Tracey Peake: [00:01](https://www.temi.com/editor/t/pckZGm00f1cmzCKI7XPj5YvUcvfhw6dT7b5NTq1jM2Oe8KJfMRjIoekOgznOKnyurGcM-XBNmhA6ey13nwC7Z0NjxpU?loadFrom=SharedLink&ts=1.87) Hello and welcome to NC state's audio abstract. I'm your host to Tracey Peake. Manuscripts from the Middle Ages give us a window into the minds of people who lived long ago, but the manuscript pages themselves and the DNA on them could give us even more insight into that time period. Tim Stinson is an associate professor of English at NC state who's bringing the Middle Ages into the digital age through DNA analysis, of medieval parchment. Thanks for being here, Tim.

Tim Stinson: [00:31](https://www.temi.com/editor/t/pckZGm00f1cmzCKI7XPj5YvUcvfhw6dT7b5NTq1jM2Oe8KJfMRjIoekOgznOKnyurGcM-XBNmhA6ey13nwC7Z0NjxpU?loadFrom=SharedLink&ts=31.19) Thanks for inviting me.

Tracey Peake: [00:32](https://www.temi.com/editor/t/pckZGm00f1cmzCKI7XPj5YvUcvfhw6dT7b5NTq1jM2Oe8KJfMRjIoekOgznOKnyurGcM-XBNmhA6ey13nwC7Z0NjxpU?loadFrom=SharedLink&ts=32.57) So let's get started with how in the world did you ever get the idea for looking at the DNA on the pages of these medievil manuscripts?

Tim Stinson: [00:42](https://www.temi.com/editor/t/pckZGm00f1cmzCKI7XPj5YvUcvfhw6dT7b5NTq1jM2Oe8KJfMRjIoekOgznOKnyurGcM-XBNmhA6ey13nwC7Z0NjxpU?loadFrom=SharedLink&ts=42.16) Well, most folks who end up being professors and my graduate training, I was of course taught mainly to think about text, right? I was looking reading medieval texts reading text about medieval texts and so forth. And typically we encountered medieval texts, of course in modern printed editions of them. But of course the original source for all manuscripts, these were hand copied books. Uh, but the entire period falls before the advent of printing. I was looking at all the versions, I could have a single point, the witnesses of it, that's what we call the, the original manuscript copies we call witnesses to the text. Right? And so when I got there and I, you know, ordered up my first round of manuscripts, I was sitting there with anticipation and they're delivered to me. I thought, Oh wow, you know, this is, this is incredible.

Tim Stinson: [01:29](https://www.temi.com/editor/t/pckZGm00f1cmzCKI7XPj5YvUcvfhw6dT7b5NTq1jM2Oe8KJfMRjIoekOgznOKnyurGcM-XBNmhA6ey13nwC7Z0NjxpU?loadFrom=SharedLink&ts=89.77) I was, I was immediately fascinated by the thing itself, the book itself, you know, of course I was still interested in the text, but from that moment forward I was really wanting to know about this book itself. Right? What is, where'd this thing come from? Who's had it in their hands? Who copied it? What's it sort of life, you know, this is an artifact that has a sort of active 600 - 700 year history behind it. And so, so my initial idea about the DNA came because, you know, here I'm handed this artifact and I'm immediately struck by, uh, the animal nature of these books, if you would. Right? So this is animal skin that has been especially treated to prepare a writing surface. And I thought to myself, well, you know, if you go across campus and ask someone how old is this book or where'd it come from, they're going to approach that question, particularly a biologist is going to approach that question from, from a very different vantage point. So that was, that was sort of the light bulb moment for me is to say, well, um, whom can I ask about this? What, what are the other sorts of approaches to answering the questions that, that I came here to answer.

Tracey Peake: [02:33](https://www.temi.com/editor/t/pckZGm00f1cmzCKI7XPj5YvUcvfhw6dT7b5NTq1jM2Oe8KJfMRjIoekOgznOKnyurGcM-XBNmhA6ey13nwC7Z0NjxpU?loadFrom=SharedLink&ts=153.36) So from there you decided to kind of approach, did you approach a biologist or a geneticist? Like how did you go about getting this done?

Tim Stinson: [02:41](https://www.temi.com/editor/t/pckZGm00f1cmzCKI7XPj5YvUcvfhw6dT7b5NTq1jM2Oe8KJfMRjIoekOgznOKnyurGcM-XBNmhA6ey13nwC7Z0NjxpU?loadFrom=SharedLink&ts=161.73) Well, I'm quite lucky because, uh, my brother's a biologist, and so the first thing I did was I wrote to him and said, do you think that maybe DNA could survive the manufacturing process, um, couldn't survive in time that long is, it has it degraded? And so I sent him a little, little bit of information about exactly how parchment was made. And he said, you know, yeah, I think, I think probably it could. We quickly took a look at what was happening out there and sure enough people are extracting it from things even older than the medieval parchment.

Tracey Peake: [03:13](https://www.temi.com/editor/t/pckZGm00f1cmzCKI7XPj5YvUcvfhw6dT7b5NTq1jM2Oe8KJfMRjIoekOgznOKnyurGcM-XBNmhA6ey13nwC7Z0NjxpU?loadFrom=SharedLink&ts=193.93) And so now you know that this is possible. What, you know, how do you get a sample of a medieval manuscript to work with?

Tim Stinson: [03:22](https://www.temi.com/editor/t/pckZGm00f1cmzCKI7XPj5YvUcvfhw6dT7b5NTq1jM2Oe8KJfMRjIoekOgznOKnyurGcM-XBNmhA6ey13nwC7Z0NjxpU?loadFrom=SharedLink&ts=202.62) Now we tend to use either a vinyl erasers like the sort of white block erasers. You see a little slices of those. If you simply rub it on the parchment, it picks up cells, picks up collagen, and, and you can use the eraser rubbings themselves to test either the college or the DNA. And that's um, minimally invasive, right? It, it's actually something that can, a conservation scientist themselves you use to clean manuscripts. So it's very safe. The other thing we use, a technique that I developed here with some of the folks and animal sciences at NC state is to use cell cytology brushes. So those are, those are what we do. Now you also asked about, about the history, right? What did I do in the past? Uh, the very first thing I did was, uh, there's lots of individual pages or leaves as we call them, of medieval manuscripts floating around on the market.

Tim Stinson: [04:17](https://www.temi.com/editor/t/pckZGm00f1cmzCKI7XPj5YvUcvfhw6dT7b5NTq1jM2Oe8KJfMRjIoekOgznOKnyurGcM-XBNmhA6ey13nwC7Z0NjxpU?loadFrom=SharedLink&ts=257.87) You can buy them lots on Ebay and things like that. So the first thing I did was get some of those leaves, individual leaves and sort of abraded the surface on both sides and cut the center out of a little spot in the margin and sent that off to be tested. But there was a, there's a long history of my work on this where what I was doing was simply trying to develop a technique that was minimally destructive or nondestructive, right? So that was sort of a long phase of the project, just simply testing different techniques. Do I get the same result doing this as I did, doing destructive testing back and forth, back and forth.

Tracey Peake: [04:54](https://www.temi.com/editor/t/pckZGm00f1cmzCKI7XPj5YvUcvfhw6dT7b5NTq1jM2Oe8KJfMRjIoekOgznOKnyurGcM-XBNmhA6ey13nwC7Z0NjxpU?loadFrom=SharedLink&ts=294.45) So just getting the DNA was a huge challenge. Right. Now you have the DNA, um, what are you getting from these samples and rubbings that you're taking and what is it telling us?

Tim Stinson: [05:05](https://www.temi.com/editor/t/pckZGm00f1cmzCKI7XPj5YvUcvfhw6dT7b5NTq1jM2Oe8KJfMRjIoekOgznOKnyurGcM-XBNmhA6ey13nwC7Z0NjxpU?loadFrom=SharedLink&ts=305.95) Right. Well, the project is still a fairly young, it's fairly early, so we're not far in time past that point of, you know, actually working on the, the problem of how to get good samples. So we've done a lot more work recently with collagen where we're, we're looking at the structural proteins and we're identifying the species and their distribution across books. And we are, we've done, we've proven we can get DNA, but to date no one is sampled say an entire book, right? That's, that's something that we actually have an ongoing project to do. And I can tell you a bit about that. What we're doing right at this moment and we're looking for the outcome. So I'm working with, um, two colleagues from the Folger Shakespeare Library, Heather Wolf and Michael Whitmore. And so what we're positing is that we, if you look at a culture that you know, is sort of literally insular, right?

Tim Stinson: [05:58](https://www.temi.com/editor/t/pckZGm00f1cmzCKI7XPj5YvUcvfhw6dT7b5NTq1jM2Oe8KJfMRjIoekOgznOKnyurGcM-XBNmhA6ey13nwC7Z0NjxpU?loadFrom=SharedLink&ts=358.64) Think about early medieval monks in England. They're on an island, they've withdrawn from life. These are also the only folks, almost the only folks who are producing books who read and write at this point in history, they're raising herd animals. So they're making their own parchment. So we would hypothesize that that sort of cultural insularity would be reflected in a sort of genetic homogeneity in the parchment. That is, you would think that it would also be reflected in the local herds and in the book reduction. If you fast forward a few centuries and you look at sort of very late medieval or early modern humanist manuscript culture, sort of that manuscript culture that's comes after the period of printing, say somewhere like London or Venice or a city like that, we would fully expect, in this very cosmopolitan, certainly not insular cultural world, that we would see that lack of insularity reflected in sort of very heterogeneous skins coming from all over as a part of, uh, a commercial sort of perhaps international trade. Again, that's, that's a kind of rough notion of what we have about how those cultures were and how the production of parchment was. But we don't really know that for sure. So what we're saying is we hypothesize that we could show this cultural insularity reflected and a sort of as it were, genetic insularity amongst herd animals, right?

Tracey Peake: [07:32](https://www.temi.com/editor/t/pckZGm00f1cmzCKI7XPj5YvUcvfhw6dT7b5NTq1jM2Oe8KJfMRjIoekOgznOKnyurGcM-XBNmhA6ey13nwC7Z0NjxpU?loadFrom=SharedLink&ts=452.08) So in other words, by examining the DNA of these manuscripts in different time periods, like the ones that we know were produced in a monastery, right? The DNA from those pages or leaves should be all from the same herd. Like you should be able to trace that this came from sheep that are related to each other or cows that are related to each other versus later when you know you have trade coming in from overseas and all different places, these leaves are going to have genetically dissimilar origins.

Tim Stinson: [08:05](https://www.temi.com/editor/t/pckZGm00f1cmzCKI7XPj5YvUcvfhw6dT7b5NTq1jM2Oe8KJfMRjIoekOgznOKnyurGcM-XBNmhA6ey13nwC7Z0NjxpU?loadFrom=SharedLink&ts=485.86) That's what we guess and we, we know also that by the end of the Medieval period say from the 13th century for it, it was increasingly common even from monks to hire their work to professional scribes. So we know at some point that turned, right, and that that writing, copying manuscripts became a sort of commercial increasingly commercial production, even if certain monasteries continued to copy and produce their own parchment. In between those two is a story where we have a rough sense of a change happening, not very good, clear historical documents that say this is exactly what parchment trade was like and when this change. And so we could begin to map the interim right when, when did the, when and where these sorts of changes happen. And of course this speaks knowing to literary production but to animal husbandry questions and issues of medieval trade things that we often don't have a lot of good data.

Tracey Peake: [09:02](https://www.temi.com/editor/t/pckZGm00f1cmzCKI7XPj5YvUcvfhw6dT7b5NTq1jM2Oe8KJfMRjIoekOgznOKnyurGcM-XBNmhA6ey13nwC7Z0NjxpU?loadFrom=SharedLink&ts=542.15) So it could give you a bigger picture of what was going on exactly when these cultures started reaching out to one another and trading with one another. Correct. Now you can look at these leaves and maybe get some genetic information about the animals that they were made from. Is there any way possible to get any genetic leavings of the monks themselves?

Tim Stinson: [09:22](https://www.temi.com/editor/t/pckZGm00f1cmzCKI7XPj5YvUcvfhw6dT7b5NTq1jM2Oe8KJfMRjIoekOgznOKnyurGcM-XBNmhA6ey13nwC7Z0NjxpU?loadFrom=SharedLink&ts=562.84) There is. In fact, uh, that's kind of the next generation of sequencing and it's probably where we're all headed. The real eyeopener for me in working as a scientist has been that they're looking at, um, sort of, uh, sequencing everything at once. That is, you know, all the animal DNA, all the human DNA, all the sort of what they're calling the microbiome of the book and thinking about it that way. So there are things like, you know, bacteria commonly associated humans that's there. Um, I've heard some folks say they're finding a mouse DNA, which makes sense. You know, you think about right? You know, uh, you, you have a, a medieval library, early modern library, all the centuries these books have been kept and mice are going to be in and out of there. Um, you know, there's also, of course non Mammal DNA, I'm all sorts, right? There's all sorts of plant material in these books, spores, things like that. So, as I said, it's, it's eyeopening for me. I was thinking, wow, there's, there's kind of this little genetic universe inside of each one of these books that we could, we can begin to map.

Tracey Peake: [10:28](https://www.temi.com/editor/t/pckZGm00f1cmzCKI7XPj5YvUcvfhw6dT7b5NTq1jM2Oe8KJfMRjIoekOgznOKnyurGcM-XBNmhA6ey13nwC7Z0NjxpU?loadFrom=SharedLink&ts=628.83) What do you see as the future of this work? Um, what impacts do you think it can have beyond just literature? Just telling us more about how these folks went about creating these manuscripts. What can it tell us about maybe other fields or do to help us sort of better understand not just the middle ages but maybe other time periods as well?

Tim Stinson: [10:50](https://www.temi.com/editor/t/pckZGm00f1cmzCKI7XPj5YvUcvfhw6dT7b5NTq1jM2Oe8KJfMRjIoekOgznOKnyurGcM-XBNmhA6ey13nwC7Z0NjxpU?loadFrom=SharedLink&ts=650.58) Right. Well I think that's a very exciting frontier and there are lots of, lots of individual fields that could benefit from this. One is if we want to think about, um, animal science or the history of sort of human animal interaction and agricultural settings. One of the things is that, um, we have this completely unparalleled faunal record in parchment. It's sitting in libraries all over Europe. There are over a million manuscript books. And then beyond that, so many single documents, things like leases, wills, every legal document, court records, um, you know, town records, business records, everything was on parchment. And much of this stuff is localized. You know, it's when people do those sorts of documents, they sign it, they date it and they tell you where they are. And this is amazing that we have this record that, that until very recently, no archaeologist looking at it as a, as faunall remains right as a year by year slice of um, animal husbandry, the history of animal husbandry for all the medieval Europe. That's, that's incredible, right? And it's just been sitting there in library unexamined as kind of scientific data, right? It's always thought of as textual data. Uh, there's also a history of trade, right?

Tim Stinson: [12:14](https://www.temi.com/editor/t/pckZGm00f1cmzCKI7XPj5YvUcvfhw6dT7b5NTq1jM2Oe8KJfMRjIoekOgznOKnyurGcM-XBNmhA6ey13nwC7Z0NjxpU?loadFrom=SharedLink&ts=734.83) When and where did things sort of stay local when, where they begin to move. So I think there are all sorts of questions that have nothing to do with literary studies and really relate to other fields that are just waiting to be asked and answered. Right? And perhaps if you step back and look at this from a even and even sort of wider angle lens to me one of the exciting things is really the team of people working together, you know, to have a conservation scientist and archaeologists and geneticists and literary scholars and librarians all working side by side. All of these people have knowledge that contextualizes and enriches the results, uh, that other folks who are getting with their research. And it's impossible to make sense of what's happening, you know, without everyone on the team in some way. Literary studies and, um, you know, archeology and philogenetics all mixing together to answer these sorts of questions. So one, to me, one exciting things move forward is the way in which this bridges gaps, not only is it useful to multiple fields, but it's bringing them together, folks who weren't ever really interacting before.

Tracey Peake: [13:32](https://www.temi.com/editor/t/pckZGm00f1cmzCKI7XPj5YvUcvfhw6dT7b5NTq1jM2Oe8KJfMRjIoekOgznOKnyurGcM-XBNmhA6ey13nwC7Z0NjxpU?loadFrom=SharedLink&ts=812.29) Well, that's really fascinating. I look forward to seeing what you guys come up with in the future. We've been speaking with Tim Stenson and associate professor of English at NC state. My name is Tracey Peake. You've been listening to the audio abstract.