NOTE ON A FAULT BRECCIA IN HALLINGDAL, NORWAY, TOGETHER WITH SOME GENERAL REMARKS ON THE FRACTURING OF THE EARTH'S CRUST

BY

OLAF ANTON BROCH

Some twenty years ago the author discovered a quartz breccia at Haga seter (chalet) in the pre-cambrian area south of Ål, Hallingdal. Air photographs (figs. 1 and 2) taken some time later revealed that the breccia belongs to a marked fracture line running SSW—NNE, parallel to the upper part of the valley of Hallingdal (maps figs. 3 and 4). This was soon afterwards confirmed by Ivan Th. Rosenqvist, who at the author's request undertook a geological survey (mapping) of the surrounding area. He was able to demonstrate that the fracture was filled throughout its entire length with quartz breccia, and that it represented a post-caledonian fault: The sub-cambrian peneplain — with folded paleozoic sediments resting upon it — north of the breccia is situated about 40 meters lower than it is to the south of it. The heights of the peneplain north and south of the breccia — 1070 and 1110 m. a. s. respectively — are recorded in the centre of the map fig. 3. (In the north-eastern part of this map one may see the large, post-caledonian explosion breccia (G) of Gardnos, cf. Broch l. c.)

In 1950 another breccia, similar to the one mentioned above, was discovered in the south-western extension of the line of direction taken by the upper part of the valley of Hallingdal, SW of the lake Strandefjord (western part of the map fig. 3). Just as in the case of the first-named breccia, this one also seems to dwindle in the south-west, whereas in the north-east it disappears under the thick valley-side moraine.

Like most other valleys of south-eastern Norway, Hallingdal in the greater part of its length runs SSE. The upper part, however, runs towards ENE. This somewhat puzzling feature seems to be explained by the existence of the breccias.

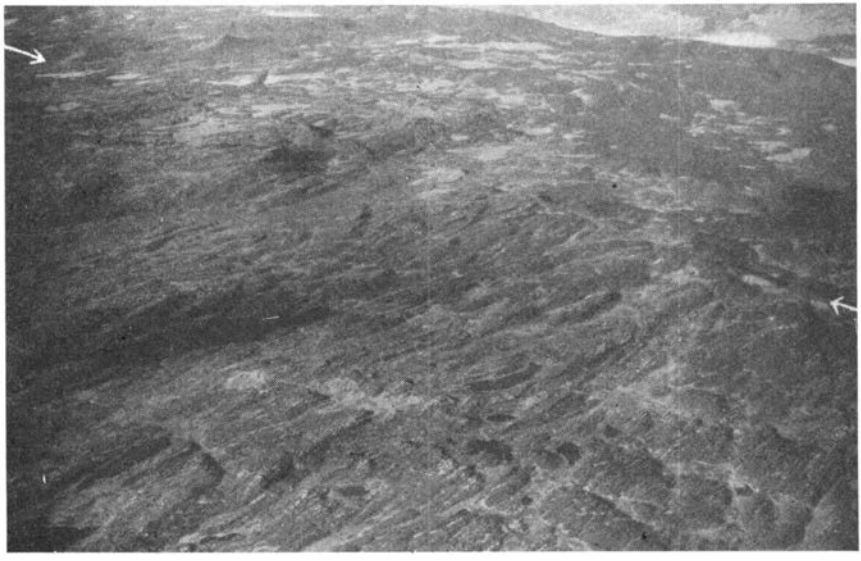

Fig. 1. Air-photo of the breccia from SE. In the background to the right, the valley of Hallingdal. Norsk Luftfoto A/S.

A glance at a good map of southern Norway reveals that many side-valleys, and also many fjords have the same direction as have the breccias mentioned, and a somewhat closer study will show, that this direction is a prominent feature in both major and minor topography. It is unquestionably a direction of fractures, and in some cases also a direction of traceable faults, e. g. the fault referred to above, the horst of Mjøsa (H on fig. 4) and part of the great breccia (Br) in the pre-cambrian of southern Norway (Bugge l. c.). Without necessarily implying any hypothesis by this, we may call it the Skager Rack direction. We shall not, however, go into further details, especially in view of the fact that a broader treatment of the fractures of southern Norway is in preparation elsewhere.

A striking feature of the fractures of the Skager Rack direction is that their formation extends over a very lang period of time. As an example we shall look at the great pegmatite dikes and some of the fracture lines in eastern Østfold (P on fig. 4). The dikes belong to the pre-cambrian Bohuslän-Østfold granite, and will be dealt with in somewhat greater detail in a paper under preparation. They are true

Fig. 2. Air-photo from NW. Lower right corner: The breccia at Haga seter. Norsk Luftfoto A/S.

fracture dikes, running ENE—WSW. Those fractures were obviously formed and also sealed up with pegmatitic solutions in pre-cambrian time. In the same region we have, however, much younger, open fractures of the same direction. They are seen in the field, and having, unlike the old, sealed up fractures left their mark on the landscape, they are well revealed by detailed topographic maps. — Another example is given by the great southern brecia (Br). From Bugge's description (l. c.) it appears that there have been repeated movements. — Yet another, very striking example is provided by the horst of Mjøsa (H). According to Skjeseth (l. c.) the movements along the faults started in eo-cambrian and continued up to permian time, perhaps even much longer, as there are, apart from the quaternary deposits, no younger rocks than permian there.

The examples selected above give an illustration of a rule which is no doubt recognized by geologists in many parts of the world. We may call it the rule of the *tendency within a given region towards constancy over geologic periods of the directions of fracturing of the Earth's crust.*

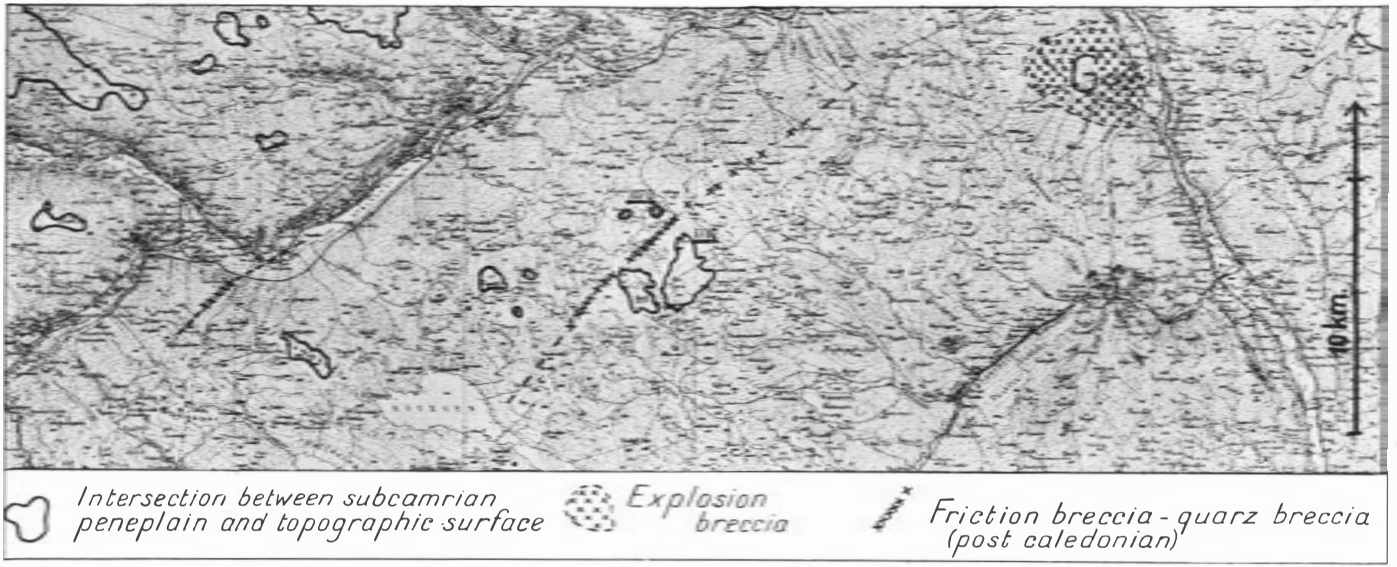

Fig. 3. Map of the breccia with major geological features of the surrounding area. Topography after Norges geografiske Opmåling, gradavd. E33. Use a magnifying glass.

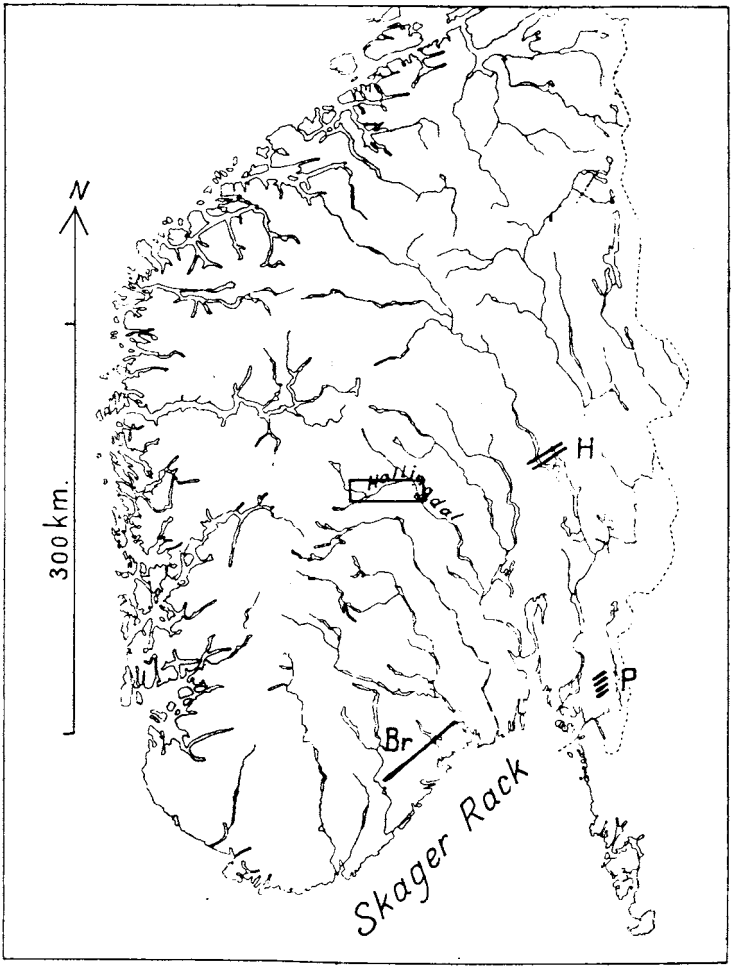

Fig. 4. Map of southern Norway. Key to fig. 3 etc.

References.

1. Broch, Olaf Anton: Gardnosbreksjen i Hallingdal. Norsk geol. tidsskr. 25, p. 16—25. Oslo 1945
2. Bugge, Arne: En forkastning i det syd-norske grunnfjell. Norges geol. unders. 130. Oslo 1928.
3. Skjeseth, Steinar: Verbal communication.