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REPORT ON THE INTERNATIONAL SYMPOSIUM ON VOLCANOLOGY, JAPAN 1962

by

C.D.Branch

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APPENDICES:

1. List of countries and numbers of participants.
2. Itinerary of overseas trip to Japan.
3. The interpretation of the suffix on volcano names.
4. Rocks collected on excursions in Japan.

FIGURES

Figure 1: Map of Japan showing active volcanoes.

Figure 2: Asama volcano, from Karuizawa. The active crater of Kama-yama (2542 m.a.s.l.) is in the centre, and the lava dome of Sekison-zan is on the left.

Figure 3: The graph used by Minakami at Asama Volcano to predict eruptions.

Figure 4: Sakura-zima volcano from the rim of the Aira Caldera at Kagosima city. The peaks are, from left to right; Hikino-hira (double), Minami-dake (active), and Kita-dake (double). Volcanologist T. Matsumoto is on the right hand side, foreground.

Figure 5: The volcano observatory of Kyoto University on Sakura-zima volcano.

Figure 6: The active crater of Naka-dake in the Aso Caldera. Note the crowds of tourists on the lip of the crater, and the terminal of the aerial rope-way, behind them.

Figure 7: Protective shelters for tourists in case of an eruption at Naka-dake (Aso Caldera). The lip of the crater is in the background.

Figure 8: Aso welded tuff containing pumice fragments. This is from the second welded tuff sheet on the eastern side of the caldera.

Figure 9: Syowa-sinzan volcano from Naka-zima lava dome in the centre of Toya Caldera Lake. The volcano consists of a lava dome which protrudes from the 'roof mountain' of uplifted country rock. To the right is Higasi-Maru-yama lava dome and the lower slopes of Usu volcano.

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SUMMARY

I visited Japan from 8th May to 2nd June, 1962, to attend the International Symposium on Volcanology and to visit instrument manufacturers, in order to gain experience for the post as Volcanologist at Rabaul. Seventy papers were presented at the Symposium, dealing with prediction of time and place of volcanic eruption, and the relation between magmas and nature of volcanic eruption. In addition, the terminology of pyroclastic flows (ignimbrites) was discussed.

Excursions were made to five volcanoes where a variety of basalts, andesites, and dacites were examined in the field and the evolution of the volcanoes studies. Volcano observatories were inspected and much data were collected on telemetering seismometer records to a central observatory. At Asama volcano especially, Minakami has evolved an effective method of prediction using the frequency of B-type earthquakes (epicentral depth 0.5 to 2 km.).

The manufacturers of seismological and volcanological instruments were visited in Kyoto and Tokyo and many catalogues of their equipment and prices are now on file.

I have included a section on the excellent organisation of the Symposium, which might be of help to those undertaking a similar task.

INTRODUCTION

An International Symposium on Volcanology was held in Japan from 9th to 19th May, 1962. It was organized by the Seismic Council of Japan in co-operation with the Volcanological Society of Japan, and was held at the Nihon Toshi Centre in Tokyo, the Seizan Hotel in Karuizawa, and the Kanko Kaikan in Hakone. The Symposium was under the sponsorship of the International Association of Volcanology of the International Union of Geodesy and Geophysics. It was attended by 204 participants which are listed in Appendix 1.

Three subjects were discussed in the Symposium:

(1) Prediction of time and place of volcanic eruption;

(2) Relation between magmas and nature of volcanic eruption;

(3) The problems of pyroclastic flows, especially their terminology.

In addition to the sessions at which 70 papers were presented, two field trips were arranged during the Symposium period, and three concurrent trips to several active volcanoes after it.

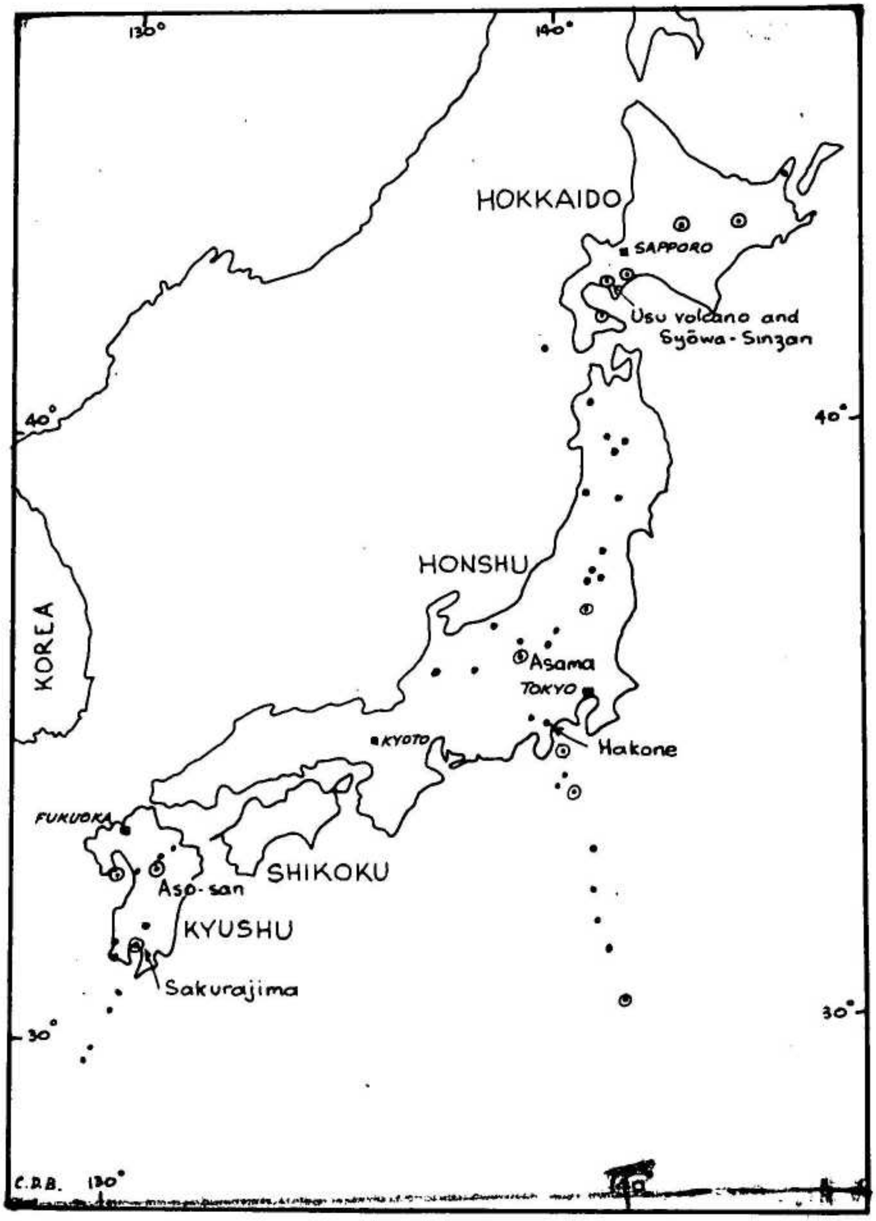

FIGURE 1: Map of Japan showing active volcanoes.

⊙ Volcanoes with permanent observation stations.

• Other volcanoes.

Named volcanoes were visited on excursions.

The purpose of my attendance at the Symposium was to study all aspects of volcanology in preparation for a term as Officer-in-Charge of the Volcanological Observatory at Rabaul, New Britain. Also, the discussions on pyroclastic flows were of great assistance to my present study of the relationship between pyroclastic flows and granite in North Queensland.

My itinerary (see Appendix 2) was that of the Symposium for the period 8th to 24th May. The remainder of the time, until I left Japan on 2nd June, was spent visiting Universities, instrument manufacturers and volcanoes in Hokkaido.

PAPERS PRESENTED

This section summarizes papers presented at the Symposium and is divided into those of interest to general volcanology and prediction; to geophysics; and to petrology. Only the papers of immediate interest will be discussed here: the 70 papers were printed in abstract form and published in a booklet given to all participants, and it is hoped that the full papers will be published soon in a special volume of the Bulletin Volcanologique.

General Volcanology

Pyroclastic Flows in Japan: S. Aramaki and M. Yamasaki: Pyroclastic flows were classified into three groups on the basis of the volume of the deposit. Deposits less than 0.1 cubic kilometers were called 'nuea ardentes': deposits between 0.1 and 100 cubic kilometers were 'intermediate size flows': deposits greater than 100 cubic kilometers were 'pyroclastic flows'. It was found that all deposits greater than 100 cubic kilometers were rhyolitic, but those smaller were either basaltic, andesitic or dacitic.

Resurgent Cauldrons: Their Relation to Granite Ring Complexes and Large Volume Rhyolitic Ash-Flow Fields: R.L. Smith and R.A. Bailey. A study of the Valles caldera in New Mexico, suggests that the final development in the history of a caldera is central doming of the caldera floor. It is concluded that some ring complexes were formed under compression.

Two papers were presented dealing with the 1959-60 eruption of Kilauea, and they are summarized together.

Internal Structure and Eruptive Mechanism of Kilauea Volcano: J.P. Eaton.

Relationship Between Differentiation of Kilauea Magmas and their Thermal History, as Shown in the 1959-60 Eruption: K.J. Murata and D.H. Richter. Primitive Kilauean magma rose from a depth of about 60 kilometers and accumulated in a magma chamber a few kilometers beneath the summit. From this chamber, magma rose to both erupt at the summit and to migrate laterally, as much as 45 kilometers along the rift zone, to erupt eventually on the flank of the volcano.

Directed Volcanic Blasts: G.S. Gorshkov. The appearance of stable earthquakes under an extinct andesitic volcano, is commonly a prelude to a catastrophic directed volcanic blast.

The Broad Approach to Volcanic Prediction: J. Healy.

The last eruption in New Zealand was Tarawera in 1886. However, many volcanoes must be considered to be still active. Detailed geological and geophysical investigations are needed to detect signs of future impending eruptions, especially from recently found volcanic centres which were previously not known to exist.

Fundamental Research for Predicting Volcanic Eruptions: T. Minakami.

Minakami is regarded as the chief authority in Japan on volcanic prediction. He described and listed the following premonitory phenomena.

1. Changes of earthquake frequency in and near the respective volcanoes.

2. Crustal deformation including upheaval, subsidence, tilting, expansion and contraction of the earth's surface near volcanoes.

3. Changes of geothermal temperature in and near craters and fumaroles.

4. Anomalous variations in the geomagnetic field on and near volcanoes.

5. Changes in the nature and volume of vapour and the volcanic gases from craters and fumaroles.

Details of Minakami's studies of earthquake foci preceeding eruptions are described in the section of Asama volcano.

Nature of Volcanic Gases and Volcanic Eruption: I. Iwasaki and others.

The nature of volcanic gases varied with their orifice temperature. It has been found that the radioactivity of gases became gradually smaller as eruptions approached, because the ratio Tn/Rn became smaller as time spent in transporting the gases from their origin to the surface decreases. In contrast, the hydrogen sulphide concentration became larger from the beginning of an eruption.

Prediction of Volcanic Eruption by Measuring the Chemical Composition and Amounts of Gases: K. Naguchi and H. Kamiya.

Volcanic eruptions are caused by the increase of gaseous pressure. Measurements of the percentages of F, Cl, S in fumarole gases indicated that eruptions were preceded by a marked increase in the amounts of these elements. Prediction times were of the order of one to two weeks.

The Temperatures in the Crater Region of Some Indonesian Volcanoes Before the Eruption: M. Newmann van Padang.

There were no distinct indications that a new eruption was preceded by an increase in temperature of the fumaroles of the volcanoes. The general application of this conclusion was disputed by Taylor (Aust.) who quoted examples from New Guinea where the reverse was true.

Seismic and Tilt Phenomena Preceding a Pelean Type Eruption from a Basaltic Volcano: G.A. Taylor.

The thesis that luni-solar influence was the trigger action for volcanic eruptions, provided seismic and other indications were near their peak intensities, was well shown in the eruptions of Lamington and Manam volcanoes. This paper created much interest among the Japanese and Hawaiian volcanologists present; each group could predict the probability of an eruption from seismic data, but they were still searching for another factor to define the time of eruption more accurately.

Geophysics.

Geomagnetic Studies on Volcano Mihara: T. Rikitake, and others.

During the period of the 1950 eruption of volcano Mihara, anomalously large decreases in the geomagnetic dip angle were observed over the volcano. This phenomenon gave a two to three months prediction of the eruption. The explanation given is that the magnetic intensity decreases as rocks are heated towards their curie point around a near surface magma chamber.

(Note: I have discussed this matter with several members of the School of Geophysics, Australian National University, who all regard the reasoning as sound.

Two recording magnetometers are needed ; one on the volcano, and one some distance away to record background variations.)

Prediction of Volcanic Eruption Aso and Sukurazima and Some Related Geophysical Problems: A. Kubotera and K. Yoshikawa.

A study has been made of the amplitude variations of volcanic microtremors. It was found that there was a sudden increase in the amplitude of tremors, maintenance of the maximum, and then a rapid decrease, before the eruption.

Petrology.

Two papers were presented dealing with the regional petrology of Japanese volcanoes. They are discussed together.

Igneous Rock Series and the Nature of Eruption:H.Kuno.

Types of Quaternary Volcanic Activity in Northeastern Japan: K. Yagi, Y. Kawano and K. Aoki.

Four rock series can be distinguished among the rocks consitiuting the Japanese volcanoes:

1. Pigeonitic series, derived from primary tholeiite magma
2. Basalt-dacite series, derived from high-alumina basalt magma;
3. Alkali rock series, derived from alkali olivine basalt magma;
4. Hypersthenic rock series, derived from any of the three primary magmas, probably through contamination by granite material.

This last magma is more viscous but also richer in volatiles than the other three magmas, and is the source of pyroclastic flow eruptions.

The three primary magmas are found in parallel belts following the main axis of the islands of Japan. The tholeiite magma is on the Pacific side of the islands, and is associated with relatively shallow earthquake epicentres; the high alumina magma is in the centre, and associated with intermediate earthquakes; and the high alkali magma is found on the Japan Sea side of the island, and is associated with deep focus earthquakes.

Kuno maintains that each of the three magmas is primary and associated with earthquakes of certain depths. However Tilley regards the high alumina basalt as derived from the tholeiitic magma by the addition of water suppressing the crystallization of feldspar.

DISCUSSIONS

As part of the Symposium programme a discussion was held on the terminology of ignimbrites. Dr. R.L. Smith (U.S.A.) was the chairman and he had been invited to prepare a list of the various definitions of the term 'ignimbrite' by the 1961 Catania Symposium on Volcanology (attended by D.A.White of this Bureau). He presented 23 published definitions of the term'ignimbrite', and many were contradictory. At this stage it was moved, but not sustained, that the term 'ignimbrite' be abandoned.

J. Healy (N.Z.) mentioned that the original term was defined on a misinterpretation of the origin of the rock to be named, and that although he came from the country where the term 'ignimbrite' originated, he was aware of the present confusion and would not mind if the term was abandoned.

I pointed out that in all uses of 'ignimbrite' or synonymous terms, there were implied two concepts; a structural concept involving vertical zoning and aerial extent inherent in any single unit; and a petrogenetical concept of rock composition and origin. In order to fully cover all these ideas, a three-term name is needed defining firstly, the rock composition (e.g. rhyolite); secondly, the type of unit and origin (e.g., pyroclastic flow (general term) welded tuff (specific)); and thirdly, structural form (e.g. sheet). A name such as 'rhyolitic pyroclastic flow sheet, covers practically all the 23 definitions listed by Smith.

It was informally concluded that the term 'ignimbrite' be retained, but that it was synonymous with the general term 'pyroclastic flow'. No-one tried to relate nuee andentes and ignimbrites. Rittmann pleaded for everyone to define the terms he uses at the commencement of each paper.

Of definitions published so far, I feel that those of R.L. Smith (U.S. Geol.Surv. Publ. 366) are most applicable and should provide the foundation for all future field and laboratory studies.

During informal discussion with the participants, I was able to glean many useful ideas. Robson (U.K.) who is the volcanologist in Trinidad, was very helpful. He is in the process of setting up a number of seismometer sub-stations recording back to a central observatory, which is similar to that envisaged for Rabaul. As yet he has not found any instrument completely suited to the task, but as they have a physicist full-time on the staff they will be able to modify them. He is keen to keep in touch with the Rabaul developments and has given an open invitation to any member of the staff to visit Trinidad.

Eaton and Richter from the Hawaiian observatory gave me much useful advice on tiltmeter methods, but these are not applicable to Rabaul conditions because the area is not so accessible. Eaton described the method of using local earthquake data for making crustal studies. Such a study is necessary in the Rabaul area since travel time tables are specific for one crustal model only and the local model, as yet unknown, is needed for determining the accurate time or origin of earthquakes related to volcanoes.

EXCURSIONS TO VOLCANOES AND OBSERVATORIES

The volcanoes visited are shown on Figure 1, and the rock specimens collected are listed in Appendix 4. Each volcano is briefly described and the observatories and research on prediction at each is discussed.

Asama Volcano

Asama is a compound volcano consisting of three overlapping bodies. These volcanoes form a mountain range running from east to west, Asama being the highest of the range. Kama-Yama (2550 metres) is the active crater on Asama volcano. The volcano has passed through four stages in its evolution:

1. Lava flows of olivine-bearing hypersthene-augite andesite;
2. Thick dacite lava flows;
3. Pumice flows of augite-hypersthene dacite;
4. Pyroclastic flows and lavas of augite-hypersthene andesite (Holocene to present).

Most eruptions were of the Vulcanian type sometimes with considerable amounts of pumice shower. The last major eruption was in 1783 when a nuee ardente was ejected. Asama has erupted frequently in the period from 1933 to 1961, the total number of eruptions amounting to nearly 2,000.

Because of the frequency of eruptions and the fact that as many as 2,000 climbers a day may visit the lip of the active crater, the prediction of eruptions is vitally important.

T.Minakami of the Earthquake Research Institute, Tokyo University, is in charge of the observatory on Asama, and since 1933, he has carried out what are probably the most important studies in predicting eruptions in Japan.

At present a network of 11 seismograph stations is established near the summit of the crater, on the mountain slopes, and at the foot of the volcano. They are operated by a tele-recording system and all records are obtained on smoked paper drums in a single room at the main observatory located four kilometers from the active crater. In this way all records have time marks from the one chronometer.

Transducers, with a period of 1 second and being either a vertical or horizontal component, are used at the ten field sub-stations. These are connected by wire to the observatory. The signals are amplified and recorded by a pengalvanometer, giving a magnification of 4,000. Similar transducers are installed at the observatory, as well as four Ishimoto seismographs with a period of 1 second and a magnifications of 50 and 350. During electrical storms the system is shut off.

Other types of equipment continuously recording at the observatory are:

(a) A Sony tape recorder, model 552, with an endless magnetic tape, used for measurement of detonations. Sounds gathered by a microphone at the crater rim are preamplified before being recorded. There is a frequency response of 50 to 8000 cps, and a lower limit of 6db. The tape has a 15 minute storage time after which the sounds are automatically erased. If they are wanted, then the tape is changed.

(b) Five field sub-stations record temperature of fumaroles etc., using thermistors, and each records graphically at the observatory.

At a sub-station near the observatory a horizontal pendulum tiltmeter and a silica tube extensiometer are set up.

A recording magnetometer is used to measure changes in the geomagnetic field around the volcano.

By accurately measuring the arrival times of earthquakes at the various stations, using 50-cycle per second oscillograph, Minakami is able to calculate epicentral depth. These fall into two groups; A-type earthquakes at an average depth of 5 km. below the crater; and B-type earthquakes at a depth of 0.5 to 2 km. The problem has been studied statistically and an empirical formula for predicting eruptions of Mt. Asama was arrived at based on the frequency of B-type volcanic earthquakes. In essence it was found that if the frequency of B-type earthquakes was about 600 per five days, then there was a 100% chance of an eruption over the following five days. This formula has been proved practical, but an additional factor, such as the luni-solar influence of Taylor is needed to trigger the eruption.

Hakone Volcano:

Hakone is a triple volcano consisting of double calderas and seven post-caldera cones. It was built up during the period from middle to younger Pleistocene. Three stages can be distinguished:

1. Formation of the oldest cone by alternating eruptions of basaltic and andesitic lava and pyroclastic rocks of pyroxene andesite. These are now exposed in the walls of the Old Somma, a caldera 11 km. by 7 km. formed at the end of this stage.

2. Eruption of pyroxene andesite and dacite lavas, followed by pumice eruptions of similar composition, giving rise to a second caldera represented now by the Young Somma.

3. Formation of seven central cones of viscous pyroxene andesite. Solfataric and seismic activity still persist in the area.

This volcano is where H.Kuno carried out his early petrological studies and the rock types are known in detail. The Old Somma lavas range from olivine basalt (SiO_2= 47.33) to pyroxene andesite (SiO_2= 63.74), with a little pyroxene dacite (SiO_2= 70.50). Most of them belong to the pigeonitic rock series, being products of fractional crystallization of the tholeiitic magma.

The Young Somma lavas range from pyroxene andesite (SiO_2= 61.10) to pyroxene dacite (SiO_2= 75.85), all of the pigeonitic rock series.

The Central Cone lavas are rather uniform pyroxene andesite of the hypersthenic rock series, perhaps derived from the high-alumina basalt magma through contamination by granitic material.

<u>Sakura-zima volcano</u>

Sakura-zima is one of the most frequently erupted volcanoes in Japan. It is situated in the southern rim of the Aira Caldera, the outline of which is now represented by the circular coast of the northern part of Kagosima Bay. The volcano is made up of three strato-volcanoes, with Minami-dake (1060 m.) being the active crater. There have been 39 recorded eruptions since 708 A.D. and activity is strong at present.

All lavas are augite-hypersthene andesite ranging in SiO_2 from 57 to 67 percent.

Two observatories are located on the volcano: one is run by the Japan Meterological Agency and has two tele-recording seismograph sub-stations, as well as a three component seismograph and a 450-time mechanical seismograph at the observatory; the other is a magnificent two storied re-inforced concrete structure recently built by Kyoto University.

There are eight sub-stations attached to the observatory each with a vertical or horizontal seismometer. They have short and long period seismographs with periods of 1.0 sec. and 8.0 sec. Magnifications range from 50 to 2,000. Tilting is measured by a water-bulb level variometer.

<u>Aso-sano</u>

This volcano is best known for its gigantic caldera which measures 17 km. by 25 km., and averages 500 m.deep . There are more than a dozen post-caldera cones in the middle of the depression. Since 769 A.D., nearly 90 eruptions have been recorded from Naka-dake, one of the central cones. The main rock in the area is Aso tuff, a composite formation of hypersthene-augite andesite welded tuff sheets, which was poured out before the caldera was formed.

Geophysical studies of the volcano began in 1928 when the observatory of Kyoto University was built 7.3 km away from the active crater of Naka-dake. The observatory now has 16 seismographs, four horizontal pendulum-type tiltmeters, and a recording magnetometer. The main difference between this observatory and the one at Asama, is that at Aso, one of the three field sub-stations is equipped with a wireless telerecording seismograph continuously sending signals to the main observatory.

Details of the wireless telerecording system are:

(a) VHF (very high frequency) multi-channel telerecorder for seismographs.

(b) Frequency of transmitting wave, 62.9 Mc.

(c) Power of transmitter, 5 watt.

(d) Modulation system, FM-PM.

(e) Band of transmitting frequency, 0.1 - 20 c/s.

(f) Sub-carriers 1.3 Kc, 1.7 Kc, 2.3 Kc.

(g) Maximum transmitting distance with a power of 5 watts is 20 km.

(h) Smoke causes weakening of carrier.

(i) A three component seismograph is used with a period of 1.2 sec, and a magnification of 1000.

The Japan Meteorological Agency also has a station on Aso-san equipped with electromagnetic seismographs, a 450-times mechanical seismograph, and a tiltmeter.

In the Aso Volcano, eruptions are mostly accompanied by a change in the amplitude and period of volcanic tremors. The amplitude of the tremors increases several hours or days before each eruption, and then decreases gradually before it almost vanishes just before the eruption. This points out the importance of knowing the individual characteristics of each volcano, because by contrast, Asama eruptions are preceeded by earthquake swarms.

Usu Volcano and Syowa-Sinzan.

Usu volcano is located on the southern rim of Toya Caldera which is 8 to 11 km in diameter. The volcano is built up of lavas and pyroclastics of augite-hypersthene andesite belonging to the pigeonitic rock series of Kuno. Two lava domes of hypersthene dacite protrude from the summit crater; they are known as 'O-Usu' and 'Ko-Osu', and reach a height of 725m. a.s.l.

Two kilometers east of Usu is the hypersthene dacite dome of Syowa-Sinzan. This mountain, 406.9m a.s.l., was formed during the period December 1943 to September 1945. In the first six months only earthquakes were felt, after which the country-side started to rise over an area about 1000 m. diameter and reached a maximum height of 100 m. in October, 1944.

The protusion of a dacite dome then began and continued until activity ceased in September, 1945. Many solfataras are still active on the surface of the dome. It is interesting to note that on the mountain a colony of algae, Cyanidium caldarium grows in spring water with a ph of 1.5 to 3.

VISIT TO JAPAN METEOROLOGICAL AGENCY.

The aims of the Agency are weather prediction and disaster prevention. Included in this second category are tsunami, seismological, and volcanological observations. Details of some of their volcano observatories were given in the section on excursions. The agency is not obliged by law to give predictions on eruptions, but it does so at public request. Most of their work duplicates that done by the Earthquake Research Institute and various Universities, and no research is carried out. However, they are the only co-ordinated organization observing volcanoes and as such, their work is of value.

The Agency has recently published volume 1, number 1, of the Volcanological Bulletin, covering the period January-March, 1961. In this the 48 active volcanoes in Japan are listed, and contoured maps of many are given. Details supplied for each volcano deal with volcanic smoke and explosion, and seismic activity. Many eruptions are illustrated by photographs.

VISIT TO EARTHQUAKE RESEARCH INSTITUTE.

This Institute is attached to Tokyo University and carries out research in seismology (theoretical and engineering), volcanology, geothermy and geomagnetism, gravity and oceanography (tsunamis and tides).

The volcanological section is under Prof.T. Minakami, and observatories are established at Asama and Oshima. The important research at Asama has been described in the section on excursions.

At the Institute I was able to examine the characteristic seismograms of A- and B-type earthquakes and to see how accurate arrival times are determined. The method used is: after the first volcano-earthquake shock is felt, the operator switches on high speed recorders, with a rate of 3 cm/sec., and time marks are put on by a 50 cycle/sec oscillograph. In this way, the small differences in arrival times at the various sub-stations are easily calculated. It is absolutely essential in this type of work to have all seismometers recording at a central observatory so that the one time mark can be used on all records.

CONCLUSIONS RELATED TO VOLCANOLOGY

1. The study by Minakami at Asama Volcano is probably the most advanced in Japan (and also the most successful for prediction).

2. The equipment needed at each volcano for predicting eruptions is as follows:

   a. Short period, high magnification, seismographs set up at numerous field sub-stations and telemetering to a central observatory:

   b. accurate tiltmeters;

c. at least two recording magnetometers;

d. continuous sound recording to measure detonations;

e. precise levelling equipment for surveying;

f. high-speed recorders and a 50 cycle/sec / oscillograph for the accurate determination of arrival times of earthquakes;

g. thermisters and recorders for temperature determinations;

h. gas collection and analysis apparatus;

i. petrological equipment;

j. volcanologists, physicists and technicians.

3. A petrological study of a volcanic group is necessary to determine the types of eruptions to be expected.

VISITS TO INSTRUMENT MANUFACTURERS AND RELATED INFORMATION.

This section is treated briefly because all details of equipment are contained in manufacturers descriptions which are now on the following B.M.R. (Geological Branch) files:

206 G/1 - Seismological, magnetometer, and oscillograph equipment;

18 B/7 - Photographic;

18 B/5 Microscopes;

18 B/11- X-ray/electron microscopes, electron probe analyser, and radio.

Akashi Seisakusho, Limited. Tokyo.

The Akashi firm manufacture high quality seismograph equipment, as well as tiltmeters; X-ray machines; electron microscopes; electron probe analysers which can detect elements in the range 6 (C) and 12 (Mg) to 92 (U); and hardness testers. Their short period HES seismograph is useful because the records are made on 35 mm film enclosed in a detachable, light-proof, box. This means that the observation room can be continuously lit, and only a small darkroom is needed to change films. However, the firm was not co-operative in adapting equipment for local needs.

Hosaka Shinde Keiki Mfg.Co.,Ltd., Tokyo.

This is a small firm manufacturing precision seismographs; natural periodmeters; vibration generators; bendingmeters; and sensitivity attenuators. They have a wide range of seismometers and recorders and were quite willing to modify their equipment to suit the buyer.

Iseya Machine Factory Kyoto.

The University of Kyoto designs their instruments for their volcano observatories and the Iseya firm manufactures them commercially. The range includes seismographs, tiltmeters, and extensometers. Most interest is in the tiltmeter, model - P1, which is highly sensitive and records tilt movement photographically on a revolving drum. This visit was a little restricted because no one at the factory could speak English and I could not speak Japanese.

Microscopes

I examined the Nippon Kogahu polarizing microscope model POH. It sells for ¥139,000 (approximately £A175) and is called a 'research microscope' although the maximum magnification was 400. The resolution of the lens systems was good, but machining of the metal parts of the body was not accurate and there was wobble in the Bertrand and polarizing slide parts. Considering the price, the microscope does not appear to be a good buy except for field use.

Stereoscopes

Large stereoscopes only are manufactured in Japan. The one available sells for ¥48,000 (£A60), and has a field of three inches and a magnification of 1.8.

Cameras

A multiplicity of excellent cameras is available. Two cameras have recently come on the market, and deserve mention. The Olympus EE is a camera using 35 mm. film, but only exposing half a frame at a time, so that on black and white film more than seventy exposures are available. It is also fitted with an automatic electric-eye exposure meter and yet sells for ¥3,300 (no tax) (£A10).

In the way of reflex 35 mm cameras, the Miranda D is excellent value at ¥29,000 (no tax) (£A39).

Camera prices in Japan are about half that paid in Australia for the same product.

ORGANIZATION OF THE SYMPOSIUM

This note is included to assist organizers of any similar meeting.

All participants agreed that the organization of the symposium was the best of any they had attended. This is a tribute to Professor Kuno and Professor Minakami who gave up two years of academic work to personally carry out the organizing. There was very little deputising of jobs and as a result, those in charge were certain that all details had been completed.

Before arriving, all participants had been posted a tourist brochure on Japan, mentioning especially the climate and the degree of formality of dress at meetings. Each person was also advised of his hotel booking and provided with a list of the other participants staying at the same hotel.

On arrival at Tokyo airport, one was met by a group of University students (who could speak English), who helped to arrange transport to the hotel (even at 1.30 a.m.).

The opening session was brief and the following item was a three day excursion. As a result, all participants were mixed by the first night and informal discussions commenced. During the formal sessions, speakers were limited to fifteen minutes to present their paper, followed by ten minutes discussion; these times were adequate. All papers were read in English at the Symposium.

Transport arrangements, bus, train and plane, were in the hands of the competent Japan Travel Bureau. Timetables were arranged to the nearest minute, and were strictly adhered to (in this way they were assisted by the natural efficiency of the government-run transport system).

All participants were informed exactly what they were doing by a detailed account given at each meal time by Kuno. The organizers also knew exactly what each participant was doing (in those cases where there was a choice of venue) by the filling in of detailed forms. Although completely organized, the programme was also flexible to allow changes to suit the vagrancies of the weather.

The following services were provided at the Symposium office in Tokyo; information desk; bulletin board; pigeon boxes; banking and postal facilities; Japan Travel Bureau services for organizing post-sessional trips; and a coffee and lunch service.

On each excursion, every bus (generally about five in all) had a guide who was well informed of both the geological and the scenic points of interest. The guide also had a supply of canvas rock sample bags. When the bag was full, it was given to the guide, together with a printed card with the owner's name and home address, plus ¥900. At the end of the symposium all samples belonging to one person were boxed and posted by sea mail to the home address. The sum of ¥900 covered the cost of posting each bag.

REACTIONS TO PROPOSALS FOR I.A.V. EXECUTIVE MEETING, BERKELEY, 1963.

Two proposals were put forward by the I.A.V. Executive Committee for discussion at the Symposium at Berkeley in 1963. They were both submitted by Professor Vledavetz (U.S.S.R.) as follows:

1. 'The following subject to be discussed in Symposium form - "Post-eruptive processes in regions of active volcanism";

2. To examine....the possibility or the impossibility of standardizing the observations in volcanological observatories'.

The first proposal brought forth no comment, but the second was worded differently in its original form and was taken to mean that an attempt would be made to standardize equipment and observations. As such, it was felt that the matter was impossible - the Hawaiian observatory staff was outspoken after the meeting - because there would be no allowance for the individuality of volcanoes.

However, I feel that as now worded, the proposal has merit, because it could sort out and stop much of the duplication which tends to go on, for example, in Japan.

APPENDIX 1: List of countries and numbers of participants.

COUNTRY	NO. OF PARTICIPANTS	COUNTRY	NO. OF PARTICIPANTS
Australia	3	Netherlands	2
Austria	1	New Zealand	1
Belgium	1	Peru	1
Canada	4	Phillipines	1
Finland	1	Republic of South Africa	1
France	5	Switzerland	1
India	1	United Kingdom	3
Indonesia	2	U.S.A.	33
Iran	1	U.S.S.R.	3
Italy	4	Japan	134
Mexico	1	Total	204

APPENDIX 2: Itinerary of overseas trip to Japan.

May	8 1962	Arrive Tokyo from Australia. Registration at Ninon Toshi Centre, Tokyo.
	9	Opening sessions of Symposium, Tokyo. Leave for Karuizawa.
	10	Visit Asama Volcano at Karaizawa.
	11	Discussion of pyroclastic flow terminology. Return Tokyo. Reception by President, Science Council of Japan.
	12	Scientific Sessions Tokyo.
	14	Scientific Sessions Tokyo. Reception by Minister for Education.
	15.	Leave for Hakone. Scientific sessions at Hakone.
	16	Field discussions at Hakone.
	17	Scientific sessions, Hakone.
	18	Field discussions at Hakone. Return Tokyo.
	19	Visit research institutions, Tokyo. Earthquake Research Institute, Japan Meterological Agency.
	20	Post-Symposium trip to Kyusu.
	21	Travelling to Ibusuki.
	22	Examine Sakura-zima volcano. Reception by Governor of Kagosima Prefecture.
	23	Examine Aso volcano.
	24	Examine Aso Volcano. Travel to Fukoka. End of Symposium.
	25.	To Kyoto, and visit University.
	26	Visit instrument makers. Travel to Tokyo.
	28	Visit instrument makers in Tokyo.
	29	Visit instrument makers in Tokyo, also Tokyo University.
	30	To Hokkaido. Visit Sappors University, To Toyako.
	31	Climb Syowa-Sinzan volcano.
June	1	Travel Toyako to Sapporo. Fly to Tokyo.
	2	Depart Tokyo for Australia.

APPENDIX 3. The interpretation of the suffix on volcano names.

Many volcano names in Japanese have a suffix which describes the type of mountain. Those commonly used are:

- dake: peak in a mountain range, e.g. Kaimondake.
- yama: mountain, e.g. Miharayama.
- san : mountain (with a feeling of affection) e.g. Fuji-san.
- (j)ima: island, e.g. Sakurajima.

APPENDIX 4. <u>Rocks collected on Excursions in Japan</u>.

Each sample is prefixed by a B.M.R. Museum number.

<u>ASAMA VOLCANO.</u>

R12176: Dacite welded tuff, Entrance to Nakanosawa Vault near Asama Observatory. Probably part of the Hotcke-iwa flow from early in the volcano history.

R12177: Andesite welded tuff. Agastuma pyroclastic flow from the 1783 eruption. Only 10 feet thick at this locality.

R12178: Andesite lava flow. Oni-oshidashi lava flow, last phase of the 1783 eruption.

<u>HAKONE VOLCANO</u>

R12179: Basaltic andesite, with phenocrysts of hypersthene and augite, and micro-phenocrysts of hypersthene and pigeonite. Oldest lava of the old somma.

R12180: Pigeonite-hypersthene-augite andesite. From the old somma.

R12181: Dacite andesite. Late stage differentiate of the pigeonite series. Pigeonite in the groundmass and augite and hypersthene as phenocrysts. SiO_2 = 67%. From the young somma.

R12182: Augite-hypersthene andesite. Viscous lava of the central cone, Kamihutago-yama. Contains cristobalite in the groundmass.

<u>SAKURA - ZIMA VOLCANO</u>

R12183: Hornblende-augite-hypersthene trachyandesite. Part of the Aira Caldera, at Ryudyazinmatsu, Iso.

R12184: Biotite-hypersthene-plagioclase liparite, containing osumilite. In Neogene welded tuff of the Aira Caldera, at Hayasaki (Sakkabira).

R12185: Augite-hypersthene andesite. SiO_2= 66.35%. Bunermi lava flow, 1475-76.

R12186: Olivine-augite-hypersthene andesite. SiO_2= 64.13%. An-ei lava flow, 1779.

R12187: Two-pyroxene andesite. SiO_2= 61.25%. Showa lava flow, 1946.

<u>ASO-SAN</u>

R12188: Andesite. From old somma (pre-caldera) at Taikanpo Pass.

R12189: Aso welded tuff. From above andesite, top of Taikanpo Pass. Specimen is of the second welded tuff sheet.

<u>SYOWA-SINZAN</u>

R12190: Hypersthene dacite. SiO_2 = 69.74%. Dome lava, 1945.

Figure 2: Asama volcano, from Karuizawa. The active crater of Kama-yama (2542 m. a.s.l.) is in the centre, and the lava dome of Sekison-zan is on the left.

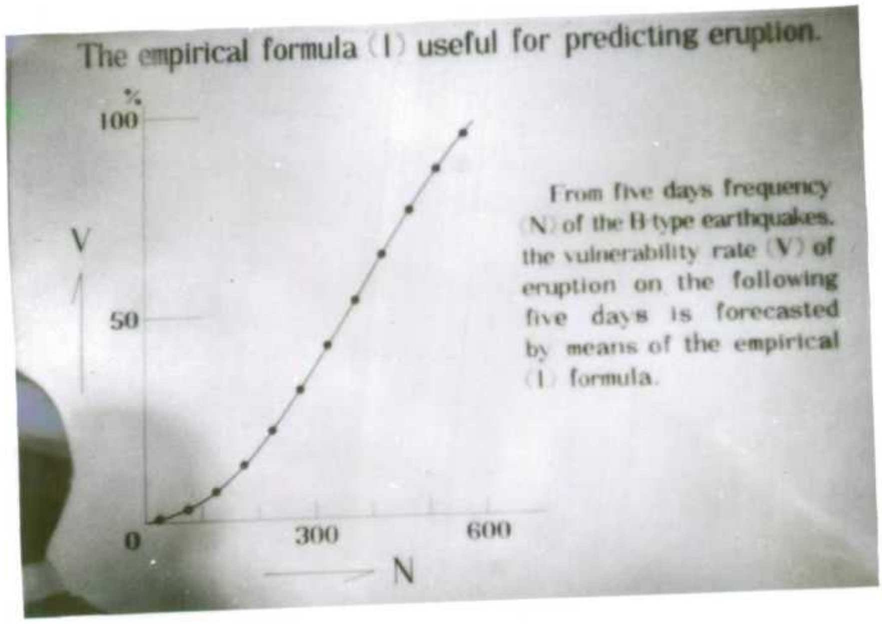

Figure 3: The graph used by Minakami at Asama Volcano to predict eruptions.

Figure 4: Sakura-zima volcano from the rim of the Aira Caldera at Kagosima city. The peaks are, from left to right; Hikino-hira (double), Minami-dake (active), and Kita-dake (double). Volcanologist T. Matsumoto is on the right hand side, foreground.

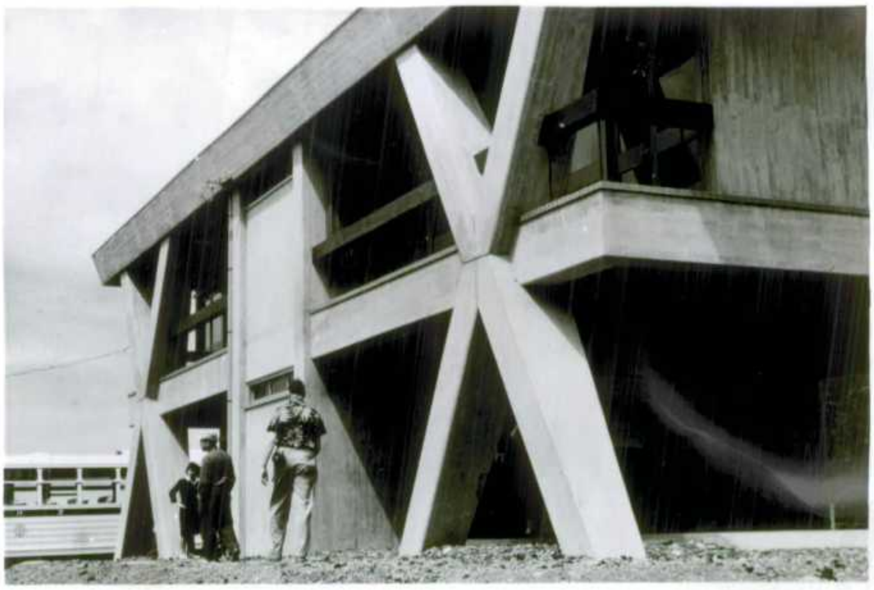

Figure 5: The volcano observatory of Kyoto University on Sakura-zima volcano.

Figure 6: The active crater of Naka-dake in the Aso Caldera. Note the crowds of tourists on the lip of the crater, and the terminal of the aerial rope-way, behind them.

Figure 7: Protective shelters for tourists in case of an eruption at Naka-dake (Aso Caldera). The lip of the crater is in the background.

Figure 8: Aso welded tuff containing flattened pumice fragments. This is from the second welded tuff sheet on the eastern side of the caldera.

Figure 9: Syowa-sinzan volcano from Naka-zima lava dome in the centre of Toya Caldera Lake. The volcano consists of a lava dome which protrudes from the 'roof mountain' of uplifted country rock. To the right is Higasi-Maru-yama lava dome and the lower slopes of Usu volcano.