example: the former mooncrescent-shaped crater lake has completely disappeared and instead of it lava flows covered the floor of the crater (Zen and Hadikusumo 1964).

↘

473. 1952 March 19 (or, 16?) - 1952 June--Didicas, Luzon Island

Submarine eruption that led to the formation of a new island. Extrusion of a lava dome? (Neumann van Padang 1953). Eruption from a parasitic crater. The diameter of the island was some 2400 m and its height was about 240 m above the sea level (CSLP No. 484).

☉ ⋈ ⋈ ⋈ ?

474. 1952 April--Kovachi, Solomon Islands, SW Pacific

Submarine explosions, no details (Fisher 1957).

π ○ ↑

475. 1952 May--Kovachi, Solomon Islands, SW Pacific

Further explosions beneath the sea level (Fisher 1957)

π ○

476. 1952 June - 1953 January 20--Kovachi, Solomon Islands, SW Pacific

Submarine eruptions and explosive activity. In the latter part of 1952 the powerful activity led to the birth of a cone above the sea level. The maximum height of the new island was 30 m. It disappeared on 1953 January 19. The explosions ceased on 1953 January 20 (Fisher 1957).

π ★ ○ ↑ ★ ↘

477. 1952 August 1--Barcena, San Benedicto island, Revillagigedo Islands

A new volcano, known as Barcena, was born on this day at the southern end of San Benedicto Island. The initial activity was of vulcanian type, accompanied by pumice eruption (Richards 1962) and a base surge (Moore 1967).

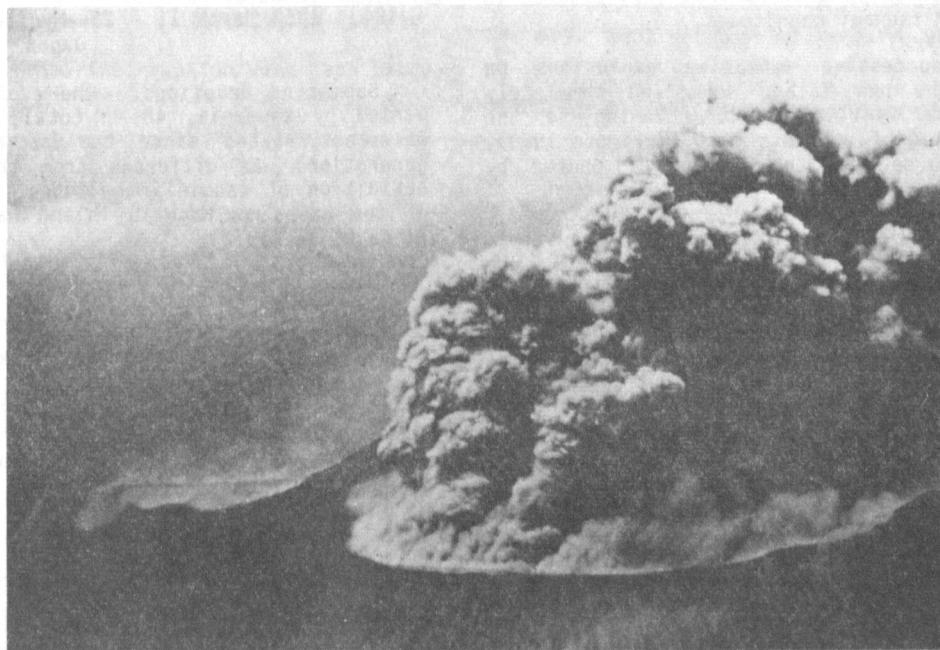
"A 1250-ft. ash and cinder cone was erected within 12 days of the birth of the volcano. Block lava half

filled the crater in middle November 1952, and in early December viscous lava pierced the eastern base of the cone and flowed out into the sea for over two months forming a delta of lava. Barcena became inactive in March 1953. A strong emission of fumarolic steam continued to escape from the crater into 1954. Since August 1954 only weak fumarolic activity has been observed from the crater and lava delta vent; the volcano is presumed to be dead" (Snodgrass and Richards 1956, p. 97).

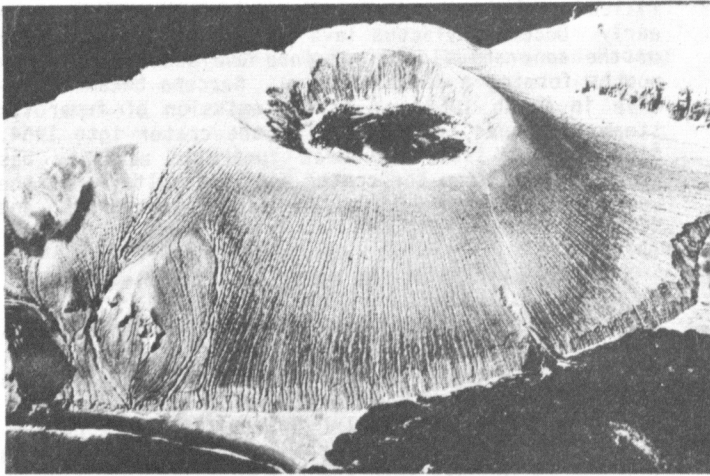
The chronology of the events is as follows:

- 1952 August 1: Birth of the volcano. Vulcanian-type activity.
- 1952 August 12: Continuous roar. Continuous vulcanian--Peleean-type eruptions.
- 1952 November 13: Intermittant low rumble. Weak ash and steam eruptions. Extrusion of lava into the crater.
- 1952 November 15: Random rumble. No correlation with volcanic activity.
- 1952 December 9: Intermittent low rumble. Weak ash and steam emissions from the crater, beginning of lava extrusion from basal vent.
- 1952 December 10 -11: Loud, continuous hissing. Weak ash and steam eruptions from the crater, extrusion of lava into the sea. Noise of sea quenching incandescent block lava.
- 1953 January 12: Intermittent faint rumble. Very weak ash and steam eruption from the crater, extrusion of lava from basal vent.
- 1953 July 13: Short bursts of hissing noise. Sea quenching hot lava.
- 1953 September 21: Bursts of hissing, probably originated from sea quenching hot lava.
- 1953 November 17 - 19: Hissing, the cause of which is the same as above (Snodgrass and Richards 1956).

π ↑ =- ★ ↘



Barcena volcano, San Benedicto Island, 19.18 N, 110.82 W, in 1952. See Event 477. (From Howell Williams).



Barcena volcano, San Benedicto Island, in 1955.
See Event 477. (From Howell Williams).

478. 1952 September 16 - 26--Myojin-Sho, Izu Islands, Japan

The first signs of the impending submarine eruptions were recorded by the underwater listening station off California on the early morning of September 16 (Morimoto 1960).

The activity that started on this day consisted of submarine explosions, base surge (Moore 1967), tsunamis (Iida et al. 1972), and the birth of a new island made up of blocky lava (Morimoto 1960). The tsunamis were relatively small ones, reaching 0.1 - 0.3 m in height at Hachijo Island, and occurred on September 16, 23, 24, and 26 respectively. For the later events, occurring after September, see items that follow. The tsunami magnitudes are not assigned as the generation mechanism differs from that assumed in the definition of tsunami magnitudes.

After two successive submarine explosions on September 23, the new island submerged completely leaving sea water yellow in color owing to the subaqueous emission of volcanic dust (Morimoto 1960). For the base surge see the series of photos by Morimoto.

On September 24, at about 12h 20m (Japanese time), a submarine explosion annihilated S. S. No. 5, the *Kaiyo-maru*, 211-ton surveying ship of the Hydrographic Office of Japan; all persons on board were lost with the vessel. There were no eyewitnesses of the event. Nine scientists and twenty-two seamen died (Morimoto 1960).

π A ↑ = ⊃ A ↘

479. 1952 October 3--Karua, New Hebrides Islands, SW Pacific

Light explosions were reported but no island emerged (Fisher 1957).

π ↑

480. 1952 October (after) 3 - before 11--Myojin-Sho, Izu Islands, Japan

The submarine volcanic feature appeared again on the sea. It was a typical volcanic spine, similar to that of Mont Pelee in 1902 - 1903 (Morimoto 1960).

π A ↑ Δ

481. 1952 October 10 - 21--Anak Krakatau, Indonesia

Ash eruptions (Suryo 1978). The vegetation was entirely destroyed when a layer of ash, almost 3 m in thickness, was desposited (Decker and Hadikusumo 1961).

↑

482. 1953 February 12 - 19--New Hebrides Islands, SW Pacific

Nameless submarine eruption centers. An outburst took place from three submarine craters that were generally active simultaneously. A large quantity of pumice was produced and a pumice cone was formed above the level of the water. It was washed away soon, however (Fisher 1957).

π A A ↘

483. 1953 March 9 - 10--Myojin-Sho, Izu Islands, Japan

After a severe explosion a new spine submerged. See item No. 480 (Morimoto 1960).

↑ Δ ↘

484. 1953 March 11 - 25--Myojin-Sho, Izu Islands, Japan

Submarine eruptions. The explosions were accompanied by tsunamis, 48 in total; tsunami magnitudes were not stated since the mechanism of the wave generations was different from that assumed in the definition of tsunami magnitude. The maximum height of the waves at Hachijo Island was as low as 0.1 m (Iida et al. 1972).

π ↑ ⊃

485. 1953 March 13 - April 1--Anak Krakatau, Indonesia

Ash eruption; eruption clouds reached an altitude of 2500 m (Suryo 1978).

↑

486. 1953 March 25 - April 3--Myojin-Sho, Izu Islands, Japan

Remarkable submarine explosions were recorded many

times. Explosions became very frequent and emission of ash and vapor became continuous (Morimoto 1960).

π ↑

487. 1953 April 3 - 5--Myojin-Sho, Izu Islands, Japan

Third appearance of the island. It presumably had been exposed above the sea surface with continuous vapor emission until the end of August and no conspicuous explosions have been recorded in this subaerial period (Morimoto 1960).

π A

488. 1953 June 27--Tuluman, Admiralty Islands, SW Pacific

Start of the new cycle of activity. For the different phases see the subsequent items from phases 1 to 14. A more detailed description of the events can be found in the volume *Volcanism in Australasia*, see the paper by Reynolds and Best (1976).

Between 1953 June 27 and 1955 November 25, six eruptive centers -- called cones -- were active. Nos. 2, 4, and 5 coalesced into a single, roughly triangular island, the northeastern side of which was some 700 m long, the others about 1000 m. The highest point of the crater was about 40 m above the average sea level. Its diameter reached 50 m approximately, but the depth was as small as 10 m. Around Cone No. 3 an irregular island built up, 400 m in length. Cone No. 6 was entirely submarine (Fisher 1957).

π ★ ○ ↑ ↗

489. 1953 June 17 - July 6--Tuluman, Admiralty Islands, SW Pacific

First phase. Submarine eruption with lava extrusion from Cone No. 1 (Fisher 1957).

π 𐄂

490. 1953 June--Off the west coast of Baja California

At 27° 25' N, 114° 35' W, off the west coast of Baja California, a submarine eruption has been suspected; the acoustic method for its detection was, however, unsuccessful. The report was -- probably -- false (Richards 1963). The event is doubtful.

π ?

491. 1953 August - September--Myojin-Sho, Izu Islands, Japan

Since the middle of August the amount of water vapors over the new island had increased. At the end of the month, there were ash clouds at least 500 m

into the air, or more. In the last week of that month an explosive stage started and the explosions at the end of August were the most destructive ones of the whole period. Large amounts of sand, ash, and pumice were ejected. About 10 days of explosive activity led to collapse of the island into the sea (Morimoto 1960).

π ↑ A ↘

492. 1953 September 21 - 22--Anak Krakatau, Indonesia

Detonations; the eruption clouds reached a maximum altitude of 3000 m (Suryo 1978).

↑

493. 1953 October 8 (or some days earlier)--Matthew Island, SW Pacific

Submarine eruption that led to the formation of a new island which is joined to the old Matthew Island by a 200-m-wide isthmus. The new island has a roughly circular shape some 750 m across and has a height of almost 200 m. It has a small crater from which lava has erupted (Fisher 1957).

π ★ ○ ↑ ↗

494. 1953 October 25 - 26--Anak Krakatau, Indonesia

Continuous detonations. The eruption clouds reached an altitude of 4000 m (Suryo 1978).

↑

495. 1953 October 30--Kick-'Em-Jenny, W. Indies

Probably submarine eruption between 0200 and 1200 local times (Robson and Tomblin 1966).

π ?

496. 1953 November 10 - 25--Anak Krakatau, Indonesia

Ash eruption (Suryo 1978).

Note: There is a printed error in the source: 1953 IX 10 - 25, instead of 1953 XI 10 - 25. The latter is the correct listing.

↑

497. 1953 November 14 - 1954 February 18--Tuluman, Admiralty Islands, SW Pacific

Second phase. Submarine eruptions with lava extrusions from Cone No. 2 (Fisher 1957).

π 𠄎

498. 1953 November--Unnamed submarine volcano, New Hebrides Islands, SW Pacific

Discoloration and churning of the water was seen, suggesting a submarine eruption which was other wise invisible. This site had submarine eruptions in 1920 (No. 357) and 1953 (No. 482), which increases very much the possibility of new underwater activity. The event is regarded as certain (Fisher 1957).

π

499. 1953--Sin-Iwo-Zima, Bonin Islands, Japan

Sulfur bubbled at some places northeast of Minami Iwo-Zima, which may be regarded as sign of submarine activity (Kuno 1962).

π

500. 1954 (probably between) January and April--Alcedo, Isabela Island, Galapagos Islands

Near Alcedo volcano, between 0° 15'- 20' S, 91° 08'- 14', at a point called Bahia Urvina, uplift of the shore was first observed during the early spring of 1954. The seaward margin of the uplifted area extended to a maximum of about 1200 m from the old shore. Vertical elevation averaged 4.6 m. Probably a rapid-uplift phenomenon, believed to have been caused by tumescence of rising lava, that moved upward within Alcedo volcano's vent. A few signs of earthquakes that accompanied the event were seen. The volcano erupted in 1954 November 9 (Richards 1957).

π ? or 𠄎 ?

501. 1954 February - March--Stromboli, Italy

Severe eruption with glowing clouds (nuées ardentes) and a tsunami whose arrival times after the explosion were as follows: Ginestra, 10 min; Panarea, 25 min; Lipari, 60 min; Sicily coast, 90 min, respectively (Imbo 1965).

○ ↑ → 𠄎 𠄎

502. 1954 April 9 - 13--Tuluman, Admiralty Islands, SW Pacific

Third phase. Submarine lava extrusion from Cone No. 3 (Fisher 1957).

π 𠄎

503. 1954 July 10 - 27--Tuluman, Admiralty Islands, SW Pacific

Fourth phase. Lava extrusions from Cone No. 2 and explosive activity from Cone No. 3. Subaerial eruptions (Fisher 1957).

→ ↑

504. 1954 October 20 - November 6--Tuluman, Admiralty Islands, SW Pacific

Fifth phase. Submarine lava extrusion from Cone No. 1 (Fisher 1957).

π 𠄎

505. 1954 November 4--Myojin-Sho, Izu Islands, Japan

Two submarine explosions were reported between 1400 and 1500, local time (Morimoto 1960).

π ↑

506. 1955 February 10 - 15--Tuluman, Admiralty Islands, SW Pacific

Sixth phase. Submarine lava extrusions from Cone No. 5. Explosive activity from Cones No. 2 and 4, preceded by uplift around Cone No. 2 (Fisher 1957).

π 𠄎 ↑

507. 1955 February 11--Anak Krakatau, Indonesia

Asn eruptions with detonations (Suryo 1978).

↑

508. 1955 (?) February 13--Unnamed volcano, Sangihe Islands, Indonesia

Concerning this supposed event, see item No. 360 as well.

The Volcano Letter, No. 527, January - March 1955, mentioned activity of a submarine volcano; the paper was quoted by Jezek (1978), who strongly questioned the existence of this volcano. According to the Volcano Letter, in the Celebes Sea, south of the Philippine Islands, a black, "smoke"-laden cloud -- probably ash -- of fume and steam was seen. It rose from the sea to a height of 200 to 300 m. A few minutes later the cloud became white, probably containing mostly steam. The cloud rose from an area of about 1800 m² of sea surface. Uncertain, as the sea here is at least 5000 m deep. Simkin et al. 1981 also considered uncertain even the time or year of the event.

π ? ?

509. 1955 February 15 - March 11--Tuluman, Admiralty Islands, SW Pacific

Seventh phase. Lava extrusions with considerable explosive activity, strong detonations from Cone No. 5 (Fisher 1957).

↗ ↑

510. 1955 February 28--Kilauea, Hawaii

Eruption of Kilauea volcano from its east rift zone, accompanied by submarine lava flow of some 5.5 million m³ (MacDonald 1955).

= ↗

511. 1955 February 28 - March 20--Stromboli, Italy

Eruption in a radial fracture on the northwestern slope, lava flow and submarine activity -- no further details (Imbo 1965).

⊙ ↗ π

512. 1955 March 11 - May 9--Tuluman, Admiralty Islands, SW Pacific

Eighth phase. Submarine lava extrusion from Cone No. 6 (Fisher 1957).

513. 1955 May 16 - June 26--Tuluman, Admiralty Islands, SW Pacific

Ninth phase. Lava extrusion with some explosive activity from Cone No. 1. A new island emerged from the extrusion of lava but was soon reduced to a submarine mound. From June 5 to June 26 spasmodic mud eruptions occurred from Cone No. 2. At the same time, an increase in the temperature and the extent of the activity in the thermal region on Lou Island was observed (Fisher 1957).

π ★ ↗ ↑ ↑ A ↘

514. 1955 June 25--Bayonnaise Rocks, Izu Islands, Japan

Submarine activity at a point 4 km north of the Rocks (Kuno 1962, Morimoto 1960).

π ↑

515. 1955 July 21 - August 2--Tuluman, Admiralty Islands, SW Pacific

Tenth phase. Spasmodic mud eruptions from Cone No. 4. Subaerial activity (Fisher 1957).

↑ ? ↑

516. 1955 September 20 and 26 - 28--Tuluman, Admiralty Islands, SW Pacific

Eleventh phase. Submarine eruptions near Cone No. 1 (Fisher 1957).

π

517. 1955 October 3 - 7--Tuluman, Admiralty Islands, SW Pacific

Twelfth phase. Submarine outbreak near Cone No. 1 (Fisher 1957).

π

518. 1955 October 15 - 16--Tuluman, Admiralty Islands, SW Pacific

Thirteenth phase. Minor steam and ash eruptions from Cone No. 4. Subaerial activity. Note that similar events were observed on October 23 as well (Fisher 1957).

↑

519. 1955 November 7 - 25--Tuluman, Admiralty Islands, SW Pacific

Fourteenth phase represents the end of the new cycle. Small explosions of steam from the west side of Cone No. 4. Subaerial activity (Fisher 1957).

↑

520. 1955 November--Submarine volcano on the Lomonosov Ridge, Arctic Ocean

According to a report (Shackelford 1981) a submarine eruption took place in the Arctic Ocean. Evidently the date is incorrect due to a misprint. For the correct date see item No. 527.

?

521. 1955--Nameless underwater eruptive center, Hawaii

MacDonald (1972) has reported a submarine eruption at the western termination of the group of Hawaiian Islands but no details are given, including the month and day of the event. As the depth of the ocean there is some 4000 m, the eruption is doubtful.

π ?

522. 1956 March 30--Bezymianny, Kamchatka

One of the greatest explosive eruptions in the present century was that of Bezymianny. For the details see Gorshkow (1959).

At the time of the paroxysmal eruption a relatively small tsunami with a tsunami magnitude of around 0 was observed (Iida et al. 1972). The maximum height of the wave was as small as 0.3 m at Attu, in the Aleutians. At the time of the tsunami's origin no tectonic shocks occurred (Rothe 1969; **Regional Catalogue of Earthquakes, 1956**, International Seismological Centre, Edinburgh). Therefore, it is concluded (Hedervari 1980) that the tsunami was generated by the air waves of the explosion, similar to the case of Krakatau (see No. 218 in Hedervari 1984) where many smaller waves were observed very far from the volcano and were recently attributed to air-sea interactions. Thus, Bezymianny represents the second example for such events.

0 ↑ ⇨

523. 1956 June--Unnamed submarine eruptive center/ east of Kauai, Hawaii

Doubtful event: A submarine eruption was suggested in the Kauai Channel, between Kauai and Oahu Islands. Sounds were heard, propagating in the water, but not positively indentified with known volcanic activity. These were observed by submarine sonar equipment (Richards 1963; MacDonald 1963) that interpreted the event as a real submarine outburst, but Eaton and others have doubted this.

Note: Simkin et al. (1981) gave May 23 for the event instead of June. For the event, described under item No. 521, they gave 1955 August 20.

π ?

524. 1957 March 11 - 12--Vsevidof/Umnak Island, Aleutian Islands

The Vsevidof eruption represents a very interesting example of the physical correlation between tectonic earthquakes and volcanic outbreaks.

A series of very great earthquakes began on 1957 January 2 and ended on June 13, the same year. The main shock that occurred on March 9 was one of the most powerful ones in the present century. Originally, its Richter magnitude was assigned as 8.25 (Duda 1965) but later on Kanamori (1977) modified some of the earlier magnitude values. Thus, the magnitude of the shock in question was 9.1 instead of 8.25. This, and all the other quakes that belong to the same series, were of shallow origin.

In Table 1, derived from Duda (1965) and Kanamori (1977), the epicentral distribution of the members of the series is shown. The data for them are given below. It is remarkable that the shocks belonged to two well-separated groups, a western and an eastern one. The western shocks (2, 5, 6, 7, 8 and 11) were concentrated around the main shock of the series, symbolized by 2. The eastern shocks (1, 3, 4, 9 and 10) were concentrated around volcano Vsevidof.

Table I. Shocks at Vsevidof/ Umnak Island, 1957

No.	Date	Latitude°	Longitude°	Magnitude
1.	January 2	53.0 N	168.0 W	7.0
2.	March 9	51.3 N	175.8 W	9.1
3.	March 9	52.5 N	169.5 W	7.1
4.	March 11	53.0 N	169.3 W	7.0
5.	March 11	51.5 N	178.5 W	7.2
.....				
Eruption:				
	March 11	53.13 N	168.68 W	
.....				
6.	March 12	51.0 N	177.0 W	7.3
7.	March 14	51.5 N	177.0 W	7.2
8.	March 16	52.0 N	179.0 W	7.2
9.	March 22	54.0 N	166.0 W	7.0
10.	April 19	52.0 N	166.5 W	7.3
11.	June 13	51.5 N	175.0 W	7.0

No doubt earthquakes No. 1, 3, and 4 (eastern group) had triggering effects on the volcano. In particular, Nos. 3 and 4 had strong and direct effects of this kind.

The main shock (No. 2) initiated a very disastrous tsunami (Iida et al. 1972) having a tsunami magnitude of around 3.5. The height of the waves reached 12 m at Unimak, Scotch Cave, and 16 m at Kauai, Hawaiian Islands.

Considering that the western and eastern shocks - although they occurred very far from each other - were manifestations of the same regional stress system, and that some of the eastern earthquakes had a triggering effect on the volcano, it can be stated that the tsunami was correlated indirectly with the eruption.

↑ ⇨

525. 1957 May--Bayonnaise Rocks, Izu Islands, Japan.

Submarine activity, no details (Kuno 1962).

π

526. 1957 September 17--Fayal, Azores

Start of the formation of a new island by submarine activity. The phenomena - off Ponta dos Capelinhos - began with a submarine variant of the

Vulcanian-type explosions, that were accompanied by jets reaching an altitude of 1000 m or more. The emergent cinder ring, progressively formed, was at first an islet, but afterwards became connected to the island by a sand isthmus. The event lasted only until September 10 (Neumann van Padang et al. 1967). The violent submarine eruption was followed by a base surge (Moore 1967). (See items No. 528 and 530 as well).

☉ ↑ π★=

527. 1957 November 21 - 24--Submarine volcano on the Lomonosov Ridge, Arctic Ocean

A submarine, subglacial eruption took place on the Lomonosov Ridge. This nameless volcano is the northernmost one on the Earth. It was mentioned already in item No. 520, but as Hantke (1962) and Simkin et al. (1981) both gave 1957 for the year of occurrence, it is clear that the year 1955, as mentioned in No. 520, is erroneous, due to a printed error in the source.

π ▲

528. 1957 November - December--Fayal, Azores

The eruption that began on 1957 September 27 (see No. 526) continued (Neumann van Padang et al. 1967).

☉☉ ↑ π★

529. 1958 April - November--West-Northwest of Capelinhos, Azores

No exact location and date are known for the event which was reported in newspapers (therefore, the event is regarded as very doubtful). Allegedly, a submarine outbreak created an underwater feature, called Mount Mikhail Lomonosov. Samples of olivine basalt and other products of the eruption were recovered from the ocean floor. Within a radius of 40 km from the eruptive center, one-third of the sediments consisted of volcanic cinders. The event is not mentioned in the comprehensive catalog of volcanoes by Simkin et al. (1981).

π ? ?

530. 1958 May 13 - October 24--Fayal, Azores

The eruption of Fayal (see items No. 526 and 528, respectively) continued. In May 1958 it changed into a Strombolian type. A spatter cone grew inside the previous cinder ring and many lava flows entered the sea. The character change was accompanied by a swarm of shocks, including several destructive ones as well, although in all likelihood they were of volcanic and not tectonic origin. Horizontal and vertical displacements of the ground as much as a few meters were also observed (Neumann van Padang et al. 1967).

☉☉ ↑ π

531. 1958 July - 1965 August--Rumble I, II and III submarine volcanoes, South Kermadec Seamounts, Northeast of New Zealand

Kibblewhite (1966) has shown that three submarine eruptive centers existed at a point lying some 256 km east-northeast of the Great Barrier Island, northeast of the Northern Island of New Zealand. They were discovered by acoustic methods and are called Rumble I, II, and III, respectively. The fourth member of the group, Rumble IV, was discovered in April 1966.

The measurements have been carried out over years. Activity and probable activity were stated in the following months (see the graph in Figure 9 of Kibblewhite (1966) page 196).

- 1958 July, August, November, December
- 1959 March, April, May, August, October, November, December
- 1960 January, March, April, November
- 1961 March, November, December
- 1962 May, June, August, October
- 1963 The whole year, particularly in March, June, July, August
- 1964 January, February, March, April, July, August, September, November, December
- 1965 From January to August, almost continuously

π

532. 1958 October 2--Anak Krakatau, Indonesia
Detonations (Suryo 1978).

↑

533. 1958 October 23--Anak Krakatau, Indonesia
Detonations (Suryo 1978).

↑

534. 1958 November 5--Anak Krakatau, Indonesia
Three small ash eruptions (Suryo 1978).

↑

535. 1958--Bayonnaise Rocks, Izu Islands, Japan
Submarine activity, no details (Kuno 1962).

π

536. 1959 February 4--Anak Krakatau, Indonesia

Ash eruption (Suryo 1978).

↑

537. 1959 June 8--Anak Krakatau, Indonesia

Ash eruption, eruption cloud up to 1500 m (Suryo 1978).

↑

538. 1959 June 15 (?)--Nameless submarine volcano, Atlantic Ocean

Hantke (1962) reported that according to press information on June 15, a pilot flying above the Atlantic Ocean about 300 km west of Ireland, saw a green spot on the water and the spot appeared to be turbulent. It was supposed to be a submarine outbreak.

Note: The event is not mentioned in other sources including Simkin et al. (1981). The site, 300 km west of Ireland, is very far from the Mid-Atlantic Ridge and its rift valley, and is not a volcanic area. Therefore, the event is very doubtful.

κ ? ?

539. 1959 June 26--Unnamed submarine volcano, Tonga Island, SW Pacific

A reef was seen on which the sea breaks. On the day mentioned, churning of the water through bubbling gases was observed (Richard 1962).

κ ?

540. 1959 June--Falcon Island, Tonga Islands, SW Pacific

The volcanic island submerged entirely. No further signs of activity were observed (Richard 1962).

κ ↓

541. 1959 October 10 - 13--Karua, New Hebrides Islands, SW Pacific

Submarine eruption, new island (Blot 1963).

κ ☆

542. 1959 December--Anak Krakatau, Indonesia

Ash eruption (Suryo 1978).

↑

543. 1959--Bayonnaise Rocks, Izu Islands, Japan

Submarine activity was reported during this year (Kuno 1962).

κ

544. 1959--Metis Shoal, Tonga Islands, SW Pacific

The rock on which the sea breaks that emerged from the sea in 1858 (see event No. 147 in Hedervari 1984) submerged either in this year or somewhat earlier - the exact date is not known - at a depth of 3.7 m (Richard 1962).

κ ↓

E. SUPPLEMENT

545. 1951 November 24--Unnamed submarine eruptive center, NE of New Guinea

A marine disturbance was reported here; dead fish and marine growth were thrown up. On the same spot a "mud volcano" was reported in 1945 (see item No. 457). The submarine eruption in 1951 is, however, doubtful (Fisher 1957), although it is mentioned by MacDonald 1972 as a true submarine eruption.

κ ?

546. 1953 July 20--Unnamed submarine volcano, Mexico

Uncertain event (Simkin et al. 1981).

κ ?

547. 1955 October--Unnamed submarine volcano, East of Taiwan

Submarine eruption, no details (Simkin et al. 1981).

κ

S: The submarine volcano, earlier unnamed, has since received the name "Ruby." Its catalog number is No. 452 and 0804-21=, respectively (Simkin et al. 1981).

LIST OF SUBMARINE VOLCANO LOCATIONS

<u>Name and Serial Number</u>	<u>Latitude (degrees)</u>	<u>Longitude (degrees)</u>	<u>Catalog Event Number</u>
ALAIID, Kurile Islands, 0900-39	50.80 N	155.50 E	418
ALCEDO, Isabela Island, Galapagos Islands, 1503-04	00.43 S	091.12 W	500
ANAK KRAKATAU, Indonesia, 0602-00	06.102 S	105.423 E	380, 381, 384, 386, 388, 389, 391, 392, 394, 395 397-408, 410, 413, 417, 423, 424, 429, 432, 435 445, 447, 450, 453, 456, 460-462, 466, 470, 472, 481, 485, 492, 494, 496 507, 532-537, 542
ASKJA, Iceland, 1703-03	63.03 N	016.75 W	376
BAJA CALIFORNIA, off west coast			490
BANUA WUHU, Sangihe Islands, Indonesia, 0607-03	03.138 N	125.491 E	313, 315, 351, 427
BARCENA, San Benedicto Island, E. Pacific, 1401-02	19.27 N	110.80 W	477
BAYONNAISE ROCKS, Izu Islands, Japan, 0804-07	31.92 N	139.92 E	322, 344-347, 420, 458, 514, 420, 458, 514, 525, 543 Also see MYOJIN-SHO
BEZYMIANNY, Kamchatka, 1000-25	56.07 N	160.72 E	522
BOGOSLOF, Aleutian Islands, 1101-30	53.93 N	168.03 W	320, 321, 325, 328, 329, 331, 332, 334, 361, 373-375, 379, 411, 412, 426
BULUSAN, Philippines, 0703-01	12.77 N	124.05 E	419
CANAL D'ORLEANS AREA, near Antarctica			335
CAPELINHOS, AZORES, west-northwest of			529
CARABOBO, North of Gulf of Darien			454
CENDRES, SE Asia, 0705-02	10.158 N	109.014 E	362
COOK INLET, Alaska			304
DEMPO, Sumatra, 0601-23	04.03 S	103.13 E	330
DIDICAS, north of Luzon Island, 0704-02	19.08 N	122.17 E	473
ELDEY, Iceland, 1701-02	63.75 N	022.92 W	372
EMPEROR OF CHINA, Banda Sea, 0605-01	06.62 S	124.22 E	377
FALCON ISLAND, Tonga Islands, SW Pacific, 0403-05	20.32 S	175.42 W	303, 341, 359, 383, 387, 393, 416, 428, 434, 446, 464, 540
FAYAL, Azores, 1802-01	38.60 N	028.73 W	526, 528, 530
FIJI ISLANDS			324
FONUALEI, Tonga Islands, SW Pacific, 0403-10	18.15 S	174.325 W	436
FUKUTOKU-OKANOBA, Bonin Islands, Japan, 0804-13	24.28 N	141.52 E	318
HAWAII			312

LIST OF SUBMARINE VOLCANO LOCATIONS

<u>Name and Serial Number</u>	<u>Latitude (degrees)</u>	<u>Longitude (degrees)</u>	<u>Catalog Event Number</u>
HODDER'S VOLCANO, West Indies, 1600-13	14.03 N	061.07 W	309
ILE DES CENDRES (see Cendres)			
IRIMOTE-JIMA, Ryukyu Islands, 0802-01	24.57 N	123.93 E	369
KARUA, New Hebrides Islands, SW Pacific, 0507-07	16.829 S	168.536 E	305, 463, 465, 467, 479, 541
KELUT, Java, 0603-28	07.93 S	112.308 E	353
KHARIMKOTAN, Kurile Islands, 0900-30	49.05 N	154.43 E	415
KICK-'EM-JENNY, W. Indies, 1600-16A	12.30 N	061.63 W	437, 449, 495
KILAUEA, Hawaii, 1302-01	19.425 N	155.292 W	365, 510
KIWU LAKE, Central African Volcanic Region			314
KLIUCHEVSKAJA SOPKA, Kamchatka, 1000-26	56.18 N	160.78 E	430
KOVACHI, Solomon Islands, SW Pacific, 0505-06	09.02 S	157.95 E	471, 474-476
LOMONOSOV RIDGE, submarine volcano, Arctic Ocean, 2001-01	88.27 N	065.60 W	520, 527
MATAVANU, Samoa, SW Pacific, 0404-04	13.52 S	172.37 W	319
MATTHEW ISLAND, SW Pacific, 0508-01	22.33 S	171.32 E	493
MAUNA LOA, Hawaii, 1302-02	19.475 N	155.608 W	355, 356, 371, 425, 469
METIS SHOAL, Tonga Islands, SW Pacific, 0403-07	19.18 S	174.87 W	544
MONACO BANK, Azores, 1802-11	37.60 N	025.88 W	337
MONT PELEE, W. Indies, 1600-12	14.82 N	061.17 W	306, 308
MYOJIN-SHO, Izu Islands, Japan, 0804-07	31.92 N	139.92 E	448, 478, 480, 483, 484, 486, 487, 491, 505 Also see Bayonnaise Rocks
NAMELESS SUBMARINE VOLCANOES OR ERUPTIVE CENTERS	See unnamed submarine volcanoes in order of serial number		
NIEUWERKERK, Banda Sea, 0605-02	06.60 S	124.675 E	368, 378
NUSHIMA, Ryukyu Islands			317
NYAMURAGIRA, Africa, 0203-02	01.38 S	029.20 E	358
OMETEPE, Nicaragua, 1404-12	11.53 E	085.62 W	311
ORMUS ISLANDS, Gulf of Arabia, 0302-14	26.00 N	057.00 E	455
PALUWEH, Lesser Sunda Islands, 0604-15	08.32 S	121.708 E	382, 390
PAVLOF, Alaska Peninsula, 1102-03	55.42 N	161.90 W	459
PERRY ISLAND, Aleutian Islands	54.00 N	168.00 W	323
PINNE MARINE BANK, Sicily Sea, 0101-07c	36.90 N	013.00 E	339
POAS, Costa Rica, 1405-04	10.20 N	084.22 W	333

LIST OF SUBMARINE VOLCANO LOCATIONS

<u>Name and Serial Number</u>	<u>Latitude</u> (degrees)	<u>Longitude</u> (degrees)	<u>Catalog Event Number</u>
RUMBLE I, II and III submarine volcanoes, South Kermadec Seamounts, northeast of New Zealand, 0401-28	35.53 S	178.87 E	531
0401-29	35.42 S	178.65 E	531
0401-30	35.70 S	178.48 E	531
SAKURA-ZIMA, Kyushu, Japan, 1802-08	31.58 N	130.67 S	342
SANTORINI, Aegean Sea, 0102-04	36.404 N	025.396 E	366, 367, 370, 385, 439, 440-444, 468
SIMUSIRI, Kurile Islands (if same as Simusiru Fudzi), 0900-19	47.02 N	152.12 E	352
SIN-IWO-ZIMA, Bonin Islands, Japan, 0804-13	24.28 N	141.52 E	316, 343, 350, 499
SMITH ROCKS, Izu Islands, Japan, 0804-08	31.28 N	139.77 E	349
STROMBOLI, Italy, 0101-04	38.789 N	015.213 E	354, 409, 501, 511
TAAL, Philippine Islands, 0703-07	14.00 N	121.00 E	336
TOKARA-IWO-JIMA, Ryukyu Islands, 0802-06	30.78 N	130.28 E	421
TORI-SIMA, Izu Islands, Japan, 0804-09	30.48 N	140.32 E	310, 438
TULUMAN, Admiralty Islands, SW Pacific, 0500-01	02.447 S	147.32 E	488, 489, 497, 502, 503 504, 506, 509, 512, 513, 515-519
UNNAMED SUBMARINE ERUPTIVE CENTERS (see unnamed submarine volcanoes in order of serial number)			
UNNAMED SUBMARINE VOLCANOES in order of serial number:			
Tonga Islands, SW Pacific, 0403-01	21.458 S	175.769 W	327, 414
" " " 0403-02	21.07 S	175.33 W	338
" " " 0403-03	20.85 S	175.53 W	363
" " " 0403-04	20.57 S	175.38 W	340, 433, 539
New Guinea (NE of), 0501-04	04.311 S	146.256 E	457, 545
New Hebrides Islands, SW Pacific, 0507-06	16.68 S	168.37 E	357, 482, 498
Sangihe Islands, Indonesia, 0607-05	03.97 N	124.17 E	360, 508
Taiwan (N of), 0801-05	26.18 N	122.458 E	348
Taiwan (E of), 0801-011	19.17 N	132.25 E	547
Mariana Islands, Cent. Pacific, 0804-21	15.62 N	145.57 E	452 and <u>S</u> in Sup- plement
Kurile Islands, 0900-23	48.08 N	153.33 E	364
Hawaii, Kauai (E of), 1302-09	21.75 N	158.75 W	523
Hawaii, 1302-10	23.58 N	163.83 W	521
Mexico, 1401-005	28.00 N	115.00 W	546
San Jorge region, 1802-03a	38.50 N	027.42 W	307
Monaco Bank, Azores, 1802-11	37.60 N	025.88 W	326, 337
Lomonosov Ridge, Arctic Ocean, 2001-01 (see Lomonosov Ridge, submarine volcano, Arctic Ocean)			

LIST OF SUBMARINE VOLCANO LOCATIONS

<u>Name and Serial Number</u>	<u>Latitude</u> (degrees)	<u>Longitude</u> (degrees)	<u>Catalog Event Number</u>
Atlantic Ocean			538
UNNAMED UNDERWATER VOLCANOES:			
see: unnamed submarine volcanoes, in order of serial number			
URACAS, Mariana Islands, Cent. Pacific, 0804-14	20.53 N	144.90 E	422
VETERAN, SE Asia, 0705-01	09.83 N	109.85 E	396
VSEVIDUF, Umnak Island, Aleutian Islands, 1101-27	53.13 N	168.68 W	524
VULCAN, New Britain, SW Pacific, 0502-14	04.271 S	152.17 E	431

ADDENDUM: The Loihi submarine volcano, Hawaiian Islands

In terms of the theory of hot spots and mantle plumes, the existence of the Hawaiian chain of extinct seamounts, inactive island volcanoes, and active volcanoes (Mauna Loa, Kilauea and some smaller vents, volcanoes, and lava lakes, e.g., Mauna Ulu, Kilauea-Iki, etc. on the eastern slope of Hawaii) is the consequence of the combined effect of the horizontal plate motion (spreading) of the Pacific lithosphere and the action of the plume that now can be found beneath Mauna Loa and Kilauea.

Starting from Kilauea and going along the chain toward the northwest, one can find progressively older volcanic features. On this basis and considering the theory of hot spots and plate tectonics, the birth of the youngest member of the chain is to be expected somewhere southeast of the East Rift Zone, which belongs to the system of Kilauea and which has been the site of the recent eruptions. Mauna Loa and Kilauea will separate from their (probably common) mantle plume within the next million years owing to the continuous northwestern displacement of the oceanic lithosphere that carries them. The mantle plume is regarded to be a feature having a fixed position relative to the core of the Earth. As a consequence of this process, these two volcanoes became extinct.

On the submarine flank of Hawaii, there is an eruptive center, named Loihi, that represents the nascent, youngest seamount within the chain as a whole. Varying estimates for its age range from 2,000 to 20,000 years. It is located on a submarine "peninsula" that is defined by the southeastern protrusion of the 2000- and 3000-m isobaths. It has a height of some 950 m above the 2000-m isobath-line.

Loihi is definitely an active volcano; volcanic earthquake swarms took place there in 1971-72 and in 1975. These swarms of shocks were caused by either intrusions of magma that flowed through the interior of the new volcano but stopped before reaching the floor of the ocean, or by effective submarine eruptions when the magma reached the floor of the ocean and phreatomagmatic explosions occurred.

Morphologically, Loihi is a typical shield volcano, having a top-caldera with a diameter of some 3200 m. According to sonar bathymetric investigations and underwater photos taken by high-resolution camera, there are two rift systems on the surface of Loihi. One system can be found north of the caldera, while the other is along the south flank. Since very little oceanic sediment has accumulated over the surface of the volcano, a relatively young age is suggested for Loihi. The lava appears to be fresh and glassy in structure. The lava may have flowed during the last two centuries, but no precise information is available about these earlier eruptions. They represent only an insignificant event in the history of Loihi. Many other eruptions must have occurred during the last millennium since the volume of Loihi is remarkably large. Loihi has 2 percent of the volume of Mauna Loa. It should continue its activity and emerge from the ocean to form a subaerial volcano. Mauna Loa and Kilauea will be extinct volcanoes.

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