Transcript of the Science Chatter Hamburg Podcast Episode 2:

Hope Bretscher talks to Michael Bueker on Objectivity in Science

[spacy-music], 'Science Chatter, Hamburg'

Michael:

So welcome everybody to this new episode of the science chatter podcast this time we're here with Hope, maybe do a quick introduction of yourself and tell us what it is you'd like to talk about

Hope:

Sure, so my name is Hope Bretscher, and I'm a postdoc here at the Max Planck Institute for the Structure and Dynamics of Matter. I'm an experimental physicist, but I'm also very interested in the way that uh science interacts with society and and how we do science um and ways that we can improve it, and make our science better, both for the scientists themselves and also for how we interact with society and our impacts on society.

Michael:

Right, well with this podcast workshop of the science chatter you've come to the right place because hopefully this is where you as a scientist can interact with society listening to the podcast. So what is it about this topic of you know, the interface between science and society that interests you?

Hope:

Yeah, well, today I wanted to share some thoughts on the topic of objectivity – um--- and why this is is because I think as scientists, or, as a scientist, I guess, I feel like I've been trained very well and I am grateful for my scientific training, in how we do research and how we do science, and I think that's something that we learn from a young age in school. Um, now, I'm American, so I don't know that much about the German education system and what you learn as a child in school here but I can say that even probably from, you know, the age of 10 we were learning about the scientific method and we had to do science fair projects where you came up with an exper—or you came up with a question, that had to be testable and you had to make a hypothesis and a prediction and outline all your variables um and present this whole picture of how you do research and how we come to some sort of scientific conclusion.

And, is that, do you have the same thing here?

Michael:

I, I think it's something that probably only rather only the students which seem to be, you know, talented or very interested in the science or mathematics would get into touch with. We've got this

competition that's called "*Jugend forscht*", which is like, you know, young people are doing research. It's got a science fair spirit, where he would test something or build a prototype of a machine or something. But then there is of course, the traditional science classes, where I would say it's probably presented more as you know, science has found out this. That's the way it works. And here's the formula to go with it. So I would guess that scientific processes as such is not really so well represented and I think that's also something that's, that's interesting to you, right?

Hope:

Yeah yeah, I mean, actually that it is then very interesting also about how um, when we have, when we come from different backgrounds how we learn about the scientific process in different ways, um, and I think that's something that I'd like to get to a little bit later. And sort of some of these reflections that I have.

Michael:

So what would you say then is the scientific method? You know, what is this objectivity that scientists have as their goal in whatever they do?

Hope:

Yeah, so objectivity, I think, is, that's the thing that I want to share about today. And I think my feeling is that as a scientist, what we're trained to think and maybe even for non scientists is that the knowledge that science produces is something special. And that's because of the methodology that we go about when we do this. Um… so we're taught that scientific knowledge is somehow more robust, potentially and that's what makes this special and why it allows society to use scientific knowledge to generate different technologies or also to drive our policy of certain ways. And you see science in in the news constantly about climate change and or or about vaccines, about COVID. Science is very important for society. But I think what I wanted to draw our attention to is that there are kind of two different camps or two different views on objectivity. And I think as a scientist, most of what I've been trained in is in one of these camps, and maybe that's what a lot of people in society as well are told. And that is that science is this type of special knowledge because of the process or the way that we do science, then we can come up with some sort of objective knowledge, objective truth, that we do experiments, we test things, we're able to make predictions and then verify them through measurable processes that other groups or other people can reproduce, and through that process, then we come out with some sort of true knowledge that then we can use and apply to society and apply to technology and hopefully help the world help the climate in some way.

Michael:

So this is what you describe as the, so this is what you describe as the view of science which is probably the more the more widely dispersed one

Hope:

Yeah, correct.

Michael:

Where as I if I understand it correctly, an objective truth is to be found by scientists and obtained by us, but then is independent of us. Is that about, right?

Hope:

Yeah, that's exactly right. So there's because of the methodology that we use as scientists the we are able to come to these objective truths that are exist sort of outside of the people that produce them, and no matter who you are, as long as you're following this scientific method, you will reach the same conclusion. It doesn't matter what your background is all these things, because there's this sort of objective truth that exists. And as long as we give, we sort of have the right practices when we do our experiments, then we will reach that conclusion.

Michael:

Right. And you've indicated that there is an entirely different way of looking at science and the results it produces.

Hope:

Yeah, so there's an alternative truth or alternative viewpoint that some I would say philosophers or social scientists have come up with, that the science that we do is actually socially constructed. So in this perspective, the science or the knowledge that we produce is generated by social processes. And so it's very influenced also by maybe who all are, maybe what's going on in the background of the science that we're doing. And those ideas and kind of society in general are going to influence the scientific conclusions.

Michael:

What are some of the factors that might influence the results that a scientist gathers?

Hope:

The social scientists that come up with this have pointed to, um, even pretty influential ideas that have come out of science, so So Darwinism was generated at a time also when capitalism and very capitalist mindsets are becoming very popular, and you can look at some of the ideas of Darwinian evolution and see sort of how those idea frameworks are very similar to kind of capitalist ideology. So that would be one example. Another idea as we look historically, again, to kind of ideas of craniometry. So this idea that like shape of your head is going to have bearing on your intelligence and the skills that you have all these things was very heavily influenced by racism at the time, also by sexism.

Michael:

Yah this is something that's widely known in Germany because it was used as sort of criminological method during, during the time of the Nazi dictatorship. And so this is something where today, there is a strong consensus in Germany that this is not a valid method of approaching you know, for example, police work and things like this. So yeah, this this seems like something that is obviously influenced by the kind of society maybe or the kind of power structures that exist around scientists. But then as physicists, I guess we might be tempted to think that something as basic as the magnitude of the elementary charge would be independent of factors like this. How would you say, is physics affected in this way? Maybe in ways that are not obvious?

Hope:

Yeah, I think this is a good question. And this is something that I've thought a lot about as a physicist is, you know, I think that when you talk to scientists, often, they'll be you know, they'll kind of condescend that maybe medicine could be influenced in this way that you know, there's a there's a really influential study that has shaped my thinking of looking at biological textbooks and and our knowledge and ideas of how fertilisation of eggs happens. And if you track the the wording that scientists were using and also how this is published in scientific literature and in science textbooks. Our understanding of the fertilisation of the egg was very shaped by ideas of gender and sexism and the role of different genders in society. So, you know, I think that, that physicists will be like,

'oh, you know, this is all well and good, you know, this is a problem maybe that biology has, but you know, we're physics,' you're right. 'The elementary charge, it's a constant. It's always gonna exist in this way.'

But what I think is key is that I think this also affects physicists. And some examples of that, again, we can look historically, at how different physics theories have been developed. So I think there's a really interesting book by Lee Smolin. And then he points to some historians that have talked about concepts of anti-realism that came about in the European physics community in the 1920s. So if you look historically, at the development of quantum mechanics there were these different camps in that the Copenhagen interpretation sort of was the camp that ended up winning out and this is a very anti-realist perspective, uh, that, you know, everything is governed by probability and nothing actually, exists in the same framework of what we interact with on a daily basis. And some historians point to the fact that the Copenhagen interpretation was really widely accepted in physics, because of sort of the chaos that came out of the First World War, and the ideas of that time, that I think across many different academic disciplines this anti realist perspective was really, was really grabbing hold.

So I think as physicists, I think this is a question that we should grapple with and that we should talk about more. And what's interesting to me is I recently read a paper by the philosopher, Helen Longino, and she puts forth a framework that sort of merges these two different perspectives. The idea both that science is a methodology that can help us to get to very objective truths, and that science has some influence of maybe constructivist ideas, that the society and kind of relationships and background ideas are going to influence society as well. And what her point is that science is relational. Um… while we do, you know, we do experiments, and may come up with theories and we try to predict things and then test them in order to come to some conclusion about a scientific

theory about a scientific truth, it's a very social process. And you can see this in that we publish papers, and peer review is one kind of the most upheld maybe tenants of modern modern science is that, you know, we publish something and then somebody gives feedback on them and you're supposed to take that feedback into account and learn from that and maybe adjust your claims or do more experiments that shapes the research output. We can also see this in conferences. It's so vital that we discuss the scientific ideas, and really, in order for scientific ideas to have any sort of power, people have to agree to them and have to come to some conclusions that they agree with your methodology, they agree with the assumptions that underlie any of your experiments. Um. And so in this way, she says that science itself is really based on relationships. So these relationships are key to science.

Michael:

So if I understand correctly, you're saying that when physicists wonder about how the research that they do might be socially influenced, they need to look beyond those things which are mere measurement values, you know, constants or maybe the cross section of some particle interaction, but rather look at the larger frameworks that underpin the research that they do. For example, let's say, the standard model as a whole or the cosmological principle, things like these, which would govern the way also that scientists arrive at questions, which are then subject to the research that they do. Is that about, right?

Hope:

Yeah, I think that's one way to put it is that, um, kind of the society that we're in and these research communities are going to shape what questions we think are interesting, um, kind of what directions are funded, what directions are pursued, um, and once we have, uhh, these kind of measurements or these experiments, we have to construct them into some grander theory. And, and I think the way that we go about doing that can also then be influenced by our kind of perspective and ideas of what science should be and what the answer is that we're looking for.

Michael:

Now, the way you put it seems like you would say that many physicists or the physics community as a whole is not very much widely aware of these, you know, social implications of the research that they do. You might even want to call it a blind spot or something. What is it you would say that that could be better about physics if everyone were aware of this social background of the research?

Hope:

Yeah, I think I think we can make physics better. And what I liked about this article by Longino is that she points out four different tenants that have upheld in order for objectivity in science to be sort of reclaimed, accepting this this sociality of science. And I think that's what as scientists we should be thinking about actively in our research. So one of her points is that we need to ensure that when criticism is made, that people will actually take that into account and they can change their change their ideas and kind of accept or respond to that criticism. Another point that she makes is that the

act of maybe criticising science or trying to reproduce things needs to be given as strong of validity in career progression as sort of new experiments. And I think this is a topic that's really present and discussed in a lot of sciences today is the problem of reproducibility

Michael:

It's also called the replication crisis, I think, in some fields, right? Where there's too little of that happening.

Hope:

Exactly. And another point that she makes is that we really need to make sure also that people have an equal voice when they're when they're discussing and criticising science. And this is, kind of these points, is one that's very personal to me, because I've been involved in a lot of work during my career as a scientist in diversity and inclusion in physics, and in science in general. And her point, and I think this is, you know, something that, I guess I've… feels intuitively right to me, and I was interested in hearing her philosophical arguments of why this is important. Is that we need to have a lot of people from a lot of different backgrounds and perspectives in science in order to come to the most, I don't know, objective or the or the strongest position because you want to have people from different perspectives and backgrounds, to be able to look and evaluate your science and evaluate the assumptions that you make and the frameworks that you surround it, in order to come to the strongest conclusion. So in order to have the best physics that we can, we really need to focus on and try and make sure that physics is also a community that accepts people of many different backgrounds and gives their voices weight. They can't just be a token in the room. They have to actually be listened to, and included and part of that dialogue.

Michael:

So you're saying that as diversity in research groups, increases to a level, which is more than we have now. It will allow researchers to come to more robust conclusions in what they do or better questions to find even.

Hope:

Yeah, exactly. And I think that this is also, you know, another way that you can think about this point is that in physics, especially in the research that I do, which is, I look at the way that light is propagating through materials or the way that electrons are moving through materials. That research is not something that we can in some way, like physically touch and see. You know, we rely on instruments to probe things that we can't interact with in our hands. And the way that then I think we understand the concepts. And what is going on in materials is also by creating analogies and creating metaphors with things that we do interact with own senses in everyday world. So for example, electricity often I'm constantly in the lab that I'm in, we're thinking about, okay, if you've got different buckets of water, and you put something in a bucket, and it's raised up and you pour it here then where will it flow out and what is the current? And so these analogies these metaphors that we build are really fundamental to how we understand the science. Now if we have people that

come from different backgrounds, so they've had different experiences growing up, they've had a different education system, they've, they've, they've experienced the world in a different way, then they might bring to the table different metaphors and analogies that can help us to understand the science and the concepts that we're interacting with in new ways. And that will lead us to different conclusions, so we can ask different questions. And again, I think that's gonna lead us to a more robust understanding of the physical world around us.

Michael:

I guess it's even kind of obvious that, you know, there has to be a social dimension to research and the results it produces when you look at the fact that scientific revolutions were often slow to be accepted. I remember recently working on the Milliken experiment, and I was surprised to find that even around 1910, there was a strong camp of the last let's say anti atomism holdouts, scientists that would say, 'Well, if we can't touch it, if we can't directly interact with the thing, then it's probably not there and all these instruments are leading us astray' and I was surprised to find that even into the 20th century, these you know, these attitudes existed. And obviously, if all the evidence was on the table by that time in a totally objective world, everyone would have come to the same conclusions. But as we all know, that's not something that happens, right?

Hope:

Yeah. And I think that debate that could be very healthy, because it really does push our understanding further and makes the theories and the ideas that then we generate more robust because you really then have to get these people that maybe have different perspective on board with the science that you're doing.

Michael:

You have to deal with the criticism basically.

Hope:

Yeah, yah.

Michael:

Right.

Hope:

Precisely.

Michael:

So as we are here in the Science Chatter Podcast, you know, working with PhD students and postdocs. How would you say that young and early career researchers are influenced by this what is maybe a way that they can help advance this diversification of science?

Hope:

Yah I think that's a great question. And I think in general as a postdoc, one thing that I feel like I've had many conversations with people is, you know, should we do something about this? And, and often the response that I think we get is there's a lot of PhD students and postdocs that are frustrated by science, by the pressures that are put upon them and how the system of science is really challenging for the scientists themselves. And so the young researchers, I think they kind of feel like you know, this is really, this is really bad. But I have no power in the system. I'm just kind of a cog in this wheel of science and I can't change anything because I need this paper. I need this publication. I need this conference or whatever, to have any sort of voice or power in science. But I think what we need to think about is that the system of science and the publications and all these is built by all of these individual pieces. So we all have a role in the system. Now I understand that, you know, maybe as a PhD student you may not be able to decide where your publication is being sent. And maybe there are some decisions in this research process that you can't you don't have the power to make. However, you do have the power to influence in some ways the culture of the group that you're in, or how you're doing the research on a daily basis, and who you're working with, who you're collaborating with, and trying to shape and make that system that you're in as inclusive as possible. And I think we should be thinking about raising our voices and learning about these issues because the scientists, the PhD students and postdocs of today are going to become the professors tomorrow, or they're going to become the science journalists, or they're going to become the science policymakers. And so I think that the education system of PhD students shouldn't just focus on laboratory skills, but we should be having conversations also about how science works, and how we can improve it. And reflecting on how each of us can make that stronger. Because the system that we have is not, it's never static. It's always changing the pressures of the publication system, and you can see of open-access, and of vaccines and all of these different factors are shifting every year. And so by our inaction or by kind of saying that, you know, throwing our hands up and say we have no role in this, we're also just reproducing the system as it is. So we should think more actively about how we create a science and a system that is better for the people that are doing it, and creating better outcomes for society.

Michael:

Okay, so here we are discussing these questions on a podcast, you know, which is hopefully something that helps people get to thinking about these questions and the diversity in science. If you were in a position to decide what PhD students would have to complete as part of their courses or something, what would you change? What would you introduce to advance these these questions?

Hope:

I wish that there was a dedicated course that taught concept of ethics in science, and also how science interact with society. Because again, I think my education and scientific training, which was partially in the classroom, and a lot, probably primarily in laboratories, was really about kind of the

day to day methodology as individuals. But I think we should be thinking about kind of the underlying assumptions that we're making about how science works, what objectivity is and how the processes and the structures of science, make something objective, and be more intentional about how we're doing our research. And today, I think mostly what we've discussed is sort of diversity and equity and science and kind of some some concepts behind this of how I think can make science better. I think we should also be thinking about this from the perspective of who has a right to science. The argument that I've made is that we can make science better by doing these certain things. But also if we look at the UN Declaration of Human Rights, I think many scientists don't realise this, but one of the tenants in there is that people have a right to science. They were right to science from the benefits of it and also, it's been interpreted, that they have a right to be doing that science and also directing the questions and the research directions of science. And as scientists this is something that we should be aware of, and we should be discussing. There's a really interesting book by Dr. Chanda Prescod-Weinstein, called, 'The Disordered Cosmos', and in this book, I think one of the ideas that was really compelling to me is that she talked also about how she thinks science can be stronger if it is more inclusive. But more fundamental to that is that all people and all children should have the right to dream about science and to ask questions about how the universe works and to wonder about the cosmology of the universe. And so I think there's also this fundamental need, that we're recognising the fact that many people want to do science, and they're not allowed to because the funding structures or the education system, or the communities don't exist to allow to allow them to participate in this amazing process. But I think as scientist, you know, I don't know I love trying to understand how the world works and I think it's amazing, and I'm filled with wonder all the time in the lab. You know, you're seeing something and you're thinking, that is so cool!

Michael:

Yes

Hope:

You know, and we want to give other people the opportunity to also participate in that. I think that's a right that people should have.

Michael:

So it seems to me like now that you've entered the door into the world of science, you want to throw the door wide open from the inside to get all of society involved.

Hope:

Yeah, exactly. And I think you know, there are a lot of initiatives today that are focusing on citizen science and the kind of creation of scientific knowledge. And I think for the the physics research that I do, it's a little harder to see how citizen science might work when you know, we're dealing with these really microscopic structures. But I think we should be thinking about who has a right to

science who should be doing it, and how this can benefit scientific knowledge, and also how it is a right of people to wonder about how the universe works.

Michael:

Thank you very much, Hope, for discussing this with us. I'm sure that science will come out stronger, you know, when these questions are more broadly tackled and science is opened up to a larger part of society and more accessible to anyone. So how would you like to close this episode then?

Hope:

Yeah, I'd like to say thanks to a couple people that have been really important in my science career and really in the past two years. I think I did my PhD in the UK and in that time I got involved in a group called TigerinSTEMM. I began a collaboration with another physicist Dr. Lia Li and scientist, Dr. Erinma Ochu, and our collaboration through the past two years, really gave me new insight into thinking about how science and society interact, and also a little bit more confidence in trying to speak about these ideas in public. And I'm really grateful and, and I really recommend checking out both of their work. They're amazing scientists.

Michael:

Yeah. So thank you very much for discussing this, and goodbye to all the listeners.

Hope:

Thanks

[space-y closing music]

Disclaimer: This is the transcript of Episode 2 of the Science Chatter Hamburg Podcast, produced by Michael Büker and Theresa Schredelseker. It is a project of the PIER Education Platform. PIER is the strategic partnership between DESY and Universitaet Hamburg. The conversation between Michael Bueker and Hope Bretscher was recorded on September 24, 2021, on the Science City Hamburg Bahrenfeld campus.