interest in relation to studies of raw materials and ceramics to answer questions regarding artefact composition, origin, and tracing possible trade routes.

For most of us, the smaller archaeo-palaeoenvironmental projects, or the normal rescue excavation, are the most frequent ones, and a large number of them have been undertaken in Scandinavia (e.g. Hjelle et al. 1992; Olsen 1992). Some have been interdisciplinary projects, others multidisciplinary. There is a difference between these. The former normally involves cooperation between the participants from the beginning, continuing through fieldwork, and ends with a final discussion/presentation in a joint paper (Moe 1972; Moe et al. 1978). It is also within this joint team framework that unexpected questions or comments may stimulate unexpected new scientific ideas. Joint work, however, always need more time, and depends on mutual respect between the participants.

In multidisciplinary projects, the participants work separately (Moe 1972), and leave the project after having finished their paper or report. Most palaeo-environmental projects are of this kind. They are easier to run, and the participants do not necessary need to agree on goals, or be involved in joint discussion. Misunderstandings are not always easy to avoid with regard to using each others terminology, suggestions or conclusions etc., and this can result in the publication of scientific errors.

A mixture of separate and joint papers is perhaps the best. At the same time each participant may present some work within their own field for their own scientific credit, parallel with new interesting joint chapters. This is important to remember and might be a problem in some cases.

Since 1992 many papers have been published on the findings of the Neolithic Ice Man in the Alps (Höphel et al. 1992; Spindler et al. 1995). A wide variety of techniques have been used, and the data available, at the moment is great (never has a body been studied better, and we know that still more material will be studied). Some of the technical methods used are well established and well known, but rarely used on prehistoric material. Others needed to be developed or adapted to the special problem or questions concern. Nearly everything regarding medical conditions, food, textiles, tools etc. will be known. As a botanist, it has certainly been of special interest to learn what plant, and tree species were used for the different tools that were found, which parts of the tree/shrub were used (Oeggl & Schoch 1995), as well as where these different species were collected.

Natural scientific measurements will always give some results. Depending on stratigraphy, sampling techniques, identification, contamination etc. the result(s) will fit into a model, or not. Some will sometimes try to hide/forget "wrong" data, while in many cases such data ought actually to receive extra attention - perhaps to the end of improving the technique used, and/or to modify a model. The "wrong" results therefore might be among the most stimulating ones scientifically.

It is not easy to extract a limited number of examples from the field of palaeo-ecological to demonstrate the effect of cooperation and joint work. References to some have already been made, and short comments on others follows.

An archaeological excavation at an iron age site above the tree line in South Norway, yielded a 14C date on burnt wood of around 8000 years BP. The archaeologist first became rather frustrated, however, the botanist provided a key to understanding the mystery after having identified some pieces of the charcoal left behind to pine (Pinus sylvestris). Fossil roots and stems from periods

when the tree line was higher are known from bogs at this altitude, and the wood dated at the iron age site obviously belonged to a former pine forest - from 8000 years ago (Moe & Odland 1992). Due to a of lack of wood at the site in the Iron Age, the Iron Age man gathered an ancient pine stump from the local mire, dried it and used it for burning.

From the same area, fish bones of salt-water fish were found in an archaeological context in a high arctic-alpine region, that is, above the present tree line which is more than 1100 m.a.s.l. in South Norway (Indrelid 1994). Material of more or less the same age from the Medieval excavations at the old harbour in Bergen (Bryggen) included bones and antlers of reindeer, a species native to the high arctic-alpine area.

Behre and Oeggl's (1996) recent summary of archaeo-botanical results on early farming in Europe and adjacent areas is an important contribution to this kind of palaeo-environmental knowledge.

Some paths, trackways and trade routes are known from historic as well as prehistoric times (Moe & van der Knaap 1990). Coins are perhaps the best artefact for identifying trade, while jewelry, some kinds of ceramics, flint etc. may be more difficult to trace. Barrels, 1000 years old made of fir (Abies alba) were found in Haiteby/Hedeby in north Germany, close to the Danish border (Behre 1983). These demonstrate a relatively long distance transport of the barrels from south Germany, where fir grew, to the Danish border, where the content of the barrels, perhaps wine, was used.

A very detailed and interesting recent analysis of sheep/goat coprolites (faeces) in an archaeological context from Switzerland demonstrate use of twigs and branches of hazel (*Corylus avellana*), birch (*Betula* sp.) and alder (*Alnus incana*) as fodder. In addition the results show that this Neolithic settlement was occupied during winter and spring. (Rasmussen, 1991, 1993: Haas & Rasmussen 1992).

A pilot study of a human coprolite from Birka, central Sweden, shows the use of lime-honey (*Tilia*) as a sweetener in food (Hjelmtveit & Moe in prep). Perhaps the honey was used in the local mead? The origin of the lime-honey is still an open question, it may have been imported from South Sweden, or more likely from Poland or the Baltic republics.

In Norway both sea level and tree line changes are and have been very important for human occupation and general adaptation (Hafsten 1979; Moe et al. 1978). The sea level changes vary a great deal geographically, from a total uplift only of a few meters in the southwestern most part of the country, to more then 220 m around Oslo in East Norway. The techniques used to determine sea level changes are more or less standardised and normally involve stratigraphic studies and 14C dating together with pollen, diatom, macrofossil, microfossil and phytoplankton analyses. The changes might be of great interest to the understanding of topographic land mass changes, localisation of sounds with strong tidal currents, and for the understanding of changes in flora and fauna composition, perhaps sometimes caused by changing climate.

The first changes in tree line and forest limits took place in Late-Glacial/Early Holocene time, during the main immigration (Berglund et al. 1995). After the climatic optimum in the Boreal period (Moe 1995) evidence for a lowering of the tree line is found in alpine and arctic-alpine areas in Europe. Major changes are found to have effected the big game hunting strategy during Mesolithic in both the southern Norwegian arctic-alpine region (Moe et al. 1978) and most likely also in the Alps. (e.g. Broglio 1992; Fedele & Buzzetti 1993). Minor tree line changes are more difficult to trace but must have taken place everywhere and disturbed game-animal movement.

Natural changes in forest composition, for instance after the immigration of for example the shade trees as beech (*Fagus sylvatica*) and/or spruce (*Picea abies*), may easily have changed the natural conditions required by certain birds and mammals, and therefore also affected humans (Moe & Hjelle in prep.).

It is obvious that natural changes have occurred, and it is obvious that prehistoric man had to adapt the changes both at the coast, along the rivers and in the more inland areas to be able to survive.

Most of the various natural scientific methods used by archaeologist today are used and are being improved by separate and independent laboratories at colleges or universities. Most of them are in daily use as parts of accepted, specialised fields of zoology, botany or geology, and most educational institutions take care of their own training and development. Also international specialist journals such as "Vegetation History and Archaeobotany" and "Holocene" have been started during the last 5-6 years and address these fields. We do not need to be prophets to predict that within few decades, "environmentologists", as most of us are, will need to fight against a potential danger of isolation.

I challenge the archaeologist and the palaeoecologist to establish and maintain contact with each other. This will prevent any second class environmental studies among the archaeologists from resulting in a possible breakdown between themselves and the independant, ecological and palaeo-ecological scientific fields which are well established in many countries today. Further, the palaeoecologist needs knowledge and understanding of the presence of man, and of environmental use and disturbances, which in periods are stronger influences than natural changes. A natural interaction will take place between fields on a reciprocal basis in joint projects, supporting the establishment of horizontal, scientific communication. It is, therefore, a great challenge for both archaeologists and archaeo-natural scientist to know each other better in the future, if we are interested in developing in our separate fields.

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Gamtos mokslų metodai: ar tai tik galimybė, ar ateities archeologijos būtinybė?

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Santrauka

Gamtos mokslų metodai yra taikomi archeologiniame darbe, tiriant aplinkos modelius, ir ateityje jie, matyt, įgis dar didesnę svarbą. Šiame darbe kalbama apie du bendradarbiavimo būdus: daugiadisciplininį ir tarpdisciplininį. Taip pat pateikiami kai kurie tokių bendrų projektų rezultatai, paminint ir šalutinį jų poveikį.

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The use of vertebrate fauna remains in the interpretation of subsistence strategy and settlement patterns, with emphasis on fish and bird bones. A case study from Kotedalen, Western Norway

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Introduction

The fact that Norway has a long coastline (Fig. 1) is reflected in the prehistoric settlement patterns of the country. Most stone age sites are found at the coast, especially close to narrow channels with strong tidal currents (Figs. 1 and 2). Given that they are coastal sites, bones of fishes and marine birds are frequent on these sites. In fact fish bones are often the most frequent vertebrates present at our stone age sites.

In Norway, zooarchaeological investigations have been undertaken for the last 70 years. However, the study of the small vertebrates, micro mammals, fishes and birds have played an important role in these investigations only since the mid seventies. This is mainly a result of the introduction of new excavation and sampling techniques.

The unique excavation of the Kotedalen site, which involved close co-operation between archaeology (Olsen 1992), botany (Hjelle 1992, Kaland 1992, Soltvedt 1992) and zoology (Hufthammer 1992) has produced some interesting results.

Material and methods

In most recent stone age excavations the soil is water sieved at the site, with 4 mm mesh and as a test 2 mm mesh (Fig. 3). These samples are both kept and analysed separately.

At the Kotedalen excavation, additional soil samples, usually 1 litre each, were taken from cultural sediments and features of special interest. These samples were brought back to the laboratory and stored. Some of these are sieved at the laboratory to help answering questions that were not recognised in the field. However in most cases they have been stored for future, and perhaps more sophisticated, generations of scientists.