7 ft; (iv) camera angle, 35° from vertical; (v) vertical distance from reflector to bottom, 3 ft; (vi) reflector angle, 70° from vertical.

Photographs were obtained in depths down to 850 ft at a number of locations in the Sound and neighboring waters. More than half of the exposures resulted in intelligible photographs. Two of the clearer and more detailed bottom photographs are shown in Figs. 1 and 2. Owing to the turbidity of the water, the region is marginal from the standpoint of underwater photography. Even when the camera was set at only 7 ft slant distance from the bottom, most of the pictures show some haze and only a few are extremely sharp.

Fig. 1. Bottom photograph taken in 76 m of water. The sloping firm mud bottom with a growth of sea anemones and hydroids is probably underlain with sand and gravel.

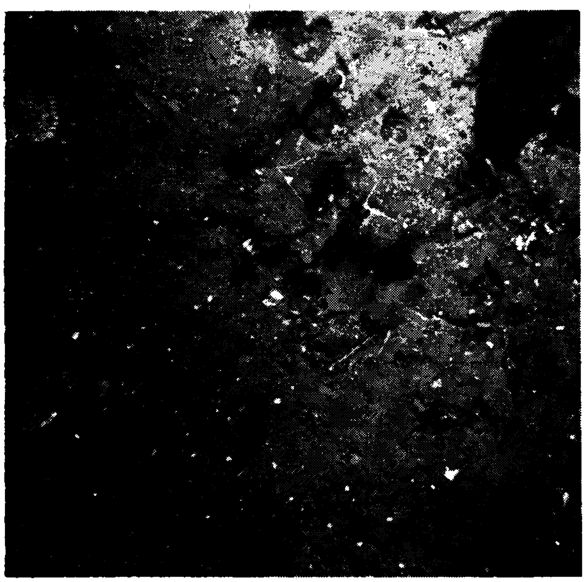

Fig. 2. Bottom photograph taken in 19 m of water. The undulating coarse sand bottom contains shell fragments, whole shells, and organic debris. Note the maple leaf in the center.

JAMES A. GAST
WAYNE V. BURT*

Department of Oceanography,
University of Washington, Seattle

References and Notes

1. Contribution No. 170 from the Department of Oceanography of the University of Washington. The work was carried out under contract N8onr-520/III, project NR 083 012, with the Office of Naval Research of the Navy Department.
2. M. Ewing, A. Vine, and J. L. Worzel, *J. Opt. Soc. Amer.* **36**, 307 (1946).
3. Pittsburgh Reflector Co., Pittsburgh, Pa. Trade name, Permaflector.

* Present address: Oregon State College.

7 June 1954.

Effect of Eruption of Hawaiian Volcanoes on the Composition and Carbon Isotope Content of Associated Volcanic and Fumarolic Gases

An opportunity was afforded during some recent eruptions of Hawaiian volcanoes to examine the gases issuing from a solfataric fumarole (Sulfur Bank, Hawaii National Park, Kilauea, Hawaii) that is in close physical association with the two active volcanoes of the island of Hawaii (Mauna Loa and Kilauea). The desirability of a systematic routine of analysis of fumarolic gases has long been recognized, and a start was made on such a project at Sulfur Bank by Ballard and Payne (*1*). These investigators also noted that the appearance of hydrogen sulfide at this fumarole seemed to be coincident with the eruption of nearby Mauna Loa (*2*).

In the present work (*3*) samples of gas were secured from pipes that were sunk at Sulfur Bank around 1922. Representative samples were obtained in gas sampling bulbs of both the evacuated and the sample-isolation types. These were removed to the laboratory and were subjected to analysis by a low-pressure technique (*4*) that was capable of analyzing gas samples as small as 0.01 cm^3, STP, and of detecting components present to the extent of 0.2 percent by volume. Some of the carbon dioxide was retained from certain of the samples and was purified by repeated complete distillation from liquid air traps for use in carbon isotopic analysis.

In one instance a sample of gas was secured from a still-hot lava flow (about 700° to 800°C) in an evacuated metal collecting tube. Also a sample of rock from the same lava flow was heated in vacuum, and the gases evolved were collected. In each of these cases, the carbon dioxide was isolated and purified as described in the preceding paragraph and was submitted for isotopic analysis. By means of standards, the isotopic content of the samples was compared with the

Table 1. Analyses of gases collected from Sulfur Bank fumarole.

Sample tube	Constituents (vol %)					
	CO_2	CO	H_2	SO_2	O_2	N_2 (residue)
During an eruptive stage of Kilauea Volcano, July 1952						
1	97.4	1.0	0.4	1.5	0	0
2	97.6	1.4	0	1.8	0	0
3*	96.2	1.7	0.4	1.6	0	0
During a quiet stage of Kilauea Volcano, June 1953						
1*a*	10.9	3.2	0	0	13.6	71.5
1*b*†	10.6	2.2	0	0	15.1	70.7
2	10.2	2.9	0	0	13.2	71.8

* No. 3 was a vacuum-bottle collection made at a later date than collections No. 1 and No. 2.
† Poor analysis.

Table 2. Stable carbon isotopic ratio in the carbon dioxide present in volcanic and Sulfur Bank fumarolic gases.

Gas sample	C^{12}/C^{13}
Sulfur Bank 1949, Mauna Loa in eruption	89.0
Sulfur Bank 1952, Kilauea in eruption	89.0
Sulfur Bank 1953, both volcanoes quiet	89.0
Gas collected from 1950 Mauna Loa lava flow	91.2
CO_2 extracted from Olivine Basalt of 1950 Mauna Loa lava flow	90.7

carbon dioxide from a Jurassic limestone that has been used as a primary standard by other workers, through the kindness of A. O. Nier (*5*). Isotopic ratio determinations of the carbon dioxide samples were made on the Consolidated-Nier type of mass spectrometer.

The results for the gas analyses are listed in Table 1. The great difference in the composition of the gas between times of eruption and quiescence of the nearby volcano is noteworthy. During the quiet period, there is strong indication of air contamination from the presence of nitrogen and oxygen in the gas. The possibility of using a systematic gas-analysis routine to detect changes in the proportions of the gaseous components with time and to use this as a predictive tool in volcanology immediately arises and, in fact, has been suggested previously.

The results for the determination of the carbon isotopic ratios are listed in Table 2. The significant points to be noted are (i) the constant value of the isotopic ratio of the carbon dioxide obtained from the Sulfur Bank fumarole despite the eruption or dormancy of the adjacent volcanoes and (ii) the "heaviness" of the fumarolic carbon dioxide when compared with the gas extracted from the lava or from above the active lava flow.

JOHN J. NAUGHTON
KAZUJI TERADA

Department of Chemistry, University of Hawaii, Honolulu

References and Notes

1. S. S. Ballard and J. H. Payne, *The Volcano Letter*, No. 469, July–Sept. 1940.
2. J. H. Payne and S. S. Ballard, *Science* **92**, 218 (1940).
3. We are deeply indebted to A. O. Nier of the Physics Department, University of Minnesota, for running some of the isotopic determinations, and to Earl Ingerson and Gordon A. Macdonald, U.S. Geological Survey, for aid and advice in the collection of the samples. Some of the early work on the preparation of the samples was done at the Frick Chemical Laboratory, Princeton University, and most of the work was aided by the Office of Naval Research, under contract Nonr-981(00), project NR 081 185.
4. S. Dushman, *The Scientific Foundations of Vacuum Technique* (Wiley, New York, 1949), p. 649.
5. A. O. Nier, *Phys. Rev.* **77**, 789 (1950).

13 September 1954.

The Visiting Research Professor

Ten years ago Carl E. Seashore of the State University of Iowa, Emeritus Professor of Psychology, but called back to serve as Dean of the Graduate College, proposed [*Science* **100**, 218 (1944)] the appointment of retired persons who desire to continue their researches as *visiting research professors* at a neighboring university. Supporting his view he appointed two visiting research professors in 1944. As one of those fortunate persons, I can testify to the enormous benefits that have accrued to me. A stipend was granted sufficient to enable the appointee to spend 3 months in residence at the university or to defray the expenses of making frequent visits for longer or shorter periods. Most important has been the fellowship of the resident staff, and the incentive to keep on doing those things that one has been doing and hoping to continue to do. I commend the visiting research professorship to university administrators and to retired professors. It is immediately available. It meets the needs of elderly persons and increases the national scholarly output. And it requires no outlay for additional buildings, libraries, or laboratories.

HENRY S. CONARD
Emeritus Professor of Botany, Grinnell College

7 September 1954

Psi and Probability Theory

The occurrence of significant deviations from mean expectancy in experiments in which guesses, cards, drawings, die faces, and so forth, are matched with targets has been attributed not only to psi (*1*) but also to error in the production, recording, selection, or analysis of the data. That these counterhypotheses to psi have been adequately refuted, either by ratiocination or by the performance of experiments in which the counterhypotheses were precluded, is testified to by the subsequent silence of their proponents. Two explanations for the results of these matching experiments have remained, namely (i) reality of psi and (ii) fallacy of probability theory. While there are comparatively few who have accepted the first explanation, there have been practically none, until recently,