Primitive
tider

21

arkeologisk
tidsskrift

Primitive tider utgis av Marie Ødegaard (redaktør), Hege Skalleberg Gjerde, Gaute Reitan, Marte Spangen, Vibeke M. Viestad og Mari Arentz Østmo
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ISSN 1501-0430

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Trykk: Reprosentralen ved Universitetet i Oslo

Forsideillustrasjon: Handelsrelaterte gjenstander fra Vikingtid. Foto: Åge Hojem, NTNU Vitenskapsmuseet. Fra artikkelen Metallsøkerfunn som grunnlag for kunnskap og vern. En case-studie fra Sunndal – et knutepunkt i jernalder og middelalder av Dahle *et al*. s.81-99.

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Rapporter

Anmeldelser

Practical experiences with cross-disciplinary research – the case of Saving Oseberg

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Funding organizations increasingly aim to stimulate cross-disciplinary cooperation in research projects by channeling resources into topics that address complex questions. Although cross-disciplinary research has been in the wind for at least 10 years and the challenges which arise are by now well-known for those who have experienced this type of work, they may not necessarily be anticipated by other researchers emerging from monodisciplinary research traditions. Reviewing cross-disciplinary research applications is a challenge still faced by funding bodies. Likewise, figuring out where to publish results is another dilemma faced by researchers involved in work which spans disciplines. The report "Case Study Review of Interdisciplinary Research in Norway" is an interesting read, as it discusses core issues influencing such work (Davé *et al*. 2018).

Here I discuss aspects of cross-disciplinary research which I have encountered as a member of the Saving Oseberg team. The opinions and reflections are certainly personal, but are nonetheless transferrable to similar projects addressing complex issues – be it in archaeology or conservation. Awareness of these issues is important in order to identify the mechanisms at play so that they may be addressed and enable smooth routes to discovery.

Background

Saving Oseberg (2014-2020) is a cross-disciplinary research project which aims to develop preservation strategies for the alum-treated wooden objects from the Oseberg find. The team has specialties within various branches of chemistry, conservation science and archaeological wood conservation. Other specialties are involved as needed and include wood science, physics, engineering, digital imaging and material science.

Objects from the Oseberg ship burial were excavated in 1904. The grave has been dated to 834 (Bonde and Christensen 1993). Today, these finds, many of which are displayed at the Viking Ship Museum, are undergoing self-destruction due to the conservation treatment applied in the early 1900s using alum salts (aluminum potassium sulfate dodecahydrate, $KAl(SO4)2 \cdot 12H2O$ and ammonium aluminum sulfate dodecahydrate, $NH4Al(SO4)2 \cdot 12H2O$). The trouble with this treatment is that the set-up requires heating of the salt solution to about 90°C. As alum is not very soluble in cold water, heating enables a greater concentration of salts to be dissolved, allowing for a greater salt loading inside the wood. The salts offer physical support upon cooling through their immediate solidification (crystallization), thus preventing shrinkage and distortion. The heating process, however, also generates sulfuric acid, which penetrates the wood along with the component ions of alum salt (Braovac and Kutzke 2012). Thus the acid absorbed by woods treated with alum has caused the slow degradation of the remaining wood polymers, resulting in severe loss of structural integrity and mechanical strength. This is especially complicated when considering that many alum-treated objects have been reconstructed from many fragments.

Not all woods from the Oseberg collection required conservation treatment before drying (see A.M. Rosenqvist 1959) for a description of the conservation treatments applied to the wooden finds). This is due to the fact that different wood types are resistant to wood-degrading bacteria to different degrees. Heartwood oak (Quercus, sp.) and pine (Pinus, sp.), for instance, survived quite well in the Oseberg mound, which explains why the ship hull and deck did not need any conservation treatment. Indeed, the ship planks were coated with a mixture of linseed oil and creosote, but this did not penetrate the wood more than a few millimeters. Had the wood been highly degraded, this treatment would not have prevented shrinkage and distortion. Other well-preserved wood types recovered included yew (Taxus baccata) and ash (Fraxinus, sp.). An overview of the types of woods which were poorly-preserved, requiring a form of conservation treatment before drying, is still incomplete; the information given in the excavation publications is not reliable (Brøgger *et al*. 1917). So far, birch (*Betula, sp.*) and maple (*Acer, sp.*) have been identified, but more work is required to obtain an accurate catalogue of woods used to construct the objects in the collection. It is exceptionally challenging to prepare high quality samples for identification under the light microscope due to alum-treated wood's extreme level of degradation.

The three main research areas of Saving Oseberg focus on material characterization, testing of existing methods to strengthen and deacidify the wood, and development of new strengthening materials. Four laboratories, in Norway, England, the Netherlands and Italy, are involved in the project, with the hub located at KHM.

This way of working not only demands the establishment of effective communication routines to maintain focus, but also a common understanding of project goals. Here, I discuss how we manage the challenges inherent to such groups, and some lessons learned. First, some aspects about conservation research are highlighted.

Setting the scene for Saving Oseberg

Only the Oseberg finds have been treated with alum salt in KHM's collections, but the treatment was widely used in Scandinavia since its development in the late 1850s (Herbst 1861, Speerschneider 1861) and has been applied beyond, such as in the US (Eaton 1962). However, the alum treatment has not been in use since the 1960s, so current preservation specialists may not be aware of the preservation challenges that accompany this treatment method or even know how to identify alum-treated collections.

Why is there a Saving Oseberg?

Put another way, why didn't we know about this problem earlier? At KHM we have been aware – since the mid-1990s – that alum-treated woods show a form of degradation unlike that observed in other archaeological woods. However, taking this awareness a step further and dealing with it is a challenge, as conservators do not have research time allocated to their positions at KHM, in addition to the fact that input from chemistry is required to understanding the material properties. The need for such resources cannot be covered within the museum's normal operating budget.

Initially, we believed that the reasons behind the observed degradation patterns were related to poor storage conditions in the past. We thought that the alum salts were swelling and shrinking with changes in relative humidity, which would in turn cause mechanical breakdown of the weak wood structure. As explained earlier, this is not the case. For many years, this misunderstanding was perpetuated as 'truth' by conservators, chemists and wood scientists without actually being confirmed by experimental work. Furthermore, no one could explain the source of acidity in the wood. KHM's Alum Research Project (ARP, 2007-2013) was the first to relate degradation to the alum-treatment itself, which required collaboration between chemistry and conservation (Braovac and Kutzke 2012). Further investigations within ARP revealed the complexity of the material and it soon became clear that the project required bolstering if we were to make further headway in finding ways of mitigating the problems. We could not rely on existing research, as only a few other groups have investigated this material, and they did not address the chemistry-aspect (see for example Bojesen-Koefoed et al. 2003; Bojesen-Koefoed and Stief 2003; Bojesen-Koefoed 2012; Häggström *et al*. 2013). Establishing Saving Oseberg felt like a quantum leap regarding personnel and infrastructure.

As mentioned, alum-treated archaeological wood is a highly complex material. The chemical composition of archaeological wood is itself highly variable, since the degree of degradation is dependent on various factors, such as wood type, size, and the presence of reactive minerals absorbed/formed during burial, etc. Adding alum salts and acid to this picture complicates it significantly. Thus, chemical characterization requires expertise from different branches of chemistry and different types of analytical instruments, neither of which is easily accessible unless one has resources. Similar challenges are faced in the re-conservation research – which must address both variations in condition and a high degree of restoration in objects.

Saving Oseberg is the first project of its kind to investigate this material to the level required to understand the observed deterioration (Braovac *et al*. 2016, 2018; McQueen *et al*. 2017, 2018a, 2018b; Łucejko *et al*. 2018; Mortensen *et al*. 2018). This understanding is the foundation from which appropriate retreatment methods are developed.

How we work

Roles

Collaborative projects can take on various forms, and depending on the amount of overlap of the fields of expertise involved, they may be classified as multidisciplinary, interdisciplinary and transdisciplinary. These terms are described by Choi and Pak (2006):

> Multidisciplinary…refers to different (hence "multi") disciplines, that are working on a problem in parallel or sequentially, and without challenging their disciplinary boundaries. Interdisciplinary brings about the reciprocal interaction between (hence "inter") disciplines, necessitating a blurring of disciplinary boundaries, in order to generate new common methodologies, perspectives, knowledge, or even new disciplines. Transdisciplinary involves scientists from different disciplines as well as nonscientists and other stakeholders and, through role release and role expansion, transcends (hence "trans") the disciplinary boundaries to look at dynamics of whole systems in a holistic way. (Choi and Pak 2006:359)

The nature of the research question will obviously influence the way teamwork is structured. Interdisciplinary and transdisciplinary best describe the way we work in Saving Oseberg. Why are these ways of working important to consider? I believe understanding the mechanisms which drive knowledge-building allows one to anticipate some of the issues that may crop up so that one can prepare to deal with them. For instance, communication, trust and role division are all important facets that impact how well we work together. Additionally, timelines and publication strategies are important to consider in the planning of such projects.

The concepts of role release and role expansion, mentioned in the description of 'transdisciplinary' are particularly interesting, as they describe processes in groups which have research questions that should be addressed from multiple perspectives.

> …each specialist helps other members to acquire skills related to the specialist's area of expertise; this requires both role release (accepting that others can do what the specialist was trained specifically to do) and role expansion (allowing that one's job can include more than what one was specifically trained to do). (Choi and Pak 2006:355)

This is an important dynamic in Saving Oseberg, where a simple example serves to illustrate this point: conservators show chemists who develop new materials how to characterize wood and ways of setting up testing regimes; chemists show conservators how to operate the instruments and analyze samples and interpret results. This form of practical insight into each other's work builds a common understanding of alum-treated wood's material properties, generates fruitful discussions about retreatment issues and allows team members to give relevant feedback on work presented at group meetings. This type of exchange also enables us to adjust research directions and formulate new questions. Out of necessity, Saving Oseberg also draws heavily on the research from fields outside of the group's expertise, such as soil science, wood science, geology and mineralogy. However, extracting that which is most relevant and meaningful demands a certain amount of knowledge, and is especially difficult while simultaneously learning new terminology. This can cause things to move more slowly than first planned.

Communication

Most of the team is located in the same building, which makes it easy to ask for advice, discuss techniques, etc. Sometimes these discussions can resolve issues immediately. It is also a good way for project members to get to know one another's work over time, which benefits discussions, and lowers thresholds for questions, especially for that important one: 'I don't understand'.

We also keep abreast of work and deal with the geographic spread in the project through weekly web meetings. It is important to invest in reliable camera and microphone systems, as it is extremely frustrating to not be able to hear or see each other properly. We also have a travel budget that allows for in-person meetings in Oslo at least once a year. Group meetings alternate between administrative- and research-based. Administrative meetings allow for updates on aspects surrounding research, such as budget and plans. At each research meeting, two members of the team present their work, which translates to a presentation every other month for each member. This is a good way to keep track of one's own work (being forced to write it up makes it clearer to oneself), and to involve the rest of the group, as presentations are accompanied by extensive discussions and questions.

Knowledge gaps

No matter how much we learn from each other, we cannot fill all the knowledge gaps. Mit Bhavsar (2017) mentions this aspect in his post on the NatureJobs blog. We alleviate it somewhat through discussions within our reference group, where external experts with different specialties are available to give guidance. In some cases, this is still not adequate, as their areas of expertise do not always cover our needs. Additionally, the systems we try to understand are so complex (messy and inconsistent are key traits of material samples in cultural heritage) that piecing together pieces of information from the literature is rife with uncertainty, because this approach does not take into account the synergistic effects which may arise in a more complex system. There are many more examples illustrating these points. In other words, we struggle with knowledge gaps that cannot always be filled. One way to deal with such uncertainties is to first try to identify them so that it is possible to evaluate how significant they are, and whether further work in this area should be prioritized or not.

Publication and dissemination

The classical way of monitoring research production is through publications. In recent years, more discipline-spanning journals have been established to meet the demands of cross-disciplinary research, especially within the field of cultural heritage. As much of our work is most suitable for journals within the natural sciences, we have chosen to publish there. However, cultural heritage journals are also appropriate, especially when tying together material science and conservation. We have approached the issue of where to publish by considering the needs of team members, most of who are in the beginning of their academic careers; we publish where it will mean most to us, and where we will receive relevant readers. Conferences are extremely important venues to create networks and receive input. Many conferences also arrange for publishing in special issues of well-known journals. The article undergoes the same peer-review process as in regular issues, but it is collected with other conference contributions.

The great thing about working in a museum is that we have access to its visitors. The museum is the perfect venue to reach out to a wide-ranging audience who is interested in the research we are doing, or in the collections we are working with. We have set up a program for Turist i egen by, where we show what goes on behind the scenes in Saving Oseberg. It is a challenging, fun day, where we too learn a lot, especially how to communicate our work to non-specialists.

Final remarks

Cross-disciplinary collaboration is not streamlined and generally requires more time than in monodisciplinary research. This is especially true in interdisciplinary and transdisciplinary projects, as team members must establish a common understanding of the research question, to learn about each other's specialties, think about their roles, and develop a common language, trust and respect, all of which require time. This is important to consider in the planning phases of such projects.

In order to get the most out of cross-disciplinary interactions I have learned that I have to do a lot of work which takes time and perseverance: I have to learn about the techniques used by the chemists in our group, and I have to teach them about conservation. What is important to keep in mind is that time used here is an investment. As our common understanding grows, it allows for methodological innovation, new research questions to be formulated and existing ones re-adjusted. As a conservator, I have to be able to interpret how analytical results affect my understanding of the material so that I know which aspects are most important to address for re-conservation. Good communication keeps the project focused on the relevant issues. This type of work is impossible to do in a group that does not trust or respect each other.

Acknowledgements

Thank you to the Saving Oseberg crew, past and present, for inspiration and for all the good discussions over the years.

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