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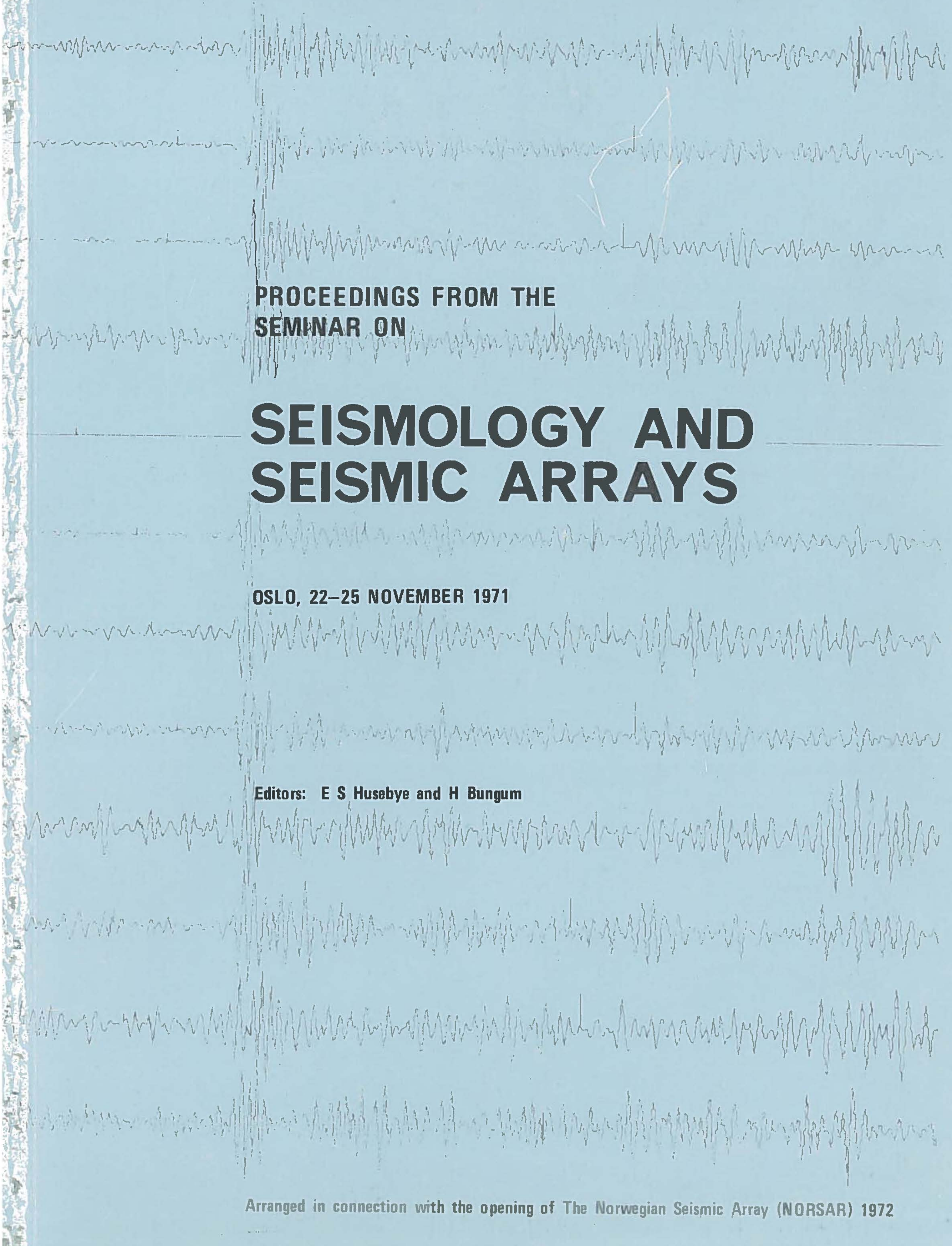

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SEISMOLOGICAL ARRAY STATIONS AND GLOBAL SEISMICITY

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INTRODUCTION

In this paper I will shortly discuss the global seismicity, the use of arrays and other high quality stations to detect and locate events and finally suggest further international cooperation to increase our knowledge of the global seismicity and to test the operational capability of existing high quality seismological stations.

Barazangi and Dorman (1969) presented an extensive and interesting study of the global seismicity. This work is based on arrival times reported from an inhomogeneous network of seismological stations. This means that the determined seismicity is biased in the sense that it reflects the distribution and sensitivity of the recording stations as well as the "true" seismicity. To my mind there exists no absolute global or regional seismicity. Seismicity must always be related to the network of stations by which it has been observed. To be quite clear, I thereby mean that different global station networks will give different global seismicity maps. To illustrate this Fig 1 shows about 250 events during 1970 located by Scandinavian and Canadian stations which have not been reported by NOAA (Dahlman et al., 1971).

SEISMIC EVENT DETECTION CAPABILITIES

Our capability to detect small events has been considerably increased throughout the last fifteen years through the establishment of the worldwide standard station network and seismic arrays. The latter stations have been in operation for more than ten years. The arrays

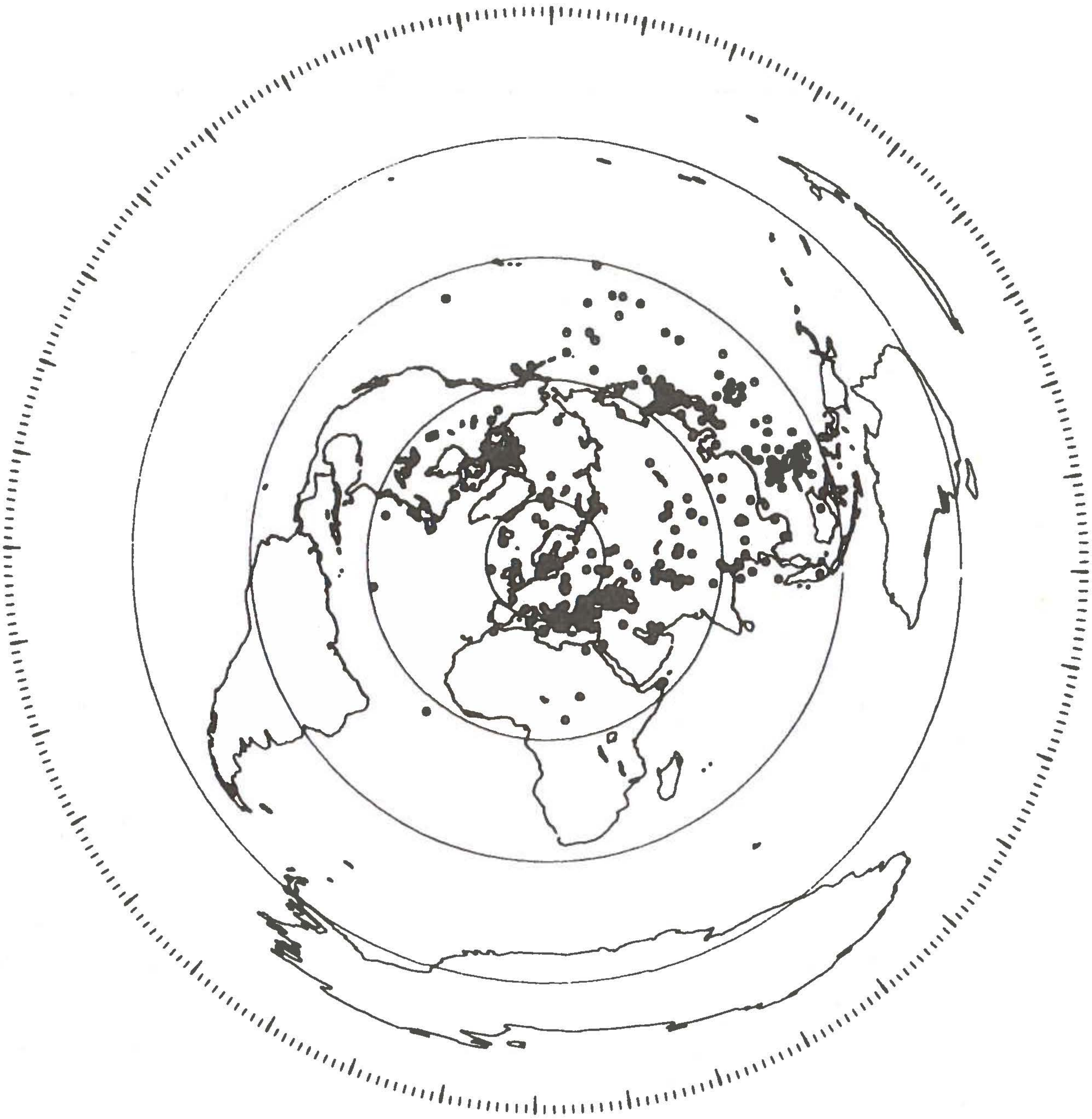

Fig 1. Events located by the Scandinavian network and not reported by NOAA.

were primarily designed to increase the detection capability for shortperiod seismic signals and thereby make it possible to detect smaller events, especially underground nuclear explosions. In the last few years large stations with sophisticated on-line data processing facilities have become operational. Some of these arrays are also able to detect and analyse longperiod signals. The present array stations are in some sense multipurpose instruments, which are supposed to be effective signal detectors, to have a good ability to locate events with reasonable accuracy and to preserve the spatial properties of the recorded signals. The combination of these different tasks in one and the same station makes it very hard to optimize the different functions mentioned above. The increase of detection capability using selected array processing methods has been studied for a limited number of events. The general impression of these works is that the increase in detection capability is less than predicted by theoretical calculation using a more idealized situation. The explanation of this is that the detection algorithms are designed for correlated signals and that they degrade substantially when the signal coherency decreases as it does for high frequency signals observed e.g. in Scandinavia. Even if the present arrays are not optimally designed to detect weak events they are by far the most powerful stations on the earth. These stations have not been fully used to demonstrate the multiarray operational capability in detecting and locating small events.

Basham and Whitham (1971) in a most interesting compilation of the data on seismological stations reported to the Secretary General of the United Nations showed that a network of about 50 shortperiod stations should be able to detect events down to m_b 4.5 in the northern hemisphere. It might be possible to reduce the number of stations to roughly 25 without seriously decreasing the detection and location capabilities, if the existing array stations were operated in an effective way to detect and report events and if certain other key stations were equipped with modern instruments. In the same study Basham and Whitham reported that the detection capability of existing longperiod stations corresponds to m_b 4.5 for earthquakes and m_b 5.5 for explosions in the northern hemisphere. It is reasonable to assume that the ultralongperiod instruments which have recently been installed at about ten places around the world, will considerably increase the detection capability for longperiod waves from earthquakes but they will probably not substantially increase the detection capability for longperiod waves from explosions.

To test the operational capability of existing high quality stations and to study the global seismicity, I think it is reasonable to suggest that a limited number of high sensitive long- and shortperiod seismological stations for a limited time period of one to two years should operate with high reliability, with efficient detection routines and data communication. Data should be collected, evaluated and published by an appropriate organization or agency. This might be the International Seismological Centre in Edinburgh, if necessary funds are made available. The data center shall locate events, compile and distribute reported data, but not make any event classification.

I am convinced that such an experiment should not only be a valuable test of the operative capability of the existing seismological stations for the detection and location of seismic events, but also give significant additional information on the global seismicity.

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