

## **ROCK CARVINGS AND THE AIR POLLUTION PROJECT IN SWEDEN 1988-1996**

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### ***Background***

In December 1994 the Rock Carvings in Tanum were inscribed on UNESCO's World Heritage List, since they are considered to be of universal cultural value and as such requires protection for the benefit of all humanity. The inscription means that they belong to the same category of sites as Alta in Norway and Valcamonica in Italy. Furthermore it means that Sweden has accepted the responsibility to preserve them for all time. Five years earlier, in 1989, a general inventory and documentation of rock carvings was begun by the National Heritage Board within the Air Pollution Project, directed towards negative environmental effects, including air pollution, on cultural heritage monuments. Occasional observations of weathering and change in the rock carvings of the Tanum Area, Bohuslän, e.g. Aspeberget had been made since the early 70s. It was not until 1983, however, at a seminar in Norrköping, that the fact was established that weathering represented a threat to rock carvings. Still the extent of the threat was not known.

### ***Inventory and documentation***

The inventory was based on documentation cards entered into the computer register at the CBNA. The aim was to create a dataset which would be the first step in the process of characterization and deeper investigation of the most seriously damaged carving surfaces. Another important goal was to secure data for further comparisons and to provide input data for various preservation measures. Excerpts of earlier documentation have also been included in the inventory. Comparisons of photo details documented on different occasions indicate the usefulness of the method for defining changes and damage. The main problem is the lack of earlier close-up photographs (Bertilsson, 1992; Bertilsson & Löwendahl, 1992). At this early stage of the inventory, five major rock carvings were picked out for more detailed documentation comprising the following stages: photographic documentation (general and detailed), geological documentation (rocks, surface structure, fissure systems and surface damage), biological documentation (algae, lichens, mosses), and chemical/biological sampling (bedrock and water sampling). Various types of photographic methods were tested (Bruxe, 1990). General photography from two different platforms (dumper and sky-lift) proved superior to photography from ground level. The latter method gives rise to certain problems in joining various component pictures into a single unit, owing to distortions of angle and surface in various sections of uneven rock surfaces.

### ***Damage-inventory phase 1 and 2***

The general damage-inventory was carried out in two phases: phase 1, between

1989-1992, comprised all the major rock carvings (approx. 200) in Bohuslän. Phase 2, between 1992-1995, comprised another 100 rock carvings in the provinces of Bohuslän, Östergötland and Uppland. In spite of the fact that the bedrock, to a certain extent, is different, in Bohuslän granite dominates, in Östergötland mica-schist and other kinds of sedimentary gneiss, and in Uppland all these three categories exist. The rate of weathering/degradation is high, the actual percentage varying between 75 and 90 (Bertilsson & Löwendahl, in press). In earlier inventories, from the mid-thirties to the mid-sixties, the corresponding percentage rate varies between 20 and 30. This was of course a most important, and at the same time, alarming result of phase 1.

On the basis of the results of phase 1 a list of the most seriously damaged rock carvings was established. The list encompassed approx. 50 rock carvings. In 1992 phase 2 of the initial programme -an enlarged and more detailed damage-inventory was initiated. In this phase detailed depictions of the damages of every single rock carving have been produced (Magnusson & Berg, 1994). Another 100 rock carvings in Bohuslän has now been subject to this measure. As a consequence of the inscription of the rock carvings of Tanum on the WHL, the interest of the damage-inventory at present is focused on the 360 rock carvings situated within this area. The inventory, which has now reached phase 3, comprises even more detailed documentation and analyses, not



*Fig. 79. A rock carving of Aspeberget in Tanum is being compared with a photograph from the same engravings taken in the 30's (Photo: The Swedish National Board, 1991).*

only of the rock carvings but also detailed descriptions of factors like topography, environment, meteorology, vegetation, possible sources of pollution, in all 39 different variables, and suggestions for preservation measures.

### ***Characterization of damage***

A short characterization of damage encompasses different types of weathering: chemical (mineral weathering), gravel weathering, flaking-off/exfoliation and fissure growth. A preliminary statistical evaluation of the present status of the rock carvings and the factors causing weathering and degradation gave rise to the following conclusion:

1. Dry deposition on the rock surfaces must be limited.
2. Acid rain and acid water in the ground running on the rock surface must be stopped.
3. The rock surfaces must be kept clean from leaves, needles and lichens.
4. Wide fluctuations of temperature on the rock surfaces must be avoided.

In general most of the damage is related to the rock surface and do not affect rocks covered by earth and moraine. A factor of high significance for the degradation has been the rather rapid change of vegetation from broad-leaf tree to coniferous tree forests that has taken place in Bohuslän in the last century. On the other hand deliberately planting of trees may be a very efficient way to screen off dry deposition, and pollution caused by roads and traffic.

### ***Preservation plan***

Although every rock carving is unique it is essential to classify them in different categories regarding the need for preservation. One possible way to do this is the following:

1. Rock carvings which must be protected and preserved at any cost.
2. Rock carvings which must remain easily accessible for research, tourists and other reasons.
3. Rock carvings which need to be documented in detail but require no further measures of preservation.

Successful monitoring and maintenance must be based on a long-term preservation plan. For the categories 1-2 continuous measures need to be taken although an annual interval might be sufficient in many cases. For category 3 a longer interval can be accepted.

### ***Future perspectives***

One conclusion from the project is that unless the effect of negative environmental factors and pollution can be reduced, many unique and priceless rock carvings will be severely damaged or even completely lost in a very short time. Since environmental pollution and rock art is a widespread phenomena the former is likely to cause equal damage to rock art not only in Sweden but in many regions of the world. Thus, a very important work of surveying, sampling, analysing, spreading of information and, in the end, conservation, which has now been established in Sweden (and in Norway), lies ahead in many parts of the world. This calls for close cooperation among specialists in rock art, archaeology, geology, geochemistry, meteorology and many other fields of research. Furthermore there is a need for prompt intervention if we want to turn the present negative trend!

*P.S.* The references were not provided.

### Riassunto

Per prevenire danni futuri alle incisioni rupestri nella zona di Tanum, in Svezia, l'autore propone una serie di interventi: inventario e documentazione delle rocce, rilevamento dei danni e del deterioramento e azioni preventive per il futuro. Un'immediata soluzione del problema è necessaria, poiché gli effetti negativi dell'inquinamento possono avere ripercussioni a livello mondiale sul patrimonio di arte rupestre.

### Summary

*The author proposes a series of actions to prevent the further deterioration of rock carvings in the Tanum Area, in Sweden, such as inventory and documentation, a survey of the damage and a proposal of preventive actions for the future. He believes that the negative effects of air pollution will have worldwide repercussions on rock art heritage unless the problem is immediately addressed.*

### Résumé

Pour éviter la dégradation des gravures rupestres dans la zone de Tanum, en Suède, l'auteur propose une série d'interventions: telles que l'inventaire et la documentation des roches, le relevé des détériorations, et des actions préventives pour l'avenir. Une solution immédiate au problème est primordiale, puisque les effets négatifs de la pollution peuvent avoir des répercussions sur le patrimoine d'art rupestre au niveau mondial.