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Labpunk - Curiosity, Intra-action and Creativeness in a Physics-art Collaboration

By *Anita Milroy, Margaret Wegener, Ashley Holmes*

In 2014, the professional society of physicists in Australia themed their national conference "The Art of Physics" (Canberra, 7-11 December, 2014). The aim was to "stimulate diverse and creative participation in the Congress" and delegates were encouraged to be "adventurous" ("Australian Institute of Physics"). Wegener, a physicist with a deep interest in the arts, invited Milroy, an artist with a deep interest in science, to collaborate to produce a body of artistic work addressing the Congress theme. Their shared experiences as metalsmiths led to the idea to transform physics relics into wearable art and small sculptural objects. Wegener's respect for the artefacts of physics research had resulted in a collection of lab "junk." Making use of this variety of oddments stretched the knowledge and skill of the metalsmiths, who were forced in some cases to handle unfamiliar materials and to try new processes. The term "Labpunk" was coined to describe the resulting works of art and science. In addition to an exhibition of approximately 50 works during the Congress, individual pieces were commissioned as gifts for each of the nine plenary speakers (Figure 1). Each gift was inspired by the research interests of the speaker. Throughout the collaboration the pair followed a fourfold aspiration: to *create* by making wearable works of art and small sculptural objects; to *reflect* on their practice with special attention to recording a dialogue between the science of physics and the art of metalsmithing and jewellery-making; to *interact*, by networking and engaging in discourse that spans cultural divides; and to *address the finite* through repurposing materials (Wegener & Milroy).

For this article, Wegener and Milroy invited creative practice researcher, Holmes, to extend the collaboration. Initially Holmes was actively engaged "in conversation" with photographs and several physical *Labpunk* works, without any prior explanation by the duo. Once Holmes had made his observations, the artists added more information about each work, in terms of inspiration, technique, process, materials, recipient's reactions and so on. Holmes took on the role of provocateur, subsequently extending the discussion to incorporate an in-depth critique of some of the assumptions behind their aspirations, and to speculate on those works that aim to interpret and be inspired by physics as wearable art. The conversations were recorded and subsequently transcribed, edited and built on over multiple drafts, circulated by email and collaboratively negotiated. Specifically, the intent was to tease out issues of process, practice and knowledge-making.

The *Labpunk* works of art-science are, by nature, material inventions and thus require a process of material thinking as proposed by Carter. Nine works from the *Labpunk* art-science praxis form a framework for this conversation. To orient the reader, an assemblage of photographs of the nine commissioned works has been provided (Figure 1).

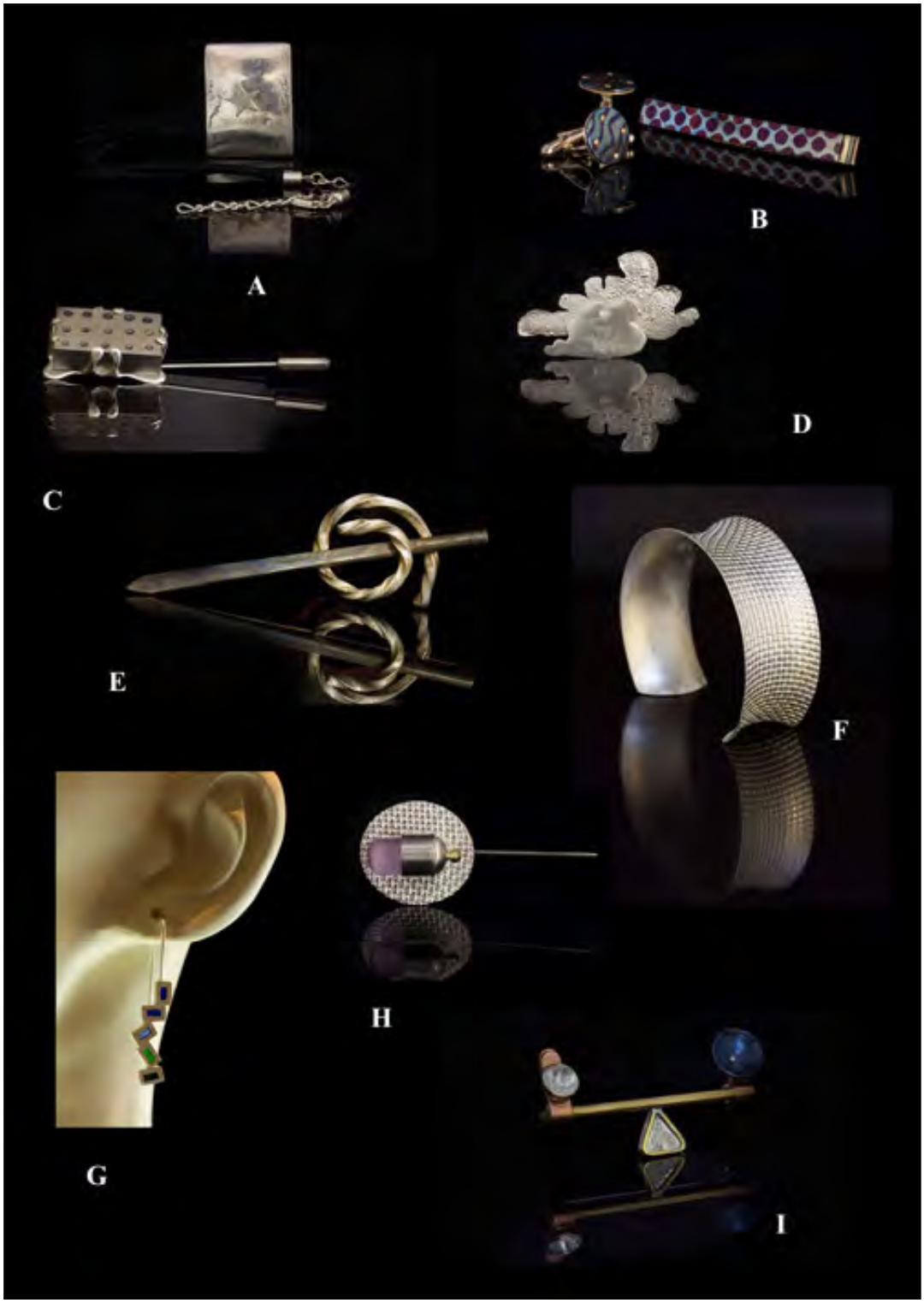

Figure 1. Milroy & Wegener, Jewellery pieces made for plenary speakers at AIP Congress 2014: A: *Star Necklace* (recipient: Doctor Lisa Harvey-Smith); B: *Duality – Particle tie clip and Wave cufflinks* (recipient: Professor Serge Haroche); C: *Laser Cooling and Trapping pin* (recipient: Professor Steven Chu); D: *Cumulus Clouds pin* (recipient: Professor Steven Sherwood); E: *Plasma Fields Dagger pin* (recipient: Professor Stephen Cowley); F: *Warped space-time cuff* (recipient: Professor Lisa Randall); G: *Enlightened Engineering earrings* (recipient: Professor Anke Rita Kayasser-Pyzalla); H: *Corkum's Flashbulb pin* (recipient: Professor Paul Corkum); I: *Higgs-saw Mechanism pin* (recipient: Professor Lawrence M Krauss). Photo: AK Milroy 2015

For artist Milroy and scientist Wegener, the process of collaboration, and working in a space that was neither totally scientific nor totally artistic in its cultural orientation, began after shared experiences as metalsmiths. This includes working in the fine jewellery-making studio of the Goldsmiths' School, Brisbane, and exhibiting with the Jewellers and Metalsmiths Group of Australia. Despite an expectation that professionally they would represent opposite poles of CP

Snow's "two cultures," they claim that their collaboration has produced works that are a unique manifestation of their individual and collective experiences along an art-science spectrum. Art-science here is hyphenated to represent transition between the two, rather than a sharp disciplinary boundary. Holmes probes them about this.

Third Culture?

Holmes: In this project you both seem to agree that the dichotomy C. P. Snow originally observed in 1959 about the split between the humanities and the sciences continues to be enacted today. Two of your stated project aims assume the existence of such a split. You claim that you have been attempting to address this divide through a creative collaborative process.

I am interested to know whether you have considered the responses to Snow by Archer and Cross who advocate design as a third culture in-between those poles? Cross says that in design culture, the phenomenon of study is the world of material human production, as opposed to the natural world in sciences; or analogy, metaphor and evaluation in humanities. For design culture, appropriate methods of investigation are: "modelling, pattern-formation and synthesis," as opposed to "controlled experiment, classification and analysis" in the sciences; and qualitative "evaluation" methods in humanities. With respect to values, Cross claims that for design culture these are: "practicality, ingenuity, empathy, and a concern for 'appropriateness.'" For science these are: "objectivity, rationality, neutrality and a concern for 'truth.'" For the humanities they say the values are "subjectivity, imagination, commitment and a concern for 'justice'" (Cross, *Designerly Ways of Knowing* 18).

So my first question is: Do you think that your jewellery-making exists in a third culture of design? Specifically with respect to the items that you made for physicists attending the AIP Congress; did you think that you were participating in the scientific pursuit in any sense other than anticipating dialogue with the scientists that you'd present your work to? Are you thinking of yourselves as designers, or as practitioners of some other kind of hybrid of art and science when you do this sort of work?

Milroy & Wegener: On reflection, we think of ourselves as a science-art (or art-science) research team. When examining our individual practices, we noticed that we have many areas of overlap as well as some areas of cultural divergence.

Milroy: On occasion we find differences in definition; negotiating a *common language* to define concepts is an ongoing part of the process. For example the term *entanglement* has direct associations with quantum physics, and may be defined as a physical phenomenon that occurs when particles interact in such a way that quantum state of each particle cannot be described independently; instead a quantum state may be given to the system as a whole (Kumar). From a humanities perspective, entanglement can be a metaphor that indicates understanding of the way that all aspects of being are inter (or intra) related (Barad *Meeting the Universe*). This is an idea that is gaining credence in contemporary ethics. The term "intra-action" was coined by Barad to represent a way of working – "a mutual constitution of entangled agencies" (Barad, *Meeting the Universe* 33). In this sense her neologism can be applied to our collaboration. The *Labpunk* works are physical artefacts emerging from this process. They are evidence of where our two practices not only met, but *intra*-acted – not only with each other as artists but also with the materials we selected.

Holmes: That's interesting. I'd like to come back to the topic of intra-action. I gather that, as metalsmiths and jewellers, you align yourselves more with art than design?

Milroy: I think of myself more as an artist than a designer; to me, design is used when you want to replicate – to make multiples, whereas I wanted to make a unique "thing" in response to whatever raw material I was given.

Wegener: I basically agree with that. Design to me is often about mass-produced things, whereas art is about one-offs or limited editions, and I'm not interested at all in mass-producing jewellery. There seems an additional differentiation – to me, calling yourself an *artist* seems a big and brave label. Who gives you the right to call yourself an artist?

Holmes: That is an interesting question. Many would say that the art world decides (Becker; Danto; Dickie). Just who comprises the art world is debatable. In 2008 the Australian Prime Minister controversially attempted to play gatekeeper for the art world with respect to semi-nude images of adolescents exhibited by photographer Bill Henson (Holmes), in the process sparking a debate about distinctions between censorship and freedom of expression.

Milroy: I think the right to call yourself by any title, designer, artist or scientist, depends on your training, on what you do every day. I would consider that any title does not imply quality or greatness – but a professional orientation, or daily occupation.

Wegener: The science world accepts a person as a scientist based on measures such as academic qualification and peer-reviewed publication record, as well as the process he/she uses. When doing research or experiments on raw materials or techniques, I consider that I am involved in a scientific pursuit. At the "Art of Physics" conference, I presented a peer-reviewed paper on laser techniques applied to jewellery-making. This was definitely a *science* activity. The exhibition was definitely an *art* form of activity. The actual making of the works is where science and art come together for me, with each being equally important. For example, I was interested to use magnets in some of the pieces of jewellery I made for the congress speakers. The physical property of magnetism enabled me to incorporate a freely-rotating star decorative element on a pendant for astronomer Lisa Harvey Smith (Figure 1 A and Figure 2). Also, using magnets as a catch for a pin (Figure 1 D and Figure 10) gave me more freedom in the design of the piece, since I was able to make a compact, unobtrusive fixing. I researched available magnet dimensions and strengths and did calculations and experiments to make sure that the catch would work.

Figure 2: MJ Wegener, *Star Necklace*, 2014. Photo: AK Milroy

In response to the definitions of Cross, I argue that some of those activities are common across domains. Science studies man-made phenomena as well as the natural world, and modelling and synthesis is very much part of what the sciences do too!

Milroy: In my activities I use elements that span those domains. As a Creative Arts PhD candidate, I note that this particular academic context involves, like a scientist, submitting to peer review and so on. As an artist I have a practice of including with each work of art a statement of inspiration to put the work in context. We included these with the plenary speaker gifts (Wegener & Milroy "Labpunk 2014"). My clients have an expectation that I will provide these – particularly with the more conceptual works. A lot of my work involves experimentation (akin to that in the sciences) to produce works in unusual media; to manipulate media in unusual ways or to create an innovative, replicable artistic technique.

Holmes: What about fashion design? Surely jewellery, as something wearable, is akin to fashion or haute couture?

Wegener: I'd like to think of what we make as art jewellery, as I'd think of haute couture as a form of wearable art.

Holmes: Weren't you acting like designers working to a brief: *make a piece for an individual suitable for a particular occasion*, rather than as artists who are traditionally unrestricted by such considerations? Your "clients" in this case had not commissioned your work; they had recipience imposed on them by occasion, and (hopefully) acceded to your artistic judgment!

Milroy: No, I don't agree; artists are often working to a brief or commission (we wouldn't have the ceilings of the Sistine Chapel without Michelangelo being given a "brief" by the then Pope). Our client was the AIP Congress. We had full artistic freedom to choose the materials and the final form. We researched the profile of each recipient. That information inspired the concept of the piece. For instance, for Laurence M Krauss, a theoretical physicist, I read a paper (Krauss & Dent) where he discusses a "Higgs-Saw mechanism," based on the neutrino seesaw concept. The article discusses the Higgs boson and dark matter. I don't fully understand the physics, but recognise the mathematical symbolism in the equations. When I was rummaging through the lab junk I came across a little brass balance scale with a hook and copper tags to attach pans for weighing things. It was the association of the shape of the scale with the equation notation that provided the concept. I decided to make a pin (Figure 1 I and Figure 3). The hook was reversed to make the triangle and silver soldered to the back of it. Then I formed and added little dishes to the copper clips. One is silver and the other, larger one is coloured titanium. The latter one represents dark matter.

Figure 3: AK Milroy, *Higgs Saw Mechanism pin*, 2014. Photo: AK Milroy

Wegener: There's a lot of dark matter in the universe, compared to normal matter, so it makes sense that it's bigger.

Milroy: Yes, it was a bit of an educated guess.

Wegener: Well you got it right! It's thought-provoking; it's happened a number of times that I see something more about a scientific principle, when it's represented in an artwork.

Milroy: The recipient seemed delighted with his pin and our *Labpunk* project. He later took it from his shirt, put it on a jacket and took a selfie. He posted that, plus a separate picture of the item, the inspiration behind it and the box on his Facebook page.

Holmes: Is there something else distinguishing art, science and design (in the space between art and science)? Art is not usually seen to necessarily have a function whereas design is more about producing something that functions. Jewellery has to function in that it has to be wearable. Would you agree with that distinction?

Wegener: With jewellery, functionality is very important. If you make a brooch and it always flops over so that you can't see the face of it, it's a failure as a piece of jewellery, and you don't get to appreciate the art in it. With regard to functionality, Snow noted that in his time, science was perceived as utilitarian, in a derogatory way in comparison to the arts.

Milroy: I think art has a function. Aesthetically, there is some function for the art to fulfil – perhaps communication – this can be with the world at large, as well as just with yourself as an artist.

Holmes: It sounds like both of you pre-envisaged each piece. You sought out information about the recipients and their research in order to make something appropriate for the person. To what extent did you pre-visualise a piece and/or experiment to make it work?

Milroy: There was a lot of experimentation. It is actually very tricky to make works from unusual materials. Normal procedures, such as sawing, soldering, forming, didn't always work the way we expected, even with some of the more usual materials (brass, silver and others). The different alloys gave us quite a few construction headaches. Often I would draw sketches to visualise and evaluate alternatives before returning to the workbench to try them out.

Wegener: Most of it was experimentation. An exception was the cuff for Lisa Randall (Figure 1 F and Figure 4). She is a theoretical particle physicist and cosmologist and has written a popular science book, which has on its front cover an image of a regular grid, distorted, that has become one of the fairly usual representations of space-time being warped. In that case, I had a clear thought, "I can make a cuff with that grid pattern on it." Roller-printing is an established metalsmithing process. I'd done some roller-printing of metal before and I had some mesh. The plan of what to do was clear. When I actually roller-printed the silver, the grid distorted even more. That made it even more appropriate.

Figure 4: MJ Wegener, *Warped Space-time cuff, 2014.* Photo: AK Milroy

Milroy: Lisa Randall seemed pleased with the gift. She removed the bracelet she was wearing and replaced it with the *Warped Space-time* cuff.

She also tweeted a thank-you note, mentioning the wooden gift box as well.

Holmes: What you are describing here, when you talk of working with the pre-existing visual metaphor for the warped nature of space-time, reminds me of what philosopher of art and founder of the Australian Experimental Art Foundation, Donald Brook, says about "memetic innovation." Brook says that the meme is in the culturally transmitted idea, not in the object:

> Memes are not material objects. They are regularly efficacious *material actions*, purposefully performed with the intention of generating items of recognisable cultural kinds. Memes are not items of the kinds that are generated by performing these actions. A poached egg is not a meme. A poached egg is an item of a cultural kind that is generated by purposefully orchestrating an assembly of familiar memes such as lighting the gas, boiling water, cracking an egg, watching the clock; and so on. (Brook "Experimental Art" 7)

Brook would argue that in imitating the cultural meme in your own way there is always the chance of the meme evolving. Interestingly, Brook says that the term *experimental art* is a tautology because what distinguishes a work of art is that the result of one's activity is not necessarily anticipated. As he claims, "art *cannot but* be experimental" ("Experimental Art" 3, emphasis in original). Essentially Brook believes that there is nothing special about art. It is the name for a category of human behaviour. It "drives cultural evolution and shapes our lives in every cultural domain." ("Experimental Art" 2). For Brook, "'Art' is the name of the category of memetic innovation and it is the unchanging propellant fuelling the engine of cultural evolution." However, the *work of art* is the name we give to a particular class of objects (Brook, *The awful truth* 15).

Wegener: By this argument art is defined to be an experiment. To many (scientists and non-scientists), an experiment is something that is absolutely characteristic of science. In thinking this way, art and science have been put on the same footing. I think that is really interesting.

Milroy: Yes, many artists, myself included, consider all art is research, because of its experimental

nature. In my own practice, I constantly experiment with new concepts, materials and techniques, many of which would perhaps be considered "outside" traditional art practice.

Experimentation and Emergence

Holmes: OK, so you've got the idea for a piece – and the idea's emerging throughout the whole making process, is that right?

Milroy: Yes, I researched the person and let that information sit *in the grey matter*, so that I was not consciously thinking of that person whilst investigating the materials. As I was experimenting with titanium and its ability to be coloured, it became a perfect choice for the gift for Serge Haroche (Figure 1 B and Figure 5). He was awarded the 2012 Nobel Prize jointly with David J Wineland, for research involving the photon, the particle of light. I thought, "How can I introduce the particle-wave duality of light? What is available?" I settled on two pieces: a tiepin and cufflinks, the colours of which depend on light reacting with oxide layers of different thickness.

Figure 5: AK Milroy, *Duality – Particle tiepin & Wave cufflinks*, 2014. Photo: AK Milroy

Holmes: Yes, I see! Rosy coloured dots, on silver coloured metal. The pattern … alternate rows, sort of offset, on the tiepin. And then on the cufflinks, there are waves!

Milroy: That's right. They're mostly made of titanium, which is used as a contemporary jewellery metal, but this came from my "lab junk" supply. So it was more the idea of using titanium as a laboratory material, rather than a jeweller's material. I kept thinking of titanium as not precious – from the lab, not from the studio. If it is heated with a flame, or direct electric current, a titanium oxide layer builds up on the surface. The thickness of the layer of oxide determines the colour. I discovered by using resists I could actually "paint" the titanium in novel and creative ways (and with a paint brush acting as a cathode) by generating different thicknesses of oxide layer.

Holmes: Yes, the waves look painterly, but the pattern on the tiepin looks like it might have been found that way.

Milroy: It came from me, drawing it. I made a template with a small circle and repeated it.

Wegener: It does look a bit industrial though, a bit like perforated metal for ventilation.

Milroy: Yes! Actually I was working with perforated aluminium on another piece, so I guess it was in my subconscious. Now that I look at it, I realise that it is almost exactly the same pattern.

For the cufflinks, the titanium was gold-riveted to the cufflink structure. You can't solder it. Titanium has a lot of properties that I wasn't aware of until I started experimenting. It is very rigid. Once you've formed it, it tends to stay that way. An innovation was the corrugation of the back which forms the clip part and helps it hold on as a tiepin. Titanium has been used before for tiepins, but I haven't seen one with a corrugated titanium clasp. The wringer I used to make the corrugation is normally used to get artist's paint out of tubes. It's made of aluminium, aluminium being so much softer than titanium, you wouldn't think it could work, but it did! In retrospect, I concluded that it was due to a combination of the type of titanium alloy and the thinness of the metal.

With *Corkum's Flashbulb* pin (Figure 1 H and Figure 6), I made a sketch in my journal, putting my construction thoughts on paper in the form of a diagram and notes of how it could look constructed from lab materials. Professor Corkum is an attosecond science researcher. An attosecond is a billionth of a billionth of a second and Corkum's team is developing a "flashbulb" to take photos at the molecular level and then animate them to make movies of molecular activities. I believe they have 80 attosecond flashes designed, but haven't yet made a 25 attosecond flash (the orbit time of an electron), which is what Corkum's research is focused on. The "gem" is actually a bit of tumbled laser crystal, Nd:YAG (neodymium-doped yttrium aluminium garnet), which is used to transmit light. So I thought, "It has to be a flashbulb." The material "spoke" to me, because it actually looks like it *could* light up. My son subsequently asked, "Is that *on*?" So I thought, "That's good!" As you move, it looks like the light could be on or off. I liked the apparent luminescence.

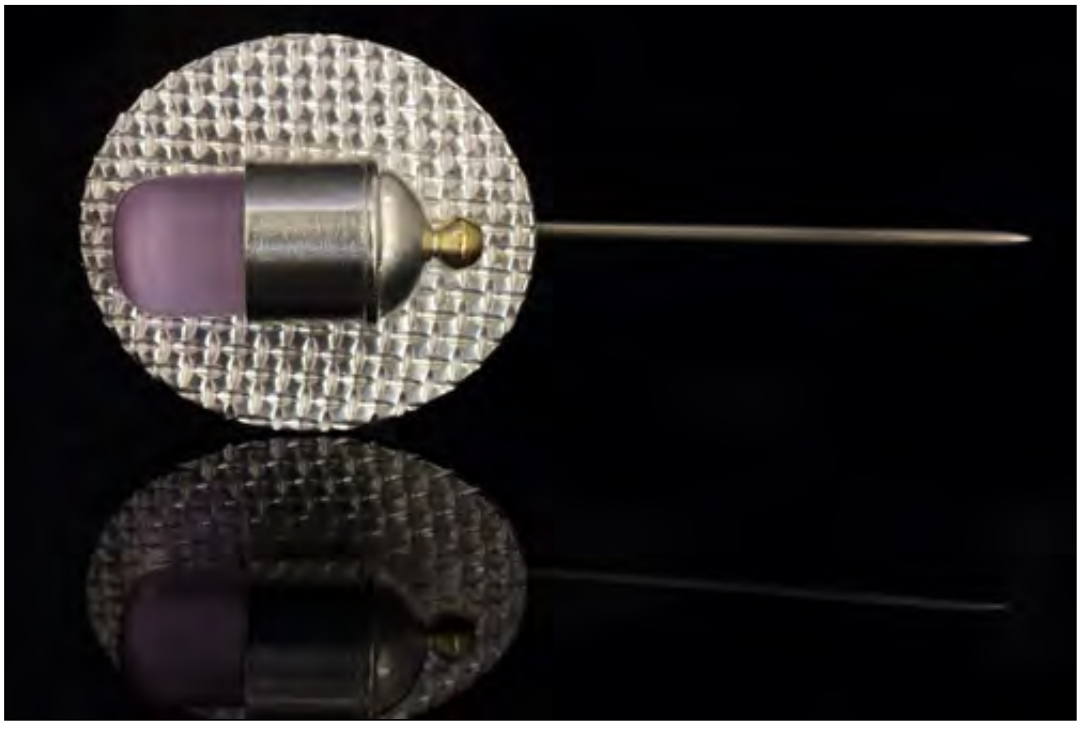

Figure 6: AK Milroy, *Corkum's Flashbulb pin*, 2014. Photo: AK Milroy

Corkum said, "Gosh, no-one has ever made me anything before." He seemed delighted to wear it on his lapel for the next few days of the conference.

Wegener: One or two of the male recipients appeared to be unused to the idea of wearing jewellery, but responses to the pieces were overwhelmingly positive. The appreciation of the gifts by the plenary speakers was clear, through both their immediate reactions and later actions. As plenary speakers recognised their own science in the pieces, they validated our attempts to

encapsulate their work.

The piece I made for Steven Chu (Figure 1 C and Figure 7) referred to his Nobel Prize work on cooling and trapping atoms with laser light, and the technique called *optical molasses*. I used an artefact from the investigation that was the subject of the technical paper I co-authored at the conference. The colours on the chunk of titanium were made by shining a laser beam on it, to form spots of titanium oxide.

Figure 7: MJ Wegener, *Laser Cooling and Trapping pin*, 2014. Photo: AK Milroy

Holmes: They look jewel-like!

Wegener: There is a slight ring structure to the spots, which comes from the way the energy is distributed in the laser beam – that is probably giving you a look of curvature.

Holmes: So, is this what you mean when you talk about *addressing the finite*, or, as you have also referred to it: *upcycling*?

Milroy: Yes. If you saw a piece of abandoned, tarnished silver microwave guide, as a long rectangular tube, you probably wouldn't look twice at it. But when you see a pair of earrings crafted from sections of the microwave guide and filled with *plique à jour* enamel (Figure 1 G and Figure 8) as made for physicist and materials scientist, Anke Rita Kaysser-Pyzalla, it suggests *upcycling* – there is now added aesthetic and monetary value.

Figure 8: AK Milroy, *Enlightened Engineering earrings*, 2014. Photo: AK Milroy

Holmes: OK. It's a sociocultural and material change. Nigel Cross, who I mentioned earlier in relation to design culture, says:

> Designers are immersed in this material culture [knowledge that resides in objects], and draw upon it as the primary resource for their thinking. Designers have the ability both to "read" and "write" in this culture: they understand what messages objects communicate, and they can create new objects which embody new messages. (*Designerly Ways of Knowing* 26)

More broadly, this is related to what Brook suggests about cultural innovation ("Experimental Art", *The awful truth*). As we discuss this concept of material change I'd like to remind you of something in the conversation transcripts (so you can't disagree with me!). You have both said that the material *talks* to you. You develop all of this knowledge about material that builds up through your practice, so that you define limits of one metal or another in terms of when it breaks and so on; that's material knowledge. You push the material and it responds.

Milroy: Yes, that's right. I think the *material agency* of the *Labpunk* objects is something that would be good to define and acknowledge.

Material Agency and Intra-action

Holmes: Because it relates to the experimental nature of scientific practice, Andrew Pickering's 1995 text is appropriate here. Observing the nature of technological engagement in the physics laboratory, Pickering claims there are two senses of practice: "the work of cultural extension and transformation in time" and "specific, repeatable sequences of activities on which scientists rely in their daily work" (3-4). He says these kinds of practices involve "two-way agency" (Pickering 16). Explaining this concept he suggests much of everyday life "has this character of coping with material agency – agency that cannot be reduced to anything within the human realm" (Pickering 6). There exists a "constitutive intertwining between human and material agency" (Pickering 16). Pickering emphasises the intentional structure of this relationship, pointing to the "temporal emergence of plans and goals and their transformability in encounters with material agency" (18). He argues: "Human intentions are bound up and intertwined (in many ways) with prior captures of material agency in the reciprocal tuning of machines and disciplined human performances"

(Pickering 20). Pickering is talking here not only about what happens when things don't work as planned, but also about the process whereby the experimenter takes in information from the project and, on the basis of experience, makes modifications, sometimes even to the objectives, in order to achieve a result that "makes sense" under the circumstances.

Pickering specifically draws this conclusion from historical analyses of scientists' notebooks. However, it is surely applicable to the way you worked here as artists?

Pickering's metaphor for the process of tuning in goal-oriented practice is that of a temporally emergent "dance of agency." It takes the form of a dialectic of resistance and accommodation, where resistance denotes failure to achieve an intended capture of agency in practice, and accommodation, an active human strategy of response to resistance, which can include revisions to goals and intentions, as well as to the material form of the machine in question and to the frame of gestures and social relations that surround it (Pickering 22).

Do you think that Pickering's notion of the two-way interchange between the practitioner and the medium apply to your work?

Milroy: Pickering's concept of the "mangle" could apply to our *Labpunk* practice as it exemplifies a dance of agency, or the intra-action between human (ourselves and existing cultural practices) and nonhuman agents (the artefacts from the physics laboratory); both of which reciprocally and emergently intertwine. I particularly like Pickering's description of the mangle's *dialectic of resistance and accommodation* as this is very evident in the comments made individually and independently by both of us, as we struggled with unfamiliar materials in the process of their "becoming" as works of art. In some cases we'd have an idea of what to do with something but it wasn't until we tried that we realised that the material did not want to be used in that way (resistance), so we either had to find another way to use the material (accommodation) or in some cases, change the plan entirely!

Holmes: Pickering describes scientific practice from the point of view of a sociologist and historian of science. I propose that he is also describing artistic practice.

Milroy: I concur. Pickering's "mangle" has application in both artistic and scientific practice. Extending this, Karen [Barad] agrees that Pickering's "posthumanist space" is where the human actors are present and "inextricably entangled with the nonhuman, no longer at the centre of the action and calling the shots" (Pickering, qtd in Barad, "Posthumanist Performativity" 808, note 9). She then makes the distinction that Pickering is talking about knowledge and suggests he does not really understand the fundamental ontological differences involved (Barad, "Posthumanist Performativity" 808). Barad says, "the world is an ongoing open process of mattering through which 'mattering' itself acquires meaning and form in the realization of different agential possibilities" ("Posthumanist Performativity" 817). She defines this onto-epistemology as "the study of practices of knowing in being" (Barad, Posthumanist Performativity" 829). Barad's 2007 thesis originally arose out of her study of Niels Bohr's physics-philosophy and quantum theory. She acknowledges that we, as human agents, are "an intrinsic and entangled part of that nature that we seek to understand" (Barad, *Meeting the Universe* 184). Her performative account for understanding (scientific) practices resonates with my artistic experience as she considers that "knowing does not come from standing at a distance and representing but rather from a direct material engagement with the world" (Barad, *Meeting the Universe* 49).

Holmes: I'm glad you alluded to Barad and Bohr and the fact that scientists who are also philosophers may contribute to this discussion, because that leads me to another thing I'd like to quiz you about, relating to your aspiration *to create*.

Creativeness, Sustainability and Knowledge

Holmes: The notion of individual creativity was not relevant in ancient and pre-modern Eastern

or Western thinking. Creation was the realm of the divine, and if manifested in an individual, it was through the divine. In those earlier times the concept of creation was much more akin to a cosmic, all-pervading form of change and regeneration. Prior to the Enlightenment the endeavours of artists and scientists were considered a form of discovery, rather than creativity (Nui and Sternberg). When the mathematician, physicist and philosopher, Alfred North Whitehead first used the term "creativity" in 1926, it was in the cosmological context, describing a process that manifests organically and inorganically at each and every moment and in every place in the universe (Meyer; Whitehead). Creativity also manifests in contemporary accounts of biological evolution. Theoretical biologist Stuart Kauffman says, "this web of life … breaks no law of physics, yet is partially lawless, ceaselessly creative. So, too, are human history and lives. This creativity is stunning, awesome, and worthy of reverence" (xi). However, some concerned with sustainability of civilisation believe it is time to counter anthropocentrism and decentre humans in order to effect radical enviro-ethics required for our species to survive (Latour *An Inquiry*). In the word "creativity," the "-ivity" suffix denotes a complex physical system meaning for the case of "create," but the word's contemporary usage conflates the social and the cosmic. We have many other terms to describe human capability – inventiveness, imagination, ingenuity, creativeness and so on.

I'd take you to task on your aspiration: *to create*. I'm saying you're using your imagination by making. Perhaps controversially, I suggest we reserve *creativity* as a term for a cosmic phenomenon rather than something that relates to the man-made world. Given your stated aspirations to "create" and to "address the finite," the latter perhaps suggesting a moral agenda, how do you respond to the proposal to decentre the human in order to reframe the sustainability objective?

Milroy: Do you think we "own" imagination as humans?

Holmes: Yes, because imagination is an intellectual pursuit. Philosophically speaking, I'm quite happy to situate creativity throughout the cosmos and say that we specialise in imagination and producing novel ideas and things.

Milroy: What about curiosity? We are curious: "What happens if I do this? Why is this like this?"

Wegener: Yes! Curiosity was something that drove investigating the materials.

Milroy: Yes, I was often peering over Wegener's shoulder: "Mmm, what have you got in that box?"

Wegener: And, "This is? – mmm, never worked with that before, I wonder what will happen?" An example is the rod labelled "pure nickel" that I forged to make a dagger blade for fusion scientist Steven Cowley (Figure 1 E and Figure 9). During this project we worked with typical jewellery materials of silver and gold, but also materials from the lab that were less familiar – nickel, high-purity silver, titanium, brass, synthetic crystals. What really drove us was curiosity.

Figure 9: MJ Wegener, *Plasma Fields Dagger pin,* 2014. Photo: AK Milroy

Milroy: I would agree that creativity is not only a human trait, but I would also question humans "owning" imagination and curiosity. There are many examples of other animals exhibiting these characteristics too! In terms of an ontological response, I don't know if it is possible to ever effectively decentre the human (as we are, after all, humans and therein lies our sense of "reality"). Probably a good conceptualisation of the decentred human, for me, would be Latour's concept of Actor Network Theory: ANT. Here, actors (human and nonhuman) all participate democratically and evolve together in systems or networks, or both (Latour *Reassembling the Social*). However, I would also agree with Pickering that ANT, as a science of semiotics, appears to lack a concept of time, which is problematic because material agency is emergent in time (Pickering & Guzik, *The Mangle of Practice* vii; 14-15). The example he gives is that scientists have to continually explore the contours of material agency as these are never known in advance — no one knows what machines there will be in the future, and what they will do. It is perhaps this "temporal emergence" of material agency that drives and sustains our curiosity as artists and scientists. Actually, at this point I would probably detour back to Barad's onto-epistemology, and note her description of "temporality and spatiality as constituted through the world's (human and non-human) iterative intra-activity" (Barad, *Meeting the Universe* 383). Immutable laws, to me, are only so until proven otherwise – described by ANT as "black boxes" – nodes which help to model complex systems. It is not until the black box becomes insufficient at modelling the system (I'm thinking of "the world is flat" model), that it is opened and redefined with a host of new actors (human and nonhuman).

Holmes: Yes! This is also Kuhn's theory of paradigms.

Wegener: Responding to statements about decentring the human, my position is that both art and science search for meaning, but they situate the human differently. Art puts human experience at the centre. Relevant to the *Labpunk* project is the (human) habit of jewellers to refine and re-use materials, and also the laws of physics which exist regardless of humans. In particular, the law of conservation of energy says that energy can neither be created nor destroyed, but can be transformed from one type to another; one embodiment of energy is mass, so physics acknowledges transformations, and acknowledges constraints on the transformations that are possible. The frameworks of both jeweller and physicist make it natural to recycle materials and transform them into something else.

Milroy: The *Labpunk* works, as material inventions, engage in the current dialogue of environmental (sustainability) concerns. To me, the works are not being directly used as political or social interventions; however, what they do, is carry with them a memory – an embodied history of our intra-actions with the social and natural worlds.

Wegener: I'd like to comment on an article our colleague Holmes introduced us to behind the scenes: sociologist Tim Dant's "Fetishism and the social value of objects" (1996). I think it is useful in reflecting on the *Labpunk* works. As well as aesthetics, this framework includes *knowledge* – the object delivers knowledge to its user by storing simple information or a synthetic understanding of some aspect of the world, and *mediation* – the object enables or enhances communications between humans (Dant 510-511). These capacities are significant for *Labpunk* objects in how they relate to the characteristics and purposes of science and art with respect to describing and mediating knowledge.

For example, an aspect of knowledge is exemplified by the pin that uses laser-patterned titanium like a gem (Figure 1 C and Figure 7). An artefact of experiments on laser-induced oxidation – in fact, the outcome of the investigation – is *stored* in the piece. In a more abstract way, the clouds pin (Figure 1 D and Figure 10), made for an atmospheric scientist, Steven Sherwood, encapsulates the physics of heat transfer for cloud formation. The process used to make the piece is highly dependent on heat transfer. The texture of the silver cloud shapes was created by heating the metal until its surface became liquid (a technique known as reticulation).

Figure 10: MJ Wegener, *Cumulus Clouds pin*, 2014. Photo: AK Milroy

We incorporated well-known physics motifs in the jewellery pieces. The capture and representation of information and understanding, in symbolism, equations, diagrams, etc, is used frequently in science practice, so this capacity is a comfortable fit for *Labpunk*.

The *mediation* value was part of our objective *to interact*. We aimed for and achieved talking points. After the plenary talk of Stephen Cowley, an audience member approached him and initiated conversation with a comment that recognised the twisted component of his pin (Figure 1 E and Figure 9) as visually similar to some of the research results he had presented. This is an example of the function of art proposed by Milroy earlier in this discussion. The *Labpunk* artefacts instigate and stimulate communication.

Milroy: Perhaps the lab *junk* has value as a *memory* of the work of people and materials; the *co-crafted* physics equipment, equations or experimental results; as "enfolded space-time matterings" (Barad, *Meeting the Universe* ix). As each of us has some experience in both the science and art worlds, we can appreciate and respond to the stories of the materials and the recipients. Respect for art and science professionals (past and present) and the materials themselves, was definitely a driving force.

Conclusion

Milroy: I find a *conversation* with the material particularly invaluable during the process of invention. This engagement can often be lost, forgotten or overlooked when subject to academic critique. Sometimes artistic practice can become over-conceptualised. Exhibiting is paramount for me. It has equivalencies to publishing, and is a form of peer review. I agree in part with Carter and Bolt when they say that works of art should be appreciated not for what they "mean" but what they "do" in a network of natural and social relations. This is evident in the *Labpunk* project. The works have enabled interactions between people, materials and places that wouldn't usually come together, and have illuminated aspects of art and science practice and knowledge-making that weren't previously obvious to the participants of this conversation. Personally speaking, this type of research continues to extend my practice, as I consider what is *knowledge*, how different disciplines intra-act with each other and within the world, and if there is the possibility of a new, common research paradigm. Barad's (*Meeting the Universe*) notion of agential realism, combined with a diffractive – rather than a reflective – methodology could perhaps be a candidate. Further, I agree with her appeal to "respectfully engage with different disciplinary practices", and to do so without "uncritically endorsing or unconditionally prioritising" one disciplinary approach over another" (Barad, *Meeting the Universe* 93).

Wegener: In this project our punk-like subversion has related to the function of objects. We have repurposed what could be considered rubbish – lab "junk" – and used lab items for other than their intended purpose. This process has drawn attention to the potentials and limitations of the materials and techniques we chose to work with. The experimental nature of art-making became very apparent.

This collaboration has fulfilled its aspirations to repurpose and create, reflect and interact. Interaction has for me involved inventing and producing public output (exhibiting and writing papers) with colleagues outside my usual physics discipline, and discussing arts practice with my physics peers.

Milroy: Yes, and in a complementary way, it has provided me with the opportunity to use new materials and processes, to engage with academics outside my arts practice, and to also engage my art peers, patrons and the general public with scientific practice. I feel that in addition to meeting our aspirations we have developed and deepened these. I would suggest that we have moved from a reflective (mirroring) to a diffractive (interference) methodology and from individual interactions to entangled intra-actions with people, things, places, space and time.

Milroy and Wegener: We accept that in actuality, the domains of science and art often involve different prerogatives. We both feel that we have gained a deeper understanding of the interaction of science and art through this project, and that the works and our individual practices are the richer for it. This is partly because each of us is so interested in the opposite end of the art-science spectrum to where we primarily identify. During the *Labpunk* project, commonalities between art and science have been shown to exist in materials, processes and motivations. Fundamentally, curiosity has been the driving factor. Our natural curiosity as researchers (human agents) led intra-actions with materials (nonhuman agents) that were both familiar and unfamiliar. We have each experienced discomfort when we came to the limits of our professional knowledge, and were faced with the other extreme of a way of working, in physics theory or arts convention, respectively.

The speculative process has been dynamic – every time we engage in a conversation in or through the works, more is revealed. When pieces are viewed and discussed it is remarkable how often more meaning becomes evident than was consciously intended by the maker.

In this project we often used the mind-set of a scientist to make works of art, for example, the processes of modelling, calculations and experiments, setting up an electrical circuit. It can also be argued that we used the mind-set of an artist to make works of science – devices of science communication in the form of jewellery. However, with the intra-action of science and art practices, and in the nexus between them, something richer has been created.

We conclude that as a consequence of the *Labpunk* project, we have had to alter normal praxis, from "science" or "art" to art-science. We have a deeper sense of the agency of the human and the nonhuman and the entangled nature of these relationships. Usual modes of knowing and research practice have been challenged by concepts, languages and materials from each other's disciplines. Perhaps the most significant shift in our practices is the acknowledgement that "matter really does matter" (Barad "Posthumanist Performativity") and that the natural, and the social (art-science), are intra-actively co-constituted; they are made together.

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MJ Wegener is a lecturer in Physics at the University of Queensland, with a focus on physics education. Wegener's PhD, centred on making and analysing holograms, was symptomatic of a deep interest in both science and the arts.

AM Holmes attained a PhD in Visual Arts – Studio Practice from the University of South Australia in 2005. He maintains lens-based and digital media artistic practice and an academic career, regularly publishing in arts journals, teaching undergraduates and supervising postgraduates in a variety of creative disciplines.

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