Towards an Ecology of Heritage Sites

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ZUSAMMENFASSUNG

Die Denkmalwissenschaften sind dank des ihnen zur Verfügung stehenden Methodenrepertoires, das in zunehmendem Maße Ansätze aus Nachbardisziplinen aufnimmt, in einer guten Position, um die komplexen Netzwerke, mit denen historische Gebäude verflochten sind, zeitlich und räumlich nachzuverfolgen. Wohl auch deshalb hat sich der Begriff Baukultur immer stärker etabliert, weist er doch auf das gesellschaftliche und kulturelle Umfeld eines Denkmals hin. Dieser Begriff greift jedoch zu kurz, wenn es darum geht, Verbindungen zur nichtmenschlichen Umwelt aufzuzeigen. In Anlehnung an den von Isabelle Stengers geprägten Begriff „ecology of practices" könnte man von einer Ökologie des Denkmals sprechen. Das bei dessen Untersuchung generierte Wissen kann eine Relevanz gewinnen, die über das engere akademische Interesse hinausgeht, insofern es praktische Aspekte berücksichtigt und die Kluft zwischen Theorie und Praxis überwindet. Dadurch eröffnet es den Handelnden neue Möglichkeiten, zum Beispiel durch die innovative Anwendung historischer Materialien. Dieser Prozess benötigt angemessene Formate für Kommunikation und Dialog zwischen verschiedenen Lebensbereichen.

Das Potenzial der interdisziplinären und intersozialen Zusammenarbeit im Bereich der Denkmalwissenschaften wird anhand des 2017 bis 2020 von der Stiftung Pro Kloster St. Johann und der Scuola Universitaria Professionale della Svizzera Italiana durchgeführten, SNF-finanzierten Projektes *Mortar Technology and Construction History at Müstair Monastery* exemplarisch dargelegt. Ein im Anschluss an das Projekt durchgeführter Workshop, an dem Archäolog*innen, Handwerker*innen und Denkmalpfleger*innen teilnahmen, hat Vorteile und Schwierigkeiten einer vertieften Interaktion zwischen Handelnden aus unterschiedlichen Lebensbereichen aufgezeigt.

Introduction

Listed buildings, monuments and sites are part of complex networks consisting of a multitude of actors. They fulfil a variety of roles and incorporate different meanings and values. Performative, practical aspects play an important role, again involving a variety of actors, depending on the type of activities performed: cultural, scientific, bureaucratic, economical, etc. Because of this in recent years the term "Baukultur", or "building culture", is gaining a growing popularity, since it points to the larger social and cultural environment of a site.

For the purpose of untangling the complex networks in which historical buildings are embedded both historically and spatially, the current culture-historical approaches appear to be too limited in scope. The analysis of the material aspects of the heritage objects, as well as their associations and connections with the non-human environment, needs a broader framework in order to be more inclusive. One such approach is provided by Alfred Gell's theory of art as agency. Gell shows how art elicits strong effects on society and interacts with the people exposed to it. He termed this effect "secondary agency". For him, art is not about "meaning and communication", but about "doing"[1] and "a system of action, intended to change the world rather than encode symbolic propositions about it".[2] This approach is eminently applicable to the sphere of heritage preservation. That is not only because of the frequent overlap between heritage objects and art, but also because vernacular heritage objects, just like art objects, demonstrably elicit strong effects and responses, and are sites of performances and activities.

From Alfred Gell's concept of secondary agency it is only a small step to granting full agency to works of art and, by extension, to the material world. This step is necessary if the scope of the analysis is to encompass not only the interactions between heritage objects and human society, but also those with its non-human environment: landscape, climate, and ecosystem. In order to reach a stronger holistic

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approach, it is helpful to abandon the dichotomy of culture and nature and view the heritage object as embedded in a vast network of human and non-human actors. Borrowing the concept of the "ecology of practices" from Belgian philosopher Isabelle Stengers, we would like to term this approach an "ecology of heritage sites".[3]

Thanks to the growing repertoire of methods at their disposal, the heritage sciences are in a good position to study this complex ecology. Such an avenue of research can gain an importance which goes beyond the heritage sciences, as long as it considers practical, performative aspects and bridges the gap between scholarship and other realities, such as craftsmanship. In so doing it opens up new possibilities in the present, for example by enabling the innovative use of traditional materials. This process however necessitates adequate formats for communication and dialogue between different actors.

The Project "Mortar Technology and Construction History at Müstair Monastery"[4]

The potential of scientific research in heritage sites for interdisciplinary and intersocial collaboration and dialogue will be exemplified by means of the SNSF-funded project "Mortar Technology and Construction History at Müstair Monastery" (from now on "mortars project"), carried out as a partnership between the Foundation Pro Convent of St. John and the Scuola Universitaria Professionale della Svizzera Italiana (2017–2020). This project studied a selection of the 5,000 fragments of mortar collected in more than 50 years of archaeological excavations at the site of Müstair, in order to understand the evolution of the construction methods and technologies between the late 8th and the 16th century AD.

The convent of St. John, a UNESCO world heritage site, is counted among the most important monuments of Switzerland (Fig. 1). Erected around 775 AD, it has been a major religious, political and economic centre for over a millennium. The abbey church represents one of only two surviving Carolingian churches in Switzerland and houses the largest cycle of frescoes from that period in Europe. Archaeologists and art historians have identified at least eight major construction phases over the course of the 1,200 years of its existence, demonstrating the continued importance of the site. The whole complex can be considered as a constantly changing organism: some buildings were destroyed and replaced, others were lost due to fires, but each age has left its traces in the materials.

The accurate archaeological and art-historical research of previous decades provided the basis for the determination of the cultural importance of the convent and stimulated a flurry of activity and deba-

Fig. 1: Convent of St. John, Müstair, canton of Grisons. View from the east (2019).

te. The mortars project was developed with a strong interdisciplinary character: starting from the findings of previous archaeological work, scientific investigations of building materials were carried out and added to the existing data.[5] The results made it possible to study transversal themes between different disciplines, highlighting similarities and differences in the mortars, with respect to the origin and use of materials, the organization and the dynamics of the construction site and the activities of the workers of the past.

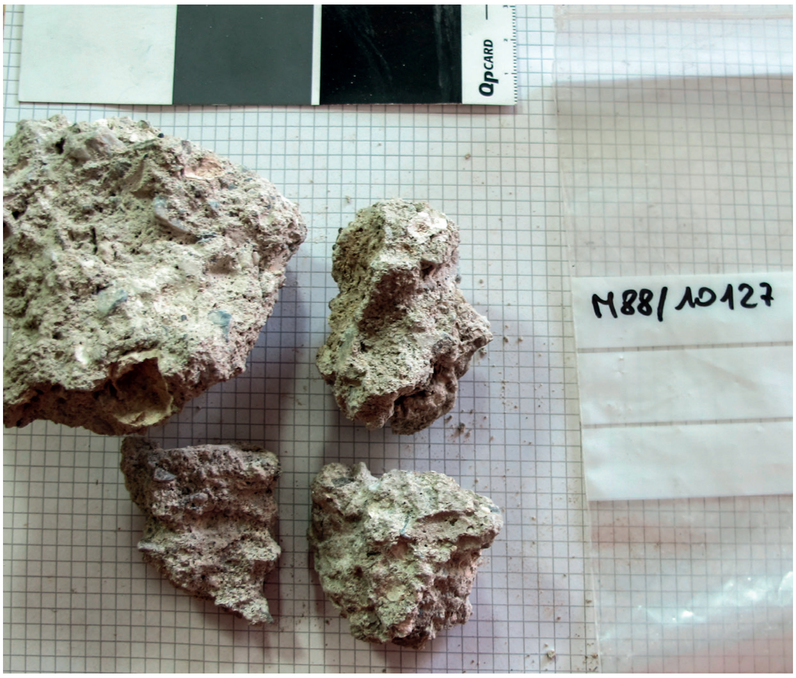

Fig. 2: One of the mortar fragments studied during the mortars project, sample 110127 (2019).

Making mortars speak

Material agents do not speak by themselves. It is humans that give them a voice through their interactions. In this sense, scientific research is a very powerful tool for letting the material world speak and reveal its secrets to us.[6] To this end, it is essential to consider the material properties of the objects to be studied.

Traditional mortars are a mix of common materials, mainly lime and sand. When looking at a piece of mortar, it is difficult to imagine the high research potential it contains (Fig. 2). In fact, as an artificial stone material, mortars can not only provide information on raw materials and supply sources but are also witnesses of a technological process and thus offer the opportunity to tell something about the societies they belong to and the actions performed at the site during and after construction.

To prepare a mortar it is necessary to select the limestone for the binder production and to divide it into fragments with homogeneous dimensions for transport.[7] To produce a binder, the limestone needs to be fired. For this, it is necessary to know how to build a kiln and arrange the stones in it, so that the firing process takes place evenly. The burning time and atmosphere, as well as the shape of the kiln, are variables that will influence the type of binder and its physical-mechanical properties. The aggregate sand is collected from a nearby watercourse. The sand will be characterized by a specific composition depending on the geology of the aerea and its grain size distribution will vary with the seasonal variations of the water stream. Before use, the aggregate can be washed or sieved to obtain particular properties depending on the aimed mortar function. The slaking procedures of the binder, the way of mixing it with aggregate, the amount of water and the application method affect the final properties of the product. The task of material "scientists" is to determine the signs of all these specific procedures and, with a backward induction, formulate hypotheses concerning execution techniques and the know-how of ancient workers. Finally, the CO_2 absorbed by a lime mortar during the setting makes it possible to date the mortar binder with the radiocarbon method, as if it was a living organism which inhaled its last breath in the moment it solidified.[8]

To collect and interpret the data generated by the scientists, and to translate it into a coherent narrative, a broad, multi-disciplinary approach was applied, which included techniques from the physical, chemical, biological and earth sciences as well as engineering. The ensemble of these sciences provides empirical and systematic methods of collecting, analysing, synthesizing and interpreting data relating to the inorganic and organic components of human history.[9] This interpretation requires a great deal of experience and the ability to create inferences on production technology and raw materials by studying the microscopic traces that remain in the materials. From such clues and signs, the investigative method reconstructs a model, which is empirical, or at most statistical, because it is linked to human activities. Carl Popper has formulated the idea that science is such only if it contemplates the possibility of error and falsification. But from the same acquired scientific data, the interpretations can be multiple, therefore the collaboration among archaeologists and geologists is crucial. For example, if data acquired by scientific analyses demonstrates that a different sand was used in two different buildings in a monumental complex, the following interpretations could be equally valid: 1) the two buildings were constructed at different times; 2) different craftsmen have worked there with different materials; 3) political reasons or other incidental facts have forced at a certain moment to change the aggregate supply. If we consider the passing of time and how environmental conditions may have changed the materials, the limited number of samples that can be analysed because they are parts of fragile and precious works of art, the intrinsic limits of the analytical techniques, the enormous number of imponderable variables involved in the archaeological research, etc., it is easy to understand how much even the so-called "hard sciences" in this context are distant from pure mathematical logic.

The method by which scientists create their versions of the past and the different interpretations by which they are challenged are rarely communicated, but it is important to consider how the researchers came to their conclusions and where the margin of uncertainty lies in this process. In particular, the choice of sampling strategy and of analytical protocol must be made transparent. In the case of the mortar project at Müstair, the analytical protocol was structured to characterize the mortars and their variations during the construction of the monastic complex, from the Carolingian (c. 775 AD) to the end of the Gothic period (16th century). The selection of representative and suitable mortar samples for scientific investigation in an entire building or a monumental complex, among thousands of fragments, is the first necessary phase of the research. In the case of the convent, the examination of the existing digital finds database, that summarizes the observations made during the excavation and the collection of the samples in the past, was an essential step in this selection process. In this specific case the documentation was very accurate but a common problem is that the person who took the sample (archaeologist or restorer) is not the same person who would perform the analysis (materials scientist, chemist, geologist) or vice versa the person interpreting the results of an analysis sometimes does not know the site and the research questions as well as others. For this reason, effective communication within the interdisciplinary team, including the translation of concepts between different scientific languages, is essential.

The preliminary macroscopic observations of each fragment were carried out in close collaboration with the archaeologists. Among the selection criteria, in addition to the presumed dating, the function of the different types of mortars within the building was considered. A further selection was made considering the macroscopic characteristics and the state of conservation. Scientific analyses on a very large number of samples (in this case 175 samples, about 30 for each phase) were essential to provide scientific relevance to the results and trace variations and persistence of historical materials and methods.

For composite materials such as mortars it is necessary to characterize the main components, such as binder and aggregate, additives and texture. The petrographic analysis is carried out under a microscope with polarized light after the preparation of small samples as thin section (slices of mortar

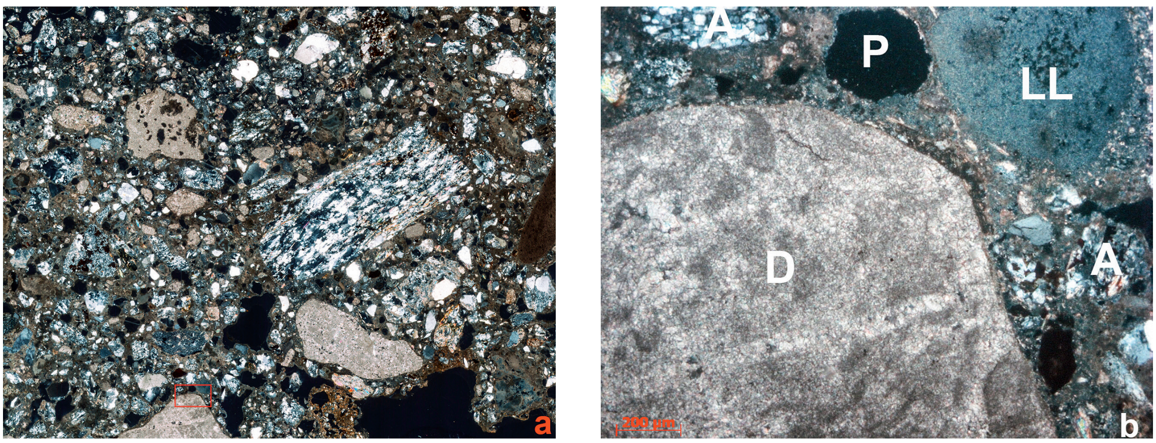

Fig. 3: Thin section of the sample 110127, crossed polars, a) entire thin section, in which aggregate sand and binder related particles can be seen, b) hotomicrograph at 50x magnification of the red area indicated in a). Some mortar components are indicated as example: A=aggregate, P=pore, D=dolomite fragment, LL=lime lump (2019).

impregnated in transparent resin, up to 30 microns thin, polished and mounted on a glass slide) (Fig. 3). This analysis requires minimal time and resources and also allows to identify with good approximation the presence of potentially problematic elements: clay, low binder content, secondary products, microcracks, etc.[10] Petrographic analysis is non-destructive and the thin sections can later be used for other types of investigations (e.g. micro-FT-IR, micro-Raman, SEM-EDS). Similarly, chemical-mineralogical analyses often performed on powdered mortars (i.e. XRD, FT-IR, XRF) are non-destructive and samples can be saved and archived for further study.

Physical and mechanical properties are of great importance, but their standard measurement requires large sample sizes and this is not often feasible on cultural heritage.[11] Despite the often large size, quantity and good state of conservation of most of the mortars samples from the convent, considerable difficulties have arisen in the preparation of standard-sized samples for physical and mechanical analysis. In fact, the coarse siliceous aggregate and the carbonate binder showed too different mechanical strengths to be cut into regular shapes without breaking, so that only a few useful samples were available. Fortunately, petrographic analysis permits a rough estimation of some of the mortar's physical and mechanical properties, such as nature and distribution of porosity.

The origin of raw materials and their possible chronological and spatial variations are an interesting and complex subject to study. In the case of Müstair, carbonate rock formations with a significant Mg content[12] have been used for the production of mortar and plaster binders of different construction phases of the buildings. These carbonate rocks emerge widely in the northern and southern sectors of the Müstair valley, corresponding to the domain of the Upper Austroalpine (Engadiner Dolomiten). It has been verified whether it was possible to discriminate the potential raw material exploitation in different periods. The strategy for the selection was developed after a study of the geological and topographic maps and lists of historical toponyms, taking into adequate consideration the accessibility to geological formations. Samples of dolomite rocks were collected in Val Müstair and their characteristics were related to the lime lumps found in mortar samples.[13] With the aim of identifying the potential provenance of the sands used as mortar aggregates, recent river sands from basins close to the Müstair convent were collected and analyzed. The results were compared with the aggregates of the mortars of the buildings. On the basis of all the results obtained, the mortars were grouped and their characteristics correlated with the production technology, construction techniques and the choice of raw materials.

The absolute dating of the mortars can specify the construction phases of the archaeological sites and confirm or contest the existing chronologies. When mortar hardens it absorbs carbon dioxide from the atmosphere and forms calcium carbonate. In principle, the hardening process corresponds to the death of a living organism; that is the point in time when no new 14C is formed and when the radiometric clock starts to tick. Problems arise if the mortar contains other carbonates which would indicate an age greater or less than the age of the binder. The method of mortar dating makes use of the fact that the contaminating carbonates are dissolved in acid at a different rate than the binder carbonate. The samples are separated chemically into several consecutive CO_2 fractions, which are all dated separately. The selective dissolution method has shown reliable results but the wide variety of mineralogical phases in a dolomitic mortar, due to the more complicated pattern of the dolomitic lime cycle, has been identified as a potential source of error for the dating process. Therefore, the dolomitic nature of the mortars used in Müstair[134]imposed the necessity to test their dating potential. The first effort of the dating research was therefore devoted to verifying the feasibility of the method based on existing dendrochronological dates from the St. John church, which provided an anchor age. Furthermore, these first tests were used to understand which type of sample preparation was suitable in the specific case.[15] Once the potential of dolomitic mortar dating was demonstrated, it was applied to investigate controversial construction phases of the heritage site, for which established dating options were not available.

An ecological approach to heritage preservation

The mortars project at the convent of St. John is an example of interdisciplinary research in the field of heritage science. If the site is seen not only as a heritage object embedded within a larger network, but also as a network in itself,[16] then the mortars studied by the project must be considered as a part of that network which until now has been silent and almost invisible. Only thanks to the methods of the scientists did the mortars gain a voice and tell us about their properties, their history, and the human and non-human interactions which have led to their creation and modification through time. The materials studied can be associated not only with the humans who created and used them to construct imposing buildings, but also with the natural world from which their constituent materials came: the rock formations, mountain slopes and rivers of their surroundings. Through the study of the material components of a site we can therefore follow the associations and connections inside a wide network of human and non-human actors.

The research activities, however, themselves influence and transform the network of a site. They can change the way we see a monument, or the values attached to it. In the case of the mortars project, the research team was able to show how the monument was embedded in its landscape, how the landscape influenced and determined its existence, and how the construction work in its turn influenced and changed the landscape. It therefore contributed to root the site more firmly in the local reality, which means it re-defined its ecology, as opposed to the strong international, culture-historical perspective assumed by most art-historical and archaeological studies by default.

The use of the term "ecology" in this context does not simply refer to the traditional concept as it is used in the biological sciences. It also includes the world of practices and performative activities carried out at heritage sites. When used in this sense, it borrows from Stengers concept of "ecology of practices". According to her notion, "there is no identity of a practice independent of its environment".[17] Stengers explicitly refers to Bruno Latour's idea of "attachments" which bind us to our world, enable us to feel and think. Heritage objects, together with their networks of actors and actions, can therefore be seen as tools for feeling and thinking. The need to acknowledge this function of monuments and to integrate it into the definition of what a cultural heritage site is has been articulated in the past by representatives of societies where such an approach is common. As Dawson Munjeri stated from an African perspective: "In these societies, the interplay of sociological and religious forces has an upper hand in shaping the notion of authenticity".[18] While they might not have the upper hand, or be as visible, in European heritage sites, social forces play an important part here as well. The problem seems to be more in being willing to recognize them.

Heritage sites, because of their high visibility, the great importance and values attributed to them, and the large amount of scholarship carried out, can function as proxies for studies aimed at shedding light on these aspects of human existence, on the interactions between human and non-human actors as well as the interdependence between human practices and their environment. The study of heritage sites can thus produce an ecology interconnected with other ecologies, and knowledge which may spill over into other domains, such as the one of craftsmanship, as shall be proposed in the following chapter.

Bridging the gap between scholarship and craftsmanship

The care for and preservation of heritage objects is always dependent on manual work by skilled craftsmen, therefore the crossing between science and craftsmanship is one which seems particularly obvious. In fact, restorers are nowadays accustomed to cooperate with scientists who provide them with information on the material properties of the art works with which they are engaged, in order to improve the outcome and durability of their interventions. The use of analytical techniques today is often an integral part of the formation of academic restorers. Restorers have therefore developed an ethos which differs from most other craftsmen. The challenge lies in crossing the boundaries between the heritage sciences and restoration as well as conservation disciplines and interacting with specialists from other crafts. Such a successful crossing would arguably have an impact on society, if it led to the creation of new practices, or the stronger spread of existing practices, beyond the conservation and restoration field.

In the case of the heritage sciences, there is great potential in the spread of traditional craftsmanship techniques which have been identified and studied on historical buildings and sites.[19] As these sites are strongly rooted in the local realities, as has been shown by the mortars project at Müstair, this can lead to a strengthening of the attachment to the locale of the actors involved. Is this preferable to the opposite, to de-attachment? According to Latour, increasing attachment, or the possibilities of attachment, leads to more effective practices and agency, since no agency is possible without it. The loss of attachment impoverishes us.[20] In other words, attachment is both the origin and the consequence of performances and actions.[21] Increasing attachment thus increases our ability to perform and act in the world. Vice versa, these performances transform the persons which are acting. In a reversal of what present common sense would tell us, Latour poses that competence follows performance. We are not *homo faber*, but *homo fabricatus*, "sons and daughters of our products and our works".[22] Such an approach lends a whole new quality to the study of historical technologies and craftsmanship, and makes the successful communication and integration of the results attained by the heritage sciences seem all the more relevant.

Translation between different domains however is not easily achieved, and may lead to errors in translation or misunderstandings. The Foundation Pro Convent of St. John and the Stiftung Kalkwerk attempted such a crossing by organizing a workshop for stonemasons in the summer of 2021, with the aim to communicate the results of the mortar project and to translate it into practice. For the workshop, a total of 11 applicants were selected. The group was composed of masons, stonemasons, archaeologists, and heritage professionals: a very heterogenous gathering. The workshop included theoretical and practical parts. In the theorical part, the main results of the mortars project were presented, and restorers communicated their views on what a correctly built and aesthetically pleasing stone wall should look like. The practical part consisted in the construction of a stone and mortar perimeter wall for the convent garden using local materials and recipes determined by the mortars project (Fig. 4). The lime had been quarried and fired in a traditional kiln in the lower Engadin by the Foundation Kalkwerk. Kalkwerk also provided an experienced mason who directed the workshop.

Fig. 4: Masonry workshop in the western courtyard of the convent of St. John, Müstair (2020).

The event was an extremely interesting and challenging experience, because it forced all the persons involved to leave their ecological niche and confront themselves with other modes of seeing, thinking, and speaking. As was to be expected, the difference was most marked between craftsmen and heritage professionals. For example, the aesthetic judgement of the restorers regarding what the product of good craftsmanship should look like contrasted starkly with the more functional approach of some of the craftsmen present. The latter also were very quick in assessing the usefulness of the scientific information presented to them for their daily work. To the dismay of the scientists presenting their papers, they did not always seem to find the information very helpful, or even new. In the practical part of the workshop, on the other hand, they skillfully assessed the suitability of the mortar mixtures and stones for the task at hand, and gave the non-craftsmen valuable insights into the processes and observations on which they based their choices and practices.

Scientific analysis can inform us about the choices and practices of construction workers in the past, but it does not tell us the rationale behind their choices. While the rationale followed by modern masons does not necessarily need to be the same as for stonemasons in the past, it still represents one possible explanation, which thus contributes to widen the interpretive possibilities. It can also be argued that, if humans are partly made by their products, the performing of similar activities and the production of similar products makes similar humans. And that, by performing certain actions, a continuity is created with the past. Thus, the gap between tangible and intangible heritage aspects is bridged, and a transition from heritage principles founded in museological practice towards a more holistic, anthropological and ecological vision, as envisaged by UNESCO when it introduced the concept of "intangible heritage",[23] is enacted.

Illustration credits

1,4 Foundation Pro Convent of St. John, Müstair

1,3 Scuola Universitaria Professionale della Svizzera Italiana

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