Pottery in Motion | EXARC

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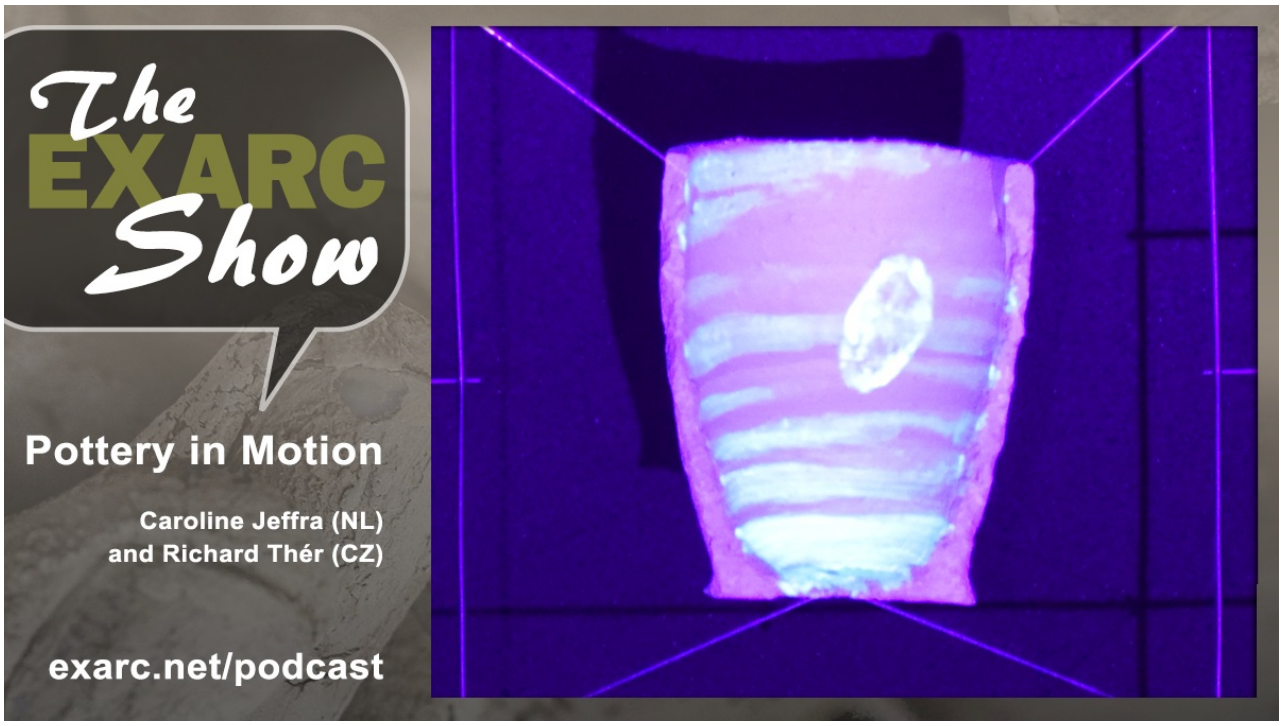

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Guests
Caroline Jeffra (NL) and Richard Thér (CZ)
Introduction
Pottery is one the most ubiquitous artefacts we recover archaeologically and is often the backbone of chronologies for understanding past cultures, but what if there's a bigger story that it can tell us? Caroline Jeffra and Richard Thér join us for October's #FinallyFriday to dive deep into the archaeology of technology. In this episode of **The EXARC Show**, we explore the world of possibilities that studying the potter's wheel can expose. Join us for discussions on the nature of innovation in the past and present, the cutting edge of materials research, and the ways that technology sheds light on the social worlds of past peoples.

Transcript
Matilda: Hello and welcome to #FinallyFriday. This chat session is run by EXARC, the society for archaeological open-air museums, experimental archaeology, ancient technology and interpretation. My name is Matilda Siebrecht and today I'm joined by two specialists from our EXARC community focussing on ancient pottery. Dr. Richard Thér is an assistant professor at the University of Hradec Králové in the Czech Republic. His research investigates the origin of the potter's wheel in Central Europe and also involves the development of methodologies for identifying ancient manufacturing techniques, particularly in relation to pottery forming and firing. Dr. Caroline Jeffra is a post-doctoral researcher at the University of Amsterdam in The Netherlands, where her research focuses on the identification of pottery-making techniques in the Bronze Age Aegean. In particular she uses experimental archaeology to explore innovation and social development via the introduction of the potter's wheel. And you may also recognize her as the director of this #FinallyFriday series. So, welcome to both of you, I have a quick question to start you off, very simple: what exactly is so

special about the potter's wheel?

Caroline: From my perspective, which is the Bronze Age, what is so special about the potter's wheel, is, it's an opportunity, because, we have an idea of what people were practicing beforehand, we have assumptions about the technical practices afterwards, and the potter's wheel really highlights connections between people. So you have this moment where people are exposed to a new technology and may choose to adopt it, and then adjacent communities may have people where they choose to adopt it as well. When you have adjacent communities or even distant communities engaging with the technology, a technology that requires intensive contact between people to learn, it gives us a great indication of where trusted connections are between craftspeople. It acts a little bit like the dye that you use in MRIs, it shows the pathways between people that existed before the introduction of the wheel. So it gives us this moment of insight, of communication and trust networks. I don't know if it's different from your perspective, Richard, because your period is a little later and also more North…

Richard: Yes, well not be so specific to my line of inquiry, in my research, but more general. For me, what is special on the potter's wheel is the amount of energy you have to invest to master this device, because the set of psycho-motoric skills which is needed for the mastering of this device is incomparable with any other pottery forming technique, which is very special related to this device. And there is also the very specific visual performance of the technology, because if you are watching the potter who is excellent in wheel throwing, you are feeling that he or she does some magic, because suddenly the vessel appears within his or her hands and it's very special, this performance of the technology, which also is a factor of attraction to this technology, during the process of innovation.

Caroline: I like that comparison that you just made, the idea of it…when you have a very skilled person, very well-experienced person, that the magic is, they make it look so simple. I feel like, in terms of thinking about this innovation, there's maybe something in that, that attracts people, to trying this technique, because of how effortless it looks. When you harness this rotational energy, the clay wants to move out to the outer edge of the wheel, so it's just a matter of directing it up, and not too far out, so that it doesn't collapse. One of the things that that speaks to that innovation as a…or looking at the social connections more broadly, because in order to trust somebody to come and participate or come and be in your work space, that speaks to a stronger social connection. And taking the time to sit down and teach someone, it's built on a stronger social connection than just looking for a resource in the landscape even…although resource searching in the landscape also has its own sort of level of secrecy around it. But I find it very satisfying to think about how a technology change presents opportunities for understanding the social and the work social lives of people in the past. Especially in the pre-historic period where we don't have direct accounts in the way that you might in later periods.

Richard: Yes, I think you pointed out very precisely and the performance which acts as a way of attracting people to the technology can be also on the other side the phenomenon which prevents its spreading, because when you imagine the amount of energy you need to master the technique, then many potters can leave the technology be, because it's not reasonable for them to acquire and keep such skill if they need to produce only a few pots during the year, in some domestic mode of production, and then they will keep the traditional hand-building technique, because it is perfect for the use of the technology and they don't need some new, fancy and very skill-demanding approaches how to form pottery.

Caroline: Yeah, the point that you just raised is very interesting I think, because…firstly is this idea of sharing knowledge versus protecting knowledge and I did find, in the course of my PhD, looking at Crete versus Cyprus, in their earliest use of the wheel, it seems that in Cyprus there were very

distinct traditions so we have, in looking at it archeologically, we can say "oh, there's this ware, there's that ware." Some of the categories of pottery were exclusively wheel-formed, some of them were exclusively handmade. And then there were some that were made with either, so it's almost like production was segmented, in a way. And so maybe these were closed communities where there's not strong connections between them sharing information. The case in Crete is, in the early Middle-Bronze Age, some potters started using the wheel for small shapes. And then, in a fairly linear progression through time actually, larger and larger shapes were made using the wheel, and this was applied to greater and greater proportions of the assemblages that I've looked at. It seems like a much more open system, you can say things like, oh, maybe it's a stronger cohesion across the craft in Crete than in Cyprus, or you can say that there are stronger connections between individual working spaces, when compared to Cyprus. So I think that there are some really interesting details to be found if we look at, not just, when did they use the wheel and what did they do, but also, how does it look broadly across what you might assume to be a homogenous culture group. There are also interesting things to be said about the mode of production in terms of intensity as well as specialization. Hand-building you can kind of walk away from, and do other tasks in between, so I feel like it, if you think about the rhythm of your whole day or your whole week, hand-building techniques are maybe a little bit more forgiving if you think about your life as a non-potter. When I'm sitting at the wheel, I end up having clay all over my arms, and it's a much wetter process, it's slip everywhere. Whereas if I'm hand-building I'm able to stop, and it's better if I stop, because sometimes you need to let the piece dry. There are some interesting things that arise when you are practicing making pottery that help you understand some of the attributes that aren't necessarily just efficiency of production but are things about the rhythm of production.

Matilda: I'm just actually going to pop in here, perhaps you could talk a bit about… your approaches are quite different, so Richard, you do use experimental archaeology but your approach focuses more on scientific analysis shall we say, whereas Caroline, your approach is more focused on the practical experiments. What do you think are the benefits of these two approaches when studying the topics that you are talking about?

Richard: Those are not two separate approaches, the practical experiments and the scientific approach. I think there is a strong interconnection between the two sides of the same story and the advantages is in the combination. After all, natural sciences are mostly experimental sciences, it means that the experiment is a crucial part needed to test and design scientific hypotheses. I personally cannot imagine scientific research leading to reliable results without experimental validation. Maybe your question targets more the subtle difference between laboratory and field experiments, and again I think that vital is their combination. The laboratory experiment brings so-called internal validity of the research, it means that you have good control on the factors affecting the results of experiments, and you can reliably say what causes the observed effect. However, it has no so-called external validity, it means that the results are not easily transferable into the past reality and this aspect is very important in archaeology because in our field, in archaeology, using experiments, we create just analogy for the interpretation of the archaeological record. We are not able to experiment directly with the phenomena we are studying, and this is the advantage of field experiments. They can design a complex of factors more relevant to past reality thus the results are more easily usable for interpretations of the past, but on the other side, the more complex of factors involved causes low control of the factors on the results of experimentation. So, again, vital is the combination of the field and laboratory experimental research, and this is what I'm trying to do in my research, to strengthen the research by the combination of the field and laboratory research, and the experiment is the basis for reaching reliable results which can be argumented on a scientific basis.

Caroline: I could not agree more that these two ideas of how you carry out experiments are complementary and need to be both present to have a robust understanding of what we're looking at.

And we kind of talk about the idea of actualism, how actualistic is your work, and the approach that I take is…I make the pots that I want to understand, and then I compare against the archaeology. So I take into account things like comparing untempered clay against tempered clay, and I compare different forming techniques and different forming methods, and then, based on the traces, the morphological traces I see on the surfaces, I look at the archaeological examples and make comparisons, and can get a better idea of what microscopic traces indicate in the archaeology. But that is something that I am capable of doing, it's a type of experiment that I have the skills to complete, and the time to complete. But something that's very important to remember is that we're all working towards the same goals of understanding the past and understanding the evidence of the past, and no one group is going to be able to answer all the questions or indeed ask all the questions, so knowing that people are doing things in the way that Richard is doing things, which is relying on much more laboratory-focused work than I have the time to do or have the ability to do, is wonderful because, in my mind, we are on the same team, working towards the same goals. And by working to our aptitudes and sharing our results we can build a better understanding together, and I feel very strongly about collaborative research, even if it's not direct collaboration, it's that reliance on one another, and trying to answer similar questions but from different perspectives in order to continuously refine our understanding, collaboratively.

Richard: And there is also one for me very important dimension of experiment and it's beyond the classical scheme of the hypothesis and the experimental testing of a hypothesis, it's about the process of understanding of the materials and the technology. When you do practical experiments you are in the process of a very intimate connection with the material and the gestures and the techniques, and using this process you gain another type of knowledge and understanding of the archaeological record, which is based on such technologies and materials. And even if you afterwards don´t use the experimental method as the method of scientific research, you can use this knowledge to untangle some problems, morphological or contextual problems which is connected to the archaeological record, due to your deep understanding of materials and technologies through your personal experience.

Caroline: Yes, absolutely, you can't know what questions to ask until you've run into the problems of not knowing the questions. It's not just experiments, it's also experience and indeed, there is this repeated theme in experimental archaeology, this idea of experiment versus experiential archaeology, and they really are so closely linked together. So you might set out to do an experiment and you do hypothesis-testing, go through all of the rigours involved with that. But unless you have the experiential background, your experiment, I think, is going to be much less robust, because you don't have a good concept of what variables you'll need to consider within the boundaries of the experiment.

Matilda: The question I was going to ask you sort of answered it. Obviously pottery has been such a big part of archaeology, as in the discipline of research itself with, pottery was one of, I think, the first non-treasure, shall we say, items to be looked at in detail. Do you think that the study of pottery has developed in a good way, are there ways that it can continue to develop, are there still, questions that are left unanswered, shall we say, in your opinion?

Caroline: I'm going to just start off with: how dare you say pottery is not a treasure!?

Matilda: I know, sorry! I was nervous about saying it…

Caroline: I'm going to just jump in and say that the more techniques we develop to understand a material, the more opportunities there are to explore that material, so I think the field absolutely is still developing, and it has a long, long way to go even. I think that we're at an exciting moment because there are so many different tracks of research that are visible higher profile through the

interconnection of research. There are a lot more open research outputs now. And something that's been both frustrating and rewarding about going through the COVID-19 pandemic is that we're sharing and communicating our research and our methods in new ways that are more accessible, online, through digital conferences and things like that. So just in terms of communication we're at a really nice intersection, but also in terms of the field there is this constant drive to find new ways to do analysis and to report those new ways to do analysis, so there are actually too many new techniques to stay up-to-date, competently up-to-date, but, we went through this sort of antiquarian phase, and then we went through the typological phase of analysis and now we're in the contextual phase. I find that a really rewarding idea that we're focussing on the context of the pottery production system, and pottery use system, where we think about how it was made, why it was made like that, who it was made for and by, what happened to it afterwards and think about the whole shared repertoire, the whole life history of these objects and what they mean.

Richard: Yes, I think for me the most important aspect of the development in the research of ancient pottery is the development of computational technology, and all the analytical and imaging technologies which are connected with it. I think in most of the cases of our research, when we are dealing mainly with the pottery forming, we rely on images, usually captured in visible light. These images are commonly used to document what is directly observed, and the human senses, the observation is very sensitive, we can see very subtle differences between the topography and morphology when we're comparing the ceramic objects. But the problem is how we can put the results in a repeatable way and into arguments which can withstand the scientific discussion. And the development of imaging techniques based on computational technologies, for example different 3D-methodological systems or X-ray computed tomography, is the way how to capture images and analyse images and quantify what we can see by the naked eye, to make it repeatable in discussions about the diagnostic traces of pottery forming techniques. And I think now we are at a time of exploring these new possibilities, because a lot of these technologies are now user-friendly and we can use it, and utilise it, as non-physicist and non-specialist in the computational science, in spite of the fact that I'm still convinced that the human senses are the basic analyst we can use to see the differences and the similarities in the context and in the complex of the visual perception.

Caroline: The computational and different ways of visualizing this material in order to understand how it was made I think - and this wasn't something I was necessarily that aware of, until I started my current position to be honest - but the visualization has come a long way, and even in the most recent years… so we have many new ways of communicating the things that we see, so that we can demonstrate the presence of evidence in ways that were inaccessible, I mean I look at some of the publications from… even the 1990s, you have black-and-white images, that are a bit grainy, and you can't make the image larger or anything like that, so it makes it harder to communicate what you're seeing, effectively, and ask others to participate in this kind of research because they can't recognize the traces themselves. They don't know how to recognize the traces themselves based on these very grainy black-and-white images. If I think now, the project that I'm on, involves a PhD-student whose specialization is 3D visualization, her name is Loes Opgenhaffen. She 3Ds-scans the experimental material that I make, and she has 3D-scanned archaeological material as well, and just watching her skill as a 3D-scanner and renderer develop over the last four years has been really interesting because, I agree with this perception, human eyes are very precise, very capable of seeing these very slight differences. When I look at the early scans that she made of this material, it almost looked like a version of the object but made in wax, so everything was a little bit rounded, all of these finer traces were a bit rounded. Now through collaboration, because she's an archaeologist, she's not a computer scientist, so that speaks to that strengthened relationship, through collaboration and through talking to her and understanding what's important to me as an archaeologist who specializes in pottery technology, and what's important to her, as a 3D visualization specialist, and negotiating how to use her tool to get the best possible results, things are much sharper now, her models are much sharper now, and I think that these relationships are getting more and more

normal, as the cost of the equipment is coming down slightly, and the cost of computer hardware comes down, and there are more and more open-access programmes like MeshLab that you can use to manipulate 3D objects. So just speaking about that in particular, there are more opportunities and more partnerships that can only benefit this field as time goes by, and I find I'm very encouraged by that, because the more ways we have to present evidence for what we're seeing and what we know is present as indicative of technology, the more people will participate in this kind of analysis and see it in their own material, because again we can't do all of the analysis just through one team. It is a collaborative field endeavour.

Richard: Yes, and also the new imaging techniques are not just ways how to visualize and share the images of our phenomena clearly, but it's also the way how to quantify the results, how to put the results into numbers and compare the different phenomena on a more statistical basis. We can use the precise 3D models on different scales starting with the microscale and ending with scanning in very fine resolution to measure different aspects of surface morphology and topography, for example we can measure surface roughness. So far has been employed, investigated is the surface finishes more than for example the forming technique, but it's usable also for other kinds of archaeological inquiry related to pottery technology. There is also for example wavelength or fractal analysis which can be applied to quantify the surface topography and also methods employed in computational geography, and in GIS, which can be used to visualize and compute the different aspects of the artefacts. So yes, I think in studying pottery there are many new ways to explore and we will see to which end this exploration will go.

Matilda: I think that's a very good time to come in with a final question, before we open this up to our listeners. So what are your plans, both of you, for the future in your research and how specifically can the EXARC community help to make a difference in regards to those points that you discussed today?

Caroline: The future directions for my research in the very short term: Richard and I are co-organizers along with Chase Minos and Roeland Paardekooper of EXARC, we're organizing a conference on this very topic. It's called Archaeological Approaches to the Study of the Potter's Wheel, and it will be all-digital, so we hope that listeners can join us there. It's the last week of November of 2020. If not, we will be having the talks available online and we will have a publication that is open-access to follow. So you can follow information on EXARC's website about that. Personally, I am concluding some of my last experimental work, within my current project, Tracing the Potter's Wheel, and I'm also looking at ways that digital visualization can help us with the presentation of museum displays and archaeological open-air museums. In terms of how EXARC can help with that, the biggest and most important thing to me is that we, as a community, keep on communicating the kind of work that we're doing, whether it is as a publication or not, and just to carry on with the attitude of we're working towards answering questions and we don't need to, and we probably cannot do it individually, through a single person or a single small group's effort, so finding ways to enhance and strengthen communication between ourselves is a really great way of making sure that we as a field keep moving things forward. And also, thank you very much for having me, even though I'm part of the team…

Matilda: You're welcome, our director was very insistent you joined today!

Caroline: It's been really nice to be on the other side, because this is a great topic and it's very close to my heart.

Richard: Concerning my future plans I think the conference Caroline mentioned for us is the possibility to discuss the many issues we are struggling with, concerning the interpretation of the archaeological record. There are still a lot of problems and will be still a lot of problems and we will

be still on the road to understand the archaeological record and what it means in terms of relations between people who are using and utilizing the technology. And we target these issues in three sessions of our conference. One of them, which is personally very important to me, is reliable methods of interpreting of what we see and what we observe, because if we take some archaeological objects we are not able to see technology, we can see just see shapes, structures, state of minerals and so on. The interpretation of these phenomena is quite complicated and we are far from the end of our development of ways of how to reliably interpret. This is personally my key line of future research, looking for the ways of interpretation of phenomena we can capture on the archaeological objects. Particularly, I'm interested in the quantification of diagnostic features observed on pottery, related to pottery forming, such as the orientation of particles on a ceramic body and analysis of surface topography of the ceramic objects. And also I would like to thank you for this opportunity.

Matilda: So we will now be having a live Q&A session so, for both Richard and Caroline, it's a two-part question: Just wondering if there are any publications out regarding different digitisation pathways (e.g. photoG vs structured light). And then the second question, maybe if you both could speak about the environments or the software that you are using to measure difference statistically? Can you tell us more about your tools so that can we build on them? So maybe Richard, if you want to go first?

Richard: It's a very complicated question and complex, looking at the whole questions related to the portray technology. I'm using different tools for different scales of recording and analysing, starting with digital microscopes. For example we are using Keyence digital microscopes to capture micro-traces in 3D space, and those microscopes have their own software which can be used to analyse and measure statistically some of the topographical and structural and textural phenomena. On the more macroscopic scale we're using standard hand-held 3D scanners, and then for me very vital is cooperation with specialists in the field of computational science, because there are no routines I can use for the specific question I can answer by the topographical analysis. So, at this time I cooperate with Josef Wilczek who is an expert on the statistical morphometry, and he programs the protocols and algorithms we are using for our analysis, and he mainly uses the R software, statistical software, to do this. We are also dealing with the analysis of orientation of particles in a ceramic body and for this purpose I'm using mainly the [which software?] and for this purpose the very important are software which can do the analysis of axial data, which is for example Oriana. The statistics of circular data is very rare and the tools which can do the analysis of the orientational data, the tools are quite scarce, so Oriana is one of the few software which can deal with the orientational data. And there are also some modules in the R software which can do for example interpolation of the orientational data. But I feel that I'm going into too much detail of this, so maybe it's better to stop here.

Matilda: Thank you, Richard. Caroline, do you have any different…I guess you're using slightly different methods, or are you also using similar software approaches?

Caroline: That's a great detailed question and within my project I am not the most qualified person to answer that, because I tend to do very naked eye type of analysis, but I can say that what we have done as a project is focus on using structured light scanning, and Loes, who spearheads the scanning aspect, the visualization aspect of our project, intentionally went out and procured a scanner, a structured light scanner, which was entry-level in terms of price. And she did that because she was really interested in trying to establish how far you could go with this tool, with practice and with getting the settings correct. And that's been a big part of why her skill as a scanning person has developed through time. The reason that this is really great is this was always part of the project in order to share the workflows that she establishes. It's a David SLS scanner - we affectionately and without affection talk about David when there are good or bad days. It's one of those things where

the user, the operator, is influencing the output a lot, and so she's worked really hard to get to a point where she understands well how to use the equipment. She has a guidebook on how to use this, which is going to be a part of our final project output. So for us it's not just about writing articles that talk about our results, it's also very much sharing our procedures so that those results are as replicable as possible. In terms of measuring difference statistically, we are not doing that, but that doesn't mean that the models that are produced are not useful for statistical analysis. It's just something that we are not doing, we are not tackling within our project.

Matilda: We have another question, from Emma: It seems common to find pottery sherds but not so common to find firing sites, at least in some periods and some areas. Emma is working on experimental firing techniques like pit firings or campfire firings based on Iron Age pottery (all unglazed and hand built) in the UK. If Emma has produced a pot experimentally, are there ways to compare it or analyse it alongside archaeological pottery to infer a firing method in the past in the absence of the firing sites themselves being found? Richard, I know that you do a lot of work related to this, correct?

Richard: Yes, the question which is directly related to what we are doing and what we published recently, because it is very a painful question, it is the fact that we have very little evidence, direct evidence of firing structures, structures for firing pottery, and even if we have some record, some remains of the pyrotechnological structures, the pottery firing does not leave any diagnostic features which we can use directly to interpret the firing structures, pottery firing structures. So basically, in most of the context we rely on the pottery and the characteristics of the pottery which reflects the firing procedure. But it's very complicated to find something which we can use to differentiate between the different types of firing structures. There has been a lot of criticism of using for example of maximum temperature, because you can reach similar maximum temperatures in different firing structures, and usually you've got some targeted temperature you would like to reach within the firing. It's not the aim of the firing to reach the maximum temperature you can reach. So far more interesting characteristics which are related to the differentiation between the pottery firing structures are the characteristics related to the dynamics of the firing, for example heating rate, soaking time, during the firing. And our research was focussed on how we can analyse the effects of the firing dynamics on the pottery sherds. And we did the research on the case of the Neolithic pottery from Central Europe and also, we combined the analysis of the original pottery with the experiments. Logically, all we do is a background in experimental archaeology and we found out that we are able to differentiate the maximum temperatures reached in the core of the vessel wall and in the margins of the vessel wall. By approximating the difference between the temperatures reached on the surface and in the core of the wall, we can approximate the firing dynamics, the heating rates of the firings, which are one of the promising ways how to differentiate between open fires and kilns for example. Another line of possible usable science traces which can be used to differentiate the different firing procedures are the colour layering which we can observe on the sherd edges or the surface of the pottery. By this I think we can differentiate between the firing structures in which the pottery is separated from the fuel, and in which the pottery is in contact with fuel. But I think there is no space to go in more detail in this. For the first inquiry, related to the firing dynamics, I would recommend to look at our article published in the Journal of Archaeological Method and Theory last year, and this problematic of colour layering is for me a more theoretical vision of what can be useful to analyse or interpret the pottery firing based on the products of the firing, on the pottery, on the archaeological pottery.

Matilda: Thank you, indeed, a very detailed answer there, Emma, so hopefully now you know exactly what to do. We have other questions, so we move on to the next one. Next question comes from Katie: What are your thoughts on Ina Berg's x-radiographic studies? How do you feel this

methodology will be most useful? Other than particle orientation, how much more does it tell us than our own macroscopic observation? I'm not sure if either one of you is aware of this or wants to start with an answer to this? Go ahead, please.

Caroline: I think x-ray studies are very useful, just in general. Ina's done a good job of building up the knowledge of x-ray studies. I think like so many things this is something that is complementary to other approaches. So, for me it's not about what more it tells us than microscopic observation, it's more about how it can complement macroscopic or particle orientation. So I'm finding that there are some things that I look at when I look at visualizations of x-rays, that looking at a high-quality 3D scan is actually really similarly informative, just in the fact that you can see much more clearly overall trends in wall thickness differences, so you can see this sort of, if there's a torsional twisting effect overall, or if there are finger impressions that tend to be oriented vertically along the vessel wall. So for me it's not a matter of "is it better or worse?", it's a matter of what does it add to the picture. And what it adds to the picture is that global view of the particle orientation, which you don't get just by looking at the surfaces obviously. There was a great article that was published I think in 2011 by Bouzakis et al.. And that was a neat combination actually of x-ray and CT-scanning. So it was giving a 3D representation alongside these x-ray analysis, x-rays of the vessel wall. So you could have the best of these two worlds I think. I mentioned in the pre-recording that it is difficult to keep up-to-date with all of the ways the field is developing, and this is one of those things for me, an example of this. That it's another approach to answering similar questions and I think it's wonderful and beneficial that she is able to, and other people are able to do the x-ray work, because that's not something that I'm doing and it is not likely to be something that I will do, so I think in general it's beneficial and the more we can integrate between these different perspectives the better off the field will be in general.

Matilda: Richard, do you have anything to add?

Richard: Yes, I think the x-ray proved to be a very useful tool how to approach the internal structure of the pot, which is very important if we are dealing with the pottery forming technology. We've got two basic ways how to approach the pottery forming, either by looking at the surface and the features we can observe on the surface, or to look into the structure, internal structure of the pot, and x-rays are one of the basic method how to do this. So far more on the global and microscopical level compared to for example thin section petrography, but I think now we are on the turn to the computed tomography, which is also x-ray technique, but the advantage of the computed tomography is that we are not working with the projection of the whole wall, we can slice it into different angles and sections, and we can create a more accurate representation of the internal structure. So the limitations of the classical x-rays I think can be overcome by using the advantages in the development in the, again, in the computational sciences and I think it will prove to be very useful in the next few years I think.

Matilda: Sounds like some exciting opportunities indeed. I have a bit more of a non-specialist question, shall we say. You've both talked a lot about innovation in your discussion already, but for those of us who are here who might not be so aware of it for example, why do you think that subjects like innovation are important to look at in archaeological research, not just pottery-related research but archaeology in general. Perhaps Caroline if you want to start?

Caroline: Innovation in general I think is something that's unbelievably important in terms of understanding how we people, how we humans do things. We're surrounded by the behaviours that innovation spurs in us of really interesting…if you think about something like, all the way back when the iPhone was launched, it was a big change but it wasn't the first smartphone, it was just the most popular smartphone. So the question starts to be: who do you trust to tell you that this innovation is worth you participating in. So for me the amazing thing about studying innovation in people, never

mind the question of archaeology or not, is the way that it reveals how we get our information and whom we trust and who we want to influence, so the idea of influencers has obviously had a bit of a shift in the recent years, but who are influencers in our behaviour and who do we influence? If you add the archaeological perspective into it, then you start to have much more interesting questions I think, that are engaging in a way that they might not be otherwise, because you can start to think about why are only a few people using this practice, this innovative practice, or why is it so widespread suddenly? Two modern examples come to mind for me: one is the use of the laser disc in video, home video. The laser disc, in terms of visual quality, was a lot better than VHS, but it was enormous and for some reason that didn't catch on and then much later DVD came in. The other example is transitioned further back, that's between, that was into using either VHS or Betamax. Betamax had a smaller format so, this is all company-based, but who decides to buy the machine to use this interface and why? It's a social thing, the choice between two potentially equal options is, who's telling you that Betamax isn't worth getting and VHS is worth getting for example. When you look at it archeologically you're looking at this long story of, this long-winding backwards path, of trust and advice and that's really fascinating to me and it can expand in so many different directions depending on what spin you put on it.

Richard: I think Caroline pointed out the basics of our fascination related to innovations. I think we're not dealing with archaeological pottery just to find out how the pottery was produced. It's not just the technology we are interested in. For me, and I think for Caroline as well, the pottery technology and technological practices, the gestures, that potters use in pottery technology are cultural traits, which are very important manifestations of the culture and society, and if we are dealing with archaeology we are dealing with the people and with the society and all the questions related to the evolution of society. And the change is one of the basic features of living organisms, and related to humankind. Innovation is one of the basic manifestations of the change within the society and this is the main reason why we are so fascinated by this phenomenon.

Matilda: Well said, I think I agree with both of you in that case, although I particularly like Caroline's mention of influencers. I can just imagine a Bronze Age Instagrammer going "hey guys, sitting here at the potter's wheel, it's a lovely time." Speaking of the potter's wheel, we have another question here from Jill: you both mentioned the conference that you're organising I think, Caroline as well, you mentioned it in a bit more detail, The Potter's Wheel, Jill's question is about that: The potter's wheel is used over such a broad area and for such a long period of time, how can conferences like the one you're organising help us to understand the wheel better? I guess it's one of these technologies, there are so many out there that just somehow pops up all over the place, and is used for a long time. What's so special about it basically? Perhaps Caroline, you want to begin?

Caroline: That's a great question from Jill. The conference that we're organising I think is going to help us understand the wheel better, because we have three themes as Richard mentioned in the earlier section. The three themes take an increasingly broad perspective on what the pottery wheel means, within groups. The first theme focuses on very much on modes of study, so exactly how do we study the wheel, how do we identify its use, what do these things mean, can we standardize the way we study or the way that we talk about it? The second theme talks more about what's happening socially when the wheel takes off, in an archaeological context. Is there a set of conditions which facilitate the growth of an innovation of this type or the growth of the expansion of the wheel as an innovation? And so the second theme has a lot of different regional discussions in time and in space and also different chronological discussions. But the idea is to really try and say: "The wheel was used in this place at this time, what are the characteristics there, what made it successful?" And then the final theme is talking much more about what the pottery wheel means to people today and in the very recent past. We tried to encourage people who can talk about communities where they have recently started using the wheel, and for what reason did they start using the wheel, what did it mean for the practices which came before. What I'm hoping from this conference and others that

might follow, is that we start thinking about this as one piece within a system, and by thinking about this one piece, from all of these different perspectives, we can start to understand the system of technological change, as it is experienced by people. Are there common things, what are the things that don't happen in common between different societies? And the secondary output of all of this is obviously bringing together people who do this work, because we often publish in context-specific outlets or in methodologically focused outlets, and by bringing all of these people together, hopefully, we can bring this focus forward altogether and into the future start putting out more high-quality interpretations of what we are seeing archeologically.

Matilda: Ok, thank you. Richard, I don't know if you had anything you wanted to add to that there?

Richard: I think the term of the conference 'understand the wheel' is more a metaphor which points out that we are still on the way to understand all the aspects of the use of the potter's wheel and all the problems which are related to analysis and interpretation of the archaeological record. And in fact, we will never be at the end of this road, so there is always new ways, new possibilities and new explorations of the issues related to interpretation of the archaeological record. So I think mainly this is hidden under the term 'understand the wheel' which is in the title of our conference.

Matilda: OK, thank you very much. It will be online, it's from November 24th to November 27th of this year. You'll be able to hear all sorts of things about the innovation of the potter's wheel. Thank you very much to both Richard and Caroline for joining us today and sharing your experience and expertise with everything. I definitely learned a lot about the technical side of pottery analysis which I never even knew about, so I'm sure our listeners also learned a lot too. So thank you to both of you for joining us today.

Richard: Yes, thank you very much for this opportunity and for the very nice questions asked to us.

Caroline: Yes, thank you very much and thank you to everybody who joined today.

Matilda: So, yes, as Caroline said, thank you very much to everyone today who's listening to this episode of #FinallyFriday by EXARC. If you would like to be more involved with EXARC, we're a very open community, why not become a member if you're not already. Alternatively, you can also make a small PayPal donation through the website to help support EXARC in its endeavours, for example like these upcoming conferences. In the meantime see you in December for the next episode, but in the meantime you can follow the very interesting conference in November. Also don't forget, the Experimental Archaeology Conference World Tour will be happening next March, so do check out that page as well for more information of how you can contribute and participate in that. Ok, so enjoy everyone and see you in December for the next episode of #FinallyFriday.