3 Becoming with glass
Medium and materiality in embodied knowledge

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Introduction

Drawing from ethnographic research conducted during 2003–2007 in a glassblowing studio in New York City, this chapter explores embodied knowledge from phenomenology to agential realism. This includes investigating not only perception in practices such as drawing but also how practice with and ideas about hot glass as both medium and material matter for theories of embodied knowledge. Turning from analyses of the development of proficiency and skill towards an inquiry into the heat of glassblowing – that which most readily transverses the various "bodies" of the hot shop – this inquiry turns the question of embodied knowledge from inter- to intra-corporeality. For philosopher Maurice Merleau-Ponty (1964), glassblowers "are like organs of one single intercorporeality" (p. 168) in which each person completes the other. For anthropologist Thomas Csordas (1994), such corporeal interstices of interaction, wherein persons experience themselves as extended in relation to and in interaction with each other, constitute intercorporeal meaning. Intra-corporeality, in distinction, builds upon feminist philosopher Karen Barad's (2007) concept of *intra-action*, which understands that agency is a phenomenon arising from a dynamism amongst so-called things – humans, objects, elements, and so forth – rather than an inherent individual, human capacity (p. 141). Attending to corporeality rather than action, the phenomenon of becoming a glassblower is arguably not only about interaction or intra-action but also about a human and nonhuman intra-corporeality replete with various materialities. One only has to think about the shared heat of the glassblower and glass. Rather than locating such materialities within the human sphere of action to illustrate how glassblowers become *among* materials, I instead reveal how the glassblower and glass co-become. This offers an alternative to understanding hot glass as a medium, arguably a concept and practice only possible within an onto-epistemology of mediation.

Drawing close

Three weeks into my Intermediate Glassblowing class at New York Glass in the fall of 2004, Paul, our instructor, took us back to the basics:

> Ok, you guys tonight we're going to learn how to make a punty and blow out a nice round sphere. I've seen what some of you have been doing – a lot of the mistakes we are making later in our pieces could be avoided if we have the proper set up. You can make nine out of the ten basic shapes, excluding a long-neck bottle, from a basic sphere.

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Paul walked us to the chalkboard to sketch the process – a typical first step for any class at New York Glass – "Everybody has their sketchbooks, right?" Some students scuttled to their bags thrown along the wall and retrieved their notebooks, me included. Others, like Joyce, a retired teacher committed to becoming at least a competent glassblower already had hers open to a blank page with pencil earnestly poised; her notebooks are expressive replications of observed demonstrations and pages of daydreamed objects of production. "Damn", Paul exclaimed, patted down his pockets, and sighed: "No chalk" (Field notes, October 5, 2004).

Pivoting towards the workbench positioned in front of the glory hole, Paul squatted at the bucket of water filled with submerged wooden hand tools, dipped his index finger into the water, and drew a sphere-shape off a pipe's end through the dust-coated cement floor. Paul is a faithful reader of Ed Schmid's hand drawn "how-to" glassblowing books and had encouraged us to buy *Advanced Glassworking Techniques* (1997) because it contained all the information from Schmid's *Ed's Big Handbook* (1993) plus more. Each book takes the novice – an amateur in the studio rather than industrial factory – through the steps of making given objects, various hot shop tasks, and glass culture. Like Schmid, Paul encouraged us to draw regularly as did many of his generation for whom Schmid's how-to books were revelations. He advised that drawing would train our capacity to observe in class, hone our understanding of shapes outside of class, including those in glass magazines, production videos, and gallery or museum exhibitions, and attune our perception to "good form". Herman, the shop technician explained as much:

> Making glass is not about making a drawing and then making it. Once you understand that the point is to [learn to] manipulate the glass, and not to blow a bowl, there is a shift in the manner of thinking about the glass, the tools, and the designs. It actually changes how you see the glass, how you feel it through the tools.

For Paul, Herman, and Schmid, drawing, be it by chalk, water-wetted fingertip, or pencil, drew the glass into the transformative dynamics of glassblowing, transforming our perception and how-to knowledge along the way.

A year after I began glassblowing, I wrote of how the iterative process of drawing and doing bore a new style of sketching:

> Before, I knew that [the angles and curves] needed to be there, but not why. [I] didn't understand the relation of the particulars to the whole object. [Tonight] when I was sketching the piece that my instructor was blowing, I drew the curves and the line of the tools against the curves. Before, I would draw the general shape, like a caricature of what the "acorn shape" was supposed to be. [Tonight] was different – just to look at one aspect, like focusing on the curve of the neck versus trying to capture the whole piece with real general lines.
>
> (Field notes, March 3, 2005)

In one book, Schmid (1993) told the readers that "your sketchbook will be your most valuable tool in your workplace" and commanded in crescendo-ing script: "DRAW DRAW DRAW!" "You'll find", he continued, "[that] by sketching already existing objects (studies) your ability to visualize qualities of the medium will become more acute" (p. 4). You draw to see, rather than draw what you see (Sennett, 2008, pp. 40–41).

I have spoken with Schmid about drawing (Personal communication, February 21, 2015). When he was in college, a friendly librarian familiar with his penchant for drawing showed him a trade catalogue from Steuben Glass Works with "thousands of these small little line drawings" by renown designer Frederick Carder (1863–1963) tucked into the back. At the same time, an art professor recommended that Schmid trace over the drawings of "Old Masters" to discover "how they made all their little marks". Schmid explained that this dialogue between Steuben's trade catalogues, Carder's sketches, tracing the Old Masters, and drawing in the hot shop "moved [him] from a representational and tight style of drawing to a loosened one of little marks [that] define[d] the action and the shape". Coupled with observation and practice, drawing helped Schmid to "break down the process into smaller components and … develop a language of glassblowing", which, he added, "is an international language", namely that of traditional glassblowing. Drawing speaks, and through drawing, the drawer learns the art's language.

Drawings and drawing can be understood to belong to what anthropologist Cristina Grasseni (2004) called an "ecology of perception, cognition and action" (p. 47) at once cultural, social, and material (see also Goodwin, 2000, p. 170; Ingold, 2000). In Grasseni's (2004) study of skilled vision in cattle breeding, she apprenticed as well as observed novices learning to see desirable breeding traits in cattle, distinguishing the good from the ordinary. As in the glassblowing social world, visual media scaffolded the learning process. Allen, one of the hot shop's young and increasingly proficient glassblowers, regularly watched video home system (VHS) videos while in college. In a later advanced glassblowing class, a retiree dutifully recorded Allen's demonstration on a digital camera, burnt the digital files to DVDs, and then distributed them to those interested. For Grasseni, these are "focusing media", namely that which, more than delivering content, frame, situate, or organize perception and practice (p. 44). Learning to see – the "enskilment" of vision – is artefact-mediated and conversely, the "organization of perception" by such "cognitive artefacts … brings forth a certain orientation to the world" – "a structure of intentionality" – that "creates a moral and aesthetic order" (p. 47). Scaffolded with such artefacts and repetition, novices who enrolled in how-to glassblowing classes at New York Glass typically learnt traditional vessel-making techniques. Through focusing on the media in interaction with drawing and doing, the novice learnt to see and blow, for example, a nice round sphere.

In *How Things Shape the Mind* (2013), Lambros Malafouris argued that the interaction of maker, material, and object is that *from which* intentionality emerges; intentionality does not belong to a circumscribed subject, but rather is an emergent property of creative material engagement. Ontologically speaking, this indicates the "process where people and things are inseparably intertwined and co-constituted" (Ihde & Malafouris, 2019, p. 198); this breaks down the distinction between making and knowing and suggests that "thinking [is] a process of material engagement" (Malafouris & Koukouti, 2017, p. 293). Thinking is conceived as a *hylonoetic* field – a "mindscape extending into the extraorganismic environment and material culture. Human cognition … entails processes and materials outside of the skull" (p. 296). We did not reproduce an interior image lodged in our minds – a representational model of drawing; when we sketched the nice round sphere, we learnt to see and eventually blow the sphere through drawing and material engagement with the paper, pencil, chalk, hot glass, and so forth. Drawing among glassblowers is, in this sense, *haptic* rather than *optic*; the pencil converts the "register of bodily movement and awareness to that of material flux" (Ingold, 2013, p. 128). Drawing does not manifest knowledge about something but is itself thinking

(pp. 128–129). Through both drawing and studying drawings, we drew hot glass into our experience, transforming ourselves in the process. We can now turn to the shifting notions of hot glass as a medium and material in order to reflect further upon the materiality of those epistemic artefacts with and through which the glassblower becomes.

Mediating materiality

Glass "talks back – a lot", said Hattie, a glass professor who instructed a summer glass class in which I was enrolled (Personal communication, July 14, 2006). Once a painter, Hattie experienced herself in "dialogue" with hot glass in contrast to the "monologue" of painting, in which she felt that she had to "tell the paint what to do". In *Making: Anthropology, Archaeology, Art and Architecture*, anthropologist Tim Ingold (2013) inquired into common usages and meanings of *material* and *materiality* in anthropological discourse; while the former often serves to define brute physicality, the latter often indicates that transformed from raw material by human design and meaning into artefacts (p. 27). Hattie's relationship with the glass is neither. In her words, she was not interested in being told what the material could do, but rather in asking: "What can this material do?" Unwontedly, Hattie articulated what the great contemporary metallurgist Cyril Stanley Smith (1903–1992) found to drive the craftsman's skill and discovery:

> The desire of the craftsperson to see what a metal can *do*, rather than the desire of the scientist to know what a metal *is*, enabled the former to discern *a* life in matter and thus, eventually, to collaborate more productively with it.
>
> (Bennett, 2010, p. 60)

Hattie's dialogue with the hot glass proceeded from a perception of "vibrant matter", to use Bennett's term, such that the direction of her artistic practice was revealed in and through actual material engagement – that emergent intentionality:

> I [am not] interested in illustrating an idea. I want to embody an idea. There were strengths and weaknesses in the material that I could manipulate. As I gain knowledge about the material, it becomes more evident how I want to use the material. Like the sound pieces where I'm trying to record whether sound vibrations from a speaker or bellringing in molten glass – it is this idea that you can actually accumulate information in a transparent material. That comes from all those years of doing weird stuff and mucking about. Like conceptually, I'm not that smart. There is no way I would have gotten there without messing with the material. It comes from seeing different things.
>
> (Hattie, personal communication, July 9, 2006).

Messing around and mucking about yielded an answer to the practical question of what to make – an example of that emergent intentionality of material engagement. As a painter, she would ask herself what she should paint, but found it a "weird" question: "It could be a very arbitrary answer. There can be these categories – death, sex – it can be very heavy-handed". In dialogue with the hot glass, by contrast, she, in the words of many glassblowers, could "follow the glass" such that her work expressed material discoveries rather than a preconceived idea. Insofar as such a process, in the words of philosopher Gilles Deleuze and psychoanalyst Félix Guattari (1987), "connect[s] operations to

a materiality, instead of imposing form upon a matter"; hot glass in the case of Hattie's practice was "less a matter submitted to laws than a materiality possessing a *nomos*" (p. 408). Hattie's work testifies to Ingold's (2011) claim that the properties of materiality are "not attributes but histories" (p. 32). Hattie created and thought through and with, not about, engagement with hot glass as materiality, creating emergent phenomena beyond, and exceeding any conventional understanding of the bodies of maker and material. At the same time, like many glassblowers in the studio, Hattie also referred to the glass as a medium:

> I was interested in the whole issue with transparency even before I knew how to make anything [in glass] given my fine art background. As a painter, painting on different supports that is classically linked to ideas of illusionistic space, representational space … Glass is like a support for abstract thought. All of a sudden, these images were floating space rather than being bound by canvas or wood. Just the way ideas float around in your head – there was a transparent medium that could support these images. As a painter, I always had this idea that there was this thing that I didn't want to do, which was illusionistic space and representation. I wanted images to float and not be illusionistic.
>
> (Hattie, personal communication, July 9, 2006)

Similarly, Schmid had heralded drawing as a technique through which to visualize the qualities of the medium. Schmid's understanding of medium seems akin to that of David Pye (1968) for whom properties are objective and scientifically measurable (p. 47; see also Ingold, 2013). As a medium, true to the word's meaning as intermediary or middle, glass functions as a substance at hand for an individual's expression.

Material and medium are often used interchangeably in the glass studio – a discursive practice dating to the origin of the American Studio Glass Movement (1960–1990). An example can be taken from the written work of Harvey Littleton (1922–2013), a ceramicist who is widely credited with launching studio glassblowing through its incorporation into college art programs and the art market (Byrd, 2012). On the one hand, Littleton (1971) heralded glass a "virtually undiscovered … medium for artistic expression" (p. 6). Littleton's link of medium and expression echoes the philosophy of John Dewey (1934/2005). For Dewey, a material becomes a medium when it is "used to express a meaning which is other than that which it is in virtue of its bare physical existence: the meaning not of what it physically is, but of what it expresses" (p. 201). On the other hand, influenced by Abstract Expressionist Ceramics, Littleton (1971) declared:

> Essential to the artist's work with glass is his understanding of the material and the basic, element subconscious action-reaction of man and material, not only in the forming of the hot glass – the melting and the forming – but in the complete integration of man and material in a totally controlled time-space concept.
>
> (p. 13)

Whereas the former belonged to a growing understanding in the mid-twentieth century of an artistic medium as a substance made available for expression by an individual, the latter echoed the valorization of "media specificity" in aesthetic theory, which called upon artists to liberate the material particularity of given medium from subject matter as had the Abstract Expressionist painters (see Greenberg, 1940/1992). In Littleton's case, he carried plastic automatism – a technique employed by the Abstract Expressionists

of direct and unmediated expression of visceral-material experience – from ceramics to glass (See Koplos & Metcalf, 2010, p. 152; MacNaughton, 1994, pp. 51–61; Slivka 1961/2010, pp. 528–530). As Hattie had both learnt to engage glass as a medium and followed it like the artisan of new materialism, namely as vibrant matter expressive of its own agency (See Bennett, 2010; Deleuze & Guattari, 1987), so too do novices learn the double-belongingness of glass in the hot shop.

In our "Beginning Glassblowing" class in the spring of 2004, for example, Paul continued with our lesson on the "nice round sphere" with an exercise that encouraged us to see glass as a substance to be commanded by technique: "Ok? First, let's work on your gathers". We parted our student circle so that he could access the steel blowpipes and solid pipes known as "punties" resting horizontally in the "pipe warmer", where their tips bathed in the blue flames of natural gas. He grabbed a punty and, to our surprise, did not take it to the adjacent heated kiln called "glory hole" to heat and then to the furnace to gather glass. Instead, he dipped the punty's tip into the bucket of water next to the workbench and tabletop of hand tools. Ignoring the sputtering steam, he directed our attention to the reflection of the pipe in the water: "You see the reflection of the pipe in the water? It's going to be the same in the furnace. You have to look for the reflection so that you know when you're going in for the gather". My eyes, like those of the other eight students, were fixed on Paul, the punty's tip, and the "fake gather" via the bucket of water. "When you retrieve the glass", he continued,

> like, as soon as you break out of the glass, you have to slow your revolutions down. If you keep rotating quickly, you'll spin off all the glass that you just gathered. So, slow rotations on the way out. Everybody got it?

We nodded and each fake gathered from the water bucket and rotated the pipe mid-air in anticipation of our next turn (Field notes, March 11, 2004).

The heavy punty swiftly cut through the water unlike the sticky, viscous glass. As we took turns fake gathering, Paul and his assistant, Maureen, corrected the speed of our pipe rotation, dip-depth, and angle. Similarly, Hattie had also been instructed to fake gather as a beginning student. Some "old-time glass factory workers" had come by her university to give a lesson, lined the students up to gather and – to Hattie and her fellow students' surprise – had them gather from a bucket of rubber. The rubber did not stick to the pipe, the tip of which bounced up when the student removed the pipe after depressing its tip into the rubber to gather. When she described the experience, Hattie laughed wholeheartedly with a contagion that soon had me laughing along. Smiling, with shoulders shrugged and hands upturned, she seemed to think the exercise absurd.

In theories of embodied knowledge framed by skill acquisition and the development of proficiency (Bourdieu, 1990; Dreyfus, 2004; Herzfeld, 2004; Wacquant, 2004), such fake gather exercises are variously understood as preparatory – a step towards assimilating and incorporating the bodily dispositions of "real gathering". Herein, embodiment is theorized as an extension into, or inhabitation of, the world, such that I am said to experience the blowpipe not as a thing in hand, but as an extension of myself. I feel the limit of my body not in my hands, but at the pipe's end – the aqueous silk of water, buoyant rubber, or viscous hot glass. In virtue of this belonging to the world, the body experiences itself as extended through tools, feeling them as things into which we have "transplanted" ourselves and "incorporat[ing] them into the bulk of our own body" (Merleau-Ponty, 1962/2005, p. 143; see also O'Connor, 2005, 2007). The brothers,

Stuart E. and Hubert L. Dreyfus (2004), a mathematician and philosopher respectively, developed a five-stage model of skill acquisition through an analysis of novices learning to drive. Therein, novices who can shift from following rules to coping with real situations become "advanced beginners" (p. 177). In this framework, a fake gather shifts the novice towards a situational understanding of gathering from a domain-independent rule (p. 177). Via an analysis of the reproduction of social power, status, and order, sociologist Pierre Bourdieu's (1990) theories of practical knowledge reveal how practical competence – *habitus* – is forged through the incorporation and adaptation of a given domain of social interactions, the *field* (p. 50). Through an iterative process of adapting previous skills to a new situation, the novice incorporates the glass, tools, and bodywork such that she can anticipate and practically comprehend a given world (O'Connor, 2005). Such a process is akin to the drills of the boxer in training described by sociologist Loïc Wacquant (2006), whose ethnography of boxing explains how boxers become invested in their practice, in which exercises are grafted onto basic patterns to slowly make progress (p. 70). It is important to note that accounts of skill learning herein proceed by way of analogy: the novice *does like* in order to *become like* the master. Of what therein is the stuff of practice – glass, water, rubber, tools?

In this sense, theories of embodied knowledge tend to proceed by way of an analysis of *operative intentionality* in univocal action – those standardized processes in which individuals do like in order to become like (Gallagher & Miyahara, 2010, p. 119). Such a framework limits understandings of knowledge to benchmarks of progress; doing like in univocal action can only ever be a matter of differing degrees of perfection (Kotva, 2015, p. 103). When the acquisition of skill is a matter of similitude and progress, that is, the enterprise of learning to blow glass is relegated to a forever-embedded hierarchy. This pertains not only to glassblowing but also to craft in general. When univocal action is the focus, the materiality of a given fake gather acquiesces to that process; it is mediated and therein creates a third term between maker and material, namely *medium*. When the novice fake gathers *as if* a general substance is introduced somewhere amidst the rubber, water, or hot glass and the gather: a medium. The absurdity of the bucket of rubber may have less to do with its indifferent buoyancy than the fact that Hattie was meant to ignore exactly those dynamics and engage the rubber *as if* it were glass. This practical lesson in mediating materiality sets a precedent for making, the glassblower's working knowledge and theories about that knowledge. When materiality is mediated, a theory of embodied knowledge, and cognition, extolls emergent intentionality and distributed mind but stops short of theorizing the intra-corporeality – the entwined corporeality – of practitioner and materiality. To draw a theory of intra-corporeality into that of embodied knowledge – a matter of materiality rather than medium – we can turn to the heat.

"In heat" among sticks and men

In the spring 2004 intermediate class, Paul gathered at the furnace, counting one, two, three, four, five, gathered again, and turn towards us, asking: "Ok, everybody?" Returning to the workbench, he grabbed a wooden block that resembles a ladle from a bucket of water behind the adjacent tool bench. Rolling the pipe back and forth over the metal "arms" of the workbench, Paul raised, cupped, and continuously rolled the "block" under the gather of hot glass, shaping the glass into the block's orb-like cavity. Lifting up the pipe's opposite end, he put both it and his thumb into his mouth and gave a terse puff of air. Removing the pipe, he watched a bubble expand at its end. As I watched Paul,

I knew that the rate at which I saw his bubble expand meant that the temperature of the glass was "correct" – a cool skin with an evenly hot interior. I had seen instructors overblow too hot glass bubbles and blow cold when the glass was too cold and stiff to the point of going red in the face. I had done both myself.

Heats always punctuate the steps of the glassblowing process to maintain the glass' malleability. Paul reheated the orb at the glory hole and returned to the bench: "Hello, yes, I am giving a demonstration here". Most of the students, largely hobbyists who had opted for an after-work class, were not sketching, but chatting, hushing, and dispersing around the bench to observe. Blocking the orb once again, Paul continued, "[n]ow we're going to neck the piece". He picked up the tong-like jacks with his right hand, lowered them perpendicularly onto the bubble just off the pipe's end, beckoned Maureen, his assistant, to blow and squeezed. Slightly angling the jacks as he squeezed, he created a gentle valley between the moile and the bubble, constricting but not closing the air passage created by his first puff. To form a sphere, an opening must remain. Paul exchanged the jacks for the "newspaper" – four folded sheets of the water-soaked *New York Times* that fit to the palm like an oven mitt – and by playing Maureen's breath, the centrifugal force of rotation and the centripetal force of the palm-held newspaper, a perfect sphere expanded before our eyes (Figure 3.1).

It was our turn now. My partner, Sam, went first and promptly smushed her sphere into a floor-level scrap-tray when she overblew it into a pear shape. I was up next. Paul was standing by the scorching hot furnace (around 1,100° Celsius) and opened the furnace door as I approached. Resting the pipe on the ledge of the hip-height opening, glass ablaze, I lowered the pipe, looking for its reflection in the molten smoulder – an indication of how close the pipe's tip was to the glass. Continuing to lower, the hot glass gripped the pipe's end, and I rotated, counting as Paul had demonstrated. I could already tell that I was gathering too deep by the too-short remainder of pipe above the glass and the weight of the far-too-submerged end.

Figure 3.1 Newspapering a sphere. Drawing by the author.

Heat followed each step of the process, but "didn't count" in an earlier class when Paul asked students what the steps of blowing a vessel were: block <heat>, paper and blow <heat>, marver and blow <heat>, hang then neck <heat>, paper and blow <heat>, paddle <heat> (Field notes, October 3, 2003). At the same time, the intense reality of the heat in glassblowing was a dealbreaker for many. The next week, Paul counted us one by one before the start of class, noting an absence: "So, who's here? Or, who's not here? There are six of you". He counted us again as two more students hurried into the circle. Paul realized that the missing student was the young woman, who had been overwhelmed by the heat the week prior. "Hmmm", he worried, "I think we scared her off the first day". In my field notes, I described her speaking of the furnace as an "airless tomb of heat" into which she felt like she was "falling" when gathering. Another woman was "scared to pass out [from the heat]" since she was "on antibiotics". Many students – be they my classmates or those I later served as a teaching assistant – "couldn't take the heat". They became dehydrated and suffered heat exhaustion even though they drank plenty of fluids and used the protective corrugated steel shield that stands between the glassblower and furnace or glory hole as a buffer. I consistently wrote of the heat, the sweat, the blazes, being scorched and burnt, thirst, deep slumbers following a day of wage-work in the hot shop, and, notwithstanding, the deep pleasure of becoming hot, penetrated to the core by heat.

Despite Paul sweating constantly, beads falling from the brow of his flushed freckled face, he could "blow glass all day and night" in his own words. Paul was one of the people who, glass artist Noah Sparks described in an interview, "were constitutionally very easy or confident around [the hot shop]" (Sparks, personal communication, November 7, 2007). For Sparks, this was critical to learning to blow glass in a productive way:

> If you actually said that you wanted to teach glassblowing in a way that would lead to productivity or whatever and you wanted to actually encourage people to do that, the first thing that you would do is either do a bunch of activities to get people comfortable with the situation of the noise and the heat or do the converse, try to scare the hell out of everybody so that most people would leave.
>
> (Sparks, personal communication, November 7, 2007)

Sparks' comment is couched in the context of developing proficiency that does not start with skills like so many accounts of craft knowledge, but with the heat. We have a choice here. We can either first invite the heat into the glassblowing social world of human action, as did Paul's tutorial explanation of the steps of blowing a bubble or sphere, or second acknowledge the hot intra-being-knowing of hot glass and glassblower. Choosing the former would be to acknowledge the importance of heating the glass or get the glass hot for the purpose of glassblowing. Choosing the latter would also be to accept that to blow hot, which is to say to think and act like a glassblower, *any-body* must be hot. Arguably, to be hot is not simply a descriptor of body or glass, but the felt *intra-corporeality* of heat. For Barad (2003), there are no independent objects with ontologically inherent boundaries and properties, but rather phenomena that are the entanglement of "intra-activity", namely emergent and co-constitutive with materiality (p. 822). To account for being-hot is not to "democratize" embodied knowledge by "invit[ing] nonhuman entities into our [human] sociality", but rather to reconceptualize body as *intra-corporeality*, namely the entanglement of human and nonhuman entities (Barad, 2007, p. 378).

Reconsidering the gather, the student must always *be hot* in order to grasp gathering. Imitating Paul's demonstrations is never a matter of reproduction. Jean Lave (1982), an anthropologist who has studied craft practice, has noted that imitation does not "internalize a direct replica of the behavior" in a "haphazard, … osmotic, … passively observational or imitative" way (p. 182). Instead, Lave has emphasized that novices should strategically approximate and slowly acquire a personal style in interaction with an ever-changing environment and systems that structure perception. Yet, when the logic of production (be it traditional or expressive) remains the primary context for an analysis of embodied knowledge, the "stuff" therein engaged easily remains an unthought medium. In the case of glassblowing, the intra-corporeality of being-in-heat, for example, is left unaddressed in favour of describing the working properties of hot glass as engaged by the glassblower. The consequence is that accounts of glassblowing focus on technique, tools, and collaboration (i.e., inter-corporeality) rather than intra-corporeality. This explication portrays the glassblower *in heat* among sticks and men, but not being-heat herself.

Getting at the heat of the intra-corporeal knowledge in glassblowing is not only a matter of understanding learning as participation, or apprenticeship to life, rather than simulation (Illich, 1971, p. 34), but also that of unpacking the ontology of participation. Pipe in hand, extended through it to the glass at its end, I touch and feel not just the hot glass at the somatic limit of my body (phenomenological embodiment), but I *am* the heat. Agential realism "denies the suggestion that our access to the world is mediated, whether by consciousness, experience, language, or any other alleged medium … call[ing] into question the presumption that a medium – an 'ether' – is even necessary" (Barad, 2007, p. 409). Blowing glass, I'm moved by a calorific body, practice, and imagination. Doing *with* rather than doing *as* means not only doing with the teacher and heat but also becoming with and of heat. Here, we might consider heat's inoculation as a primer without which the novice could not learn. Heat, if you will, is the radical immanence of the glassblower's art; you're either hot or you're not. By following the heat in a consideration of the intra-corporeality of glassblowing, we follow the heat as materiality, co-emergent with and of glassblower, fire, and furnaces. Unlike a consideration of heat as a working property of glass as a medium, this acknowledges the intra-penetration of heat across human and nonhuman bodies. Becoming with the glass means becoming with the heat. Not unlike the licks of flame that escape furnaces and glory holes, heat exceeds any arc of action, production, operative intentionality, or goal. Attending to intra-corporeality, a theory of embodied knowledge must dispense with operative assumptions of a working medium.

Conclusion

Though beyond the scope of this chapter, the intra-corporeality of heat among glassblowers, particularly its non-operative excess, presses us to consider other excessive and forgotten materialities. Most readily, the constituent components of glass – silica, soda, lime, and others, which make the mixture known as *batch* – come to mind. On any day of my fieldwork at New York Glass, I arrived with barely a thought of this. Studio technicians had already melted 50-pound bags of batch such that the hot glass was ready and waiting to be gathered into that day's production – that arc of operative intentionality or action. Yet, it is precisely this absence that is meaningful for understanding how medium and materiality work in theories of embodied knowledge. When an explication of embodied knowledge analyses materiality associated with skill acquisition without an account of its

appearance outside of the arc of action, it arguably participates in an onto-epistemology of mediation. It is precisely the absence of the constituent components of glass in studio conversations, lessons, and curricula, for example, that allows for its appearance as a working medium on a given day. From this vantage, an account of embodied knowledge is freed from excess and unwanted materialities to focus on the acquisition of skill in relation to and with a medium. Yet, the development of skin irritations, coughs, or in the worst case, silicosis, is no less part of embodied knowledge of the glassblower. Turning towards forgotten, discarded, and usurped materialities, we can attend to becoming with glass in multiplicity, in excess of a given arc of action or intention, deepening and broadening accounts of embodied knowledge.

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