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Aarno Kahma, Aimo Nurmi and Pentti Mattsson:

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# ON THE COMPOSITION OF THE GASES GENERATED BY SULPHIDE-BEARING BOULDERS DURING WEATHERING AND ON THE ABILITY OF PROSPECTING DOGS TO DETECT SAMPLES TREATED WITH THESE GASES IN THE TERRAIN

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The gas compounds generated by sulphide-bearing boulders in weathering were analyzed with a gas chromatograph. The main component of the gases emitted was found to be sulphur dioxide ($SO_2$), in addition to which the occurrence of hydrogen sulphide ($H_2S$) and carbonyl sulphide (COS) in varying amounts was established.

The ability of a German shepherd dog (Alsation) trained in ore prospecting to react to sulphide-bearing rocks was tested in the field with pumice samples treated with sulphur dioxide, hydrogen sulphide and a solution of $Na_2SO_3$. The prospecting dog proved to be extremely adept at detecting the samples treated with gases. The results of the tests are given in the text.

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## INTRODUCTION

The Geological Survey of Finland has been experimenting since 1962 with German shepherd dogs, or Alsations, in tracking down sulphide-bearing boulders; and since 1964 it has been systematically using these specially trained dogs for ore prospecting purposes. In this exploration work, it has been proved that in wooded and soil-covered areas, in particular, a trained dog is noticeably more effective than an experienced boulder prospector. In a comparative experiment carried out in 1965 at Virtasalmi over a tract 9 sq. km in area, for example, the dog found 1 330 sulphide-bearing boulders in the test field, whereas the boulder prospector managed to find only 270, even though the man knew he was taking part in a test in competition with a dog (Kahma 1965).

To determine the composition of the gases generated by sulphide-bearing boulders in weathering, Aimo Nurmi, co-author of this report, and Mr. Torsti Ruuskanen made tentative analyses with a gas chromatograph at the chemical laboratory of the Military Research Center of Finland. Clear indications were discovered of not only sulphur dioxide ($SO_2$) and hydrogen sulphide ($H_2S$) but also carbonyl sulphide (COS). These preliminary findings were then checked at the chemical laboratory of the State Technical Research Center by Miss Inkeri Komsi under the supervision of Dr. Kalevi Heinonen, using a gas chromatograph (Perkin-Elmer M 900) with a hot-wire detector and silica gel as fill in the colums. It was noted in both investigations that sulphur dioxide is the main component of the gas compound and that hydrogen sulphide and carbonyl sulphide are accessory components. A fourth gas peak also appeared quite clearly in the chromatogram, but the gas could not be identified.

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## THE FIELD EXPERIMENT

A field experiment was arranged at the distance of about 35 km from Helsinki to ascertain the ability of prospecting dogs to detect samples treated with $SO_2$ and $H_2S$ gases. In a wooded area of some 5 000 sq. m, 10 samples of pumice treated with $SO_2$ gas, 10 treated with $H_2S$ gas and 10 with a solution of $Na_2SO_3$ were placed along with ten untreated samples and nine natural boulders containing sulphides. The samples treated in different ways were marked in the terrain with ribbons of different colors tied to trees.

All the pumice samples used in the experiment, which measured 5 cm in width and 10 cm in length, had been carefully washed and then rinsed with distilled water and finally dried in a drying oven at the temperature of 200°C for several hours. Ten samples were placed in each of two vacuum desiccators, after which one was filled with $SO_2$ and the other with $H_2S$ gas. Ten more of the dried samples were treated with an $Na_2SO_3$ solution of 10 ppm strength and dried carefully and the remaining 10 control samples were placed in sterile plastic bags.

The samples were transferred from the desiccators and plastic bags, untouched by hand, with sticks gathered in the woods to the test field.

The temperature of the air varied in the terrain between 14.6° and 15.3°C, and the relative humidity, between 88 and 96 per cent.

Preparing the test field took about 50 minutes, immediately after which the e-periment was made with a 5-year-old German shepherd dog named "Haka". The dog tracked down the following samples in the terrain:

| | samples found | % |
|---|---|---|
| Untreated control samples | 0 | 0 |
| Pumice samples treated with $SO_2$ | 8 | 80 |
| Pumice samples treated with $H_2S$ | 9 | 90 |
| Pumice samples treated with $Na_2SO_3$ | 0 | 0 |
| Sulphide-bearing natural samples | 9 | 100 |

The dog reacted to the natural sulphide-bearing samples with unerring accuracy, and it also found the great majority of the samples treated with $H_2S$ and $SO_2$.

To get an idea of how quickly the hydrogen sulphide and the sulphur dioxide evaporated from the pumice camples, the experiment was repeated after a break of two hours. This time the dog found all the hydrogen sulphide samples but only 60 per cent of the pumice samples treated with sulphur dioxide. Although there is reason to regard the repeated field experiment with caution because the dog might have remembered some of the places where the samples were located, the experiment nevertheless would seem to show that at least the sulphur dioxide evaporates from pumice at a comparatively rapid rate - which explains why also in the first experiment the dog was unable to detect 20 per cent of the samples treated with sulphur dioxide.

Since the dog had not reacted to the pumice samples treated with a sodium-sulphite solution, they were then buried under a thin layer of peat. The experiment was carried out a third time after rainfall the next day. Now the dog found all the samples treated with sodium sulphite and, besides, 35 per cent of the stones treated with sulphur dioxide and 40 per cent of the ones treated with hydrogen sulphide gases that had been placed in the field the day before as well as, of course, every single one of the boulders with a natural sulphide content. The probability is that humus acids released from the debris layer had caused the formation of sulphur dioxide during the 24-hour period, owing to the rain, in the samples treated with sodium sulphite.

The results of the experiment described here show that a dog trained in prospecting reacts with great sensitivity to gases emitted by sulphide-bearing material. It has therefore been demonstrated that dogs can be useful in ore-prospecting work in supplementing the other methods of exploration. Prospecting dogs are now used not only in Finland but also Sweden (Nilsson, 1971; 1973) and the U.S.S.R. (Orlov, Robonen and Kirilenko, 1969).

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