CHAPTER 14.

ADDRESSING THE FUTURITY OF LITERATE ACTION: TRACING THE ENDURING CONSEQUENCES OF ACTING WITH INSCRIPTIONS THROUGHOUT THE LIFEWORLD

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In articulating a model of writing development that adequately addresses the rich variety of textual engagements people encounter throughout the length and expanse of their lives, the Lifespan Development Writing Group (Bazerman et al., 2018) calls for theoretical and methodological perspectives that trace writers' becoming across multiple settings. Noting that the biographical sequence of literate activities shaping people's experiences of their hobbies, religious worship, schooling, government bureaucracy, and employment function as "pathways for engaging with and practicing new genres, for confronting different kinds of cognitive, linguistic, motivational, and social demands, and for developing new forms of communicative relationships" (Bazerman et al., 2018, p. 23), the LDWG asserts that as persons' "adolescent and adult social worlds expand into new professional, commercial, civic, and other affiliational contexts, so do the possibilities and exigencies for their writing development" (p. 23). This chapter offers one response to the call for increased attention to the textual trajectories of meaning-making that people build, and build continually from, throughout their lifespans and across their lifeworlds. Based on data collected for an IRB-approved multi-year longitudinal case study of one writer throughout his college years, but that also reaches back to his early childhood, this chapter traces his use of a variety of everyday inscriptions in ways that extend across and weave together his engagements with disciplinary science and religious worship.

As an undergraduate microbiology major, Samuel's (a pseudonym) science coursework found him navigating a dense network of "inscriptions," a term for material documents that "covers everything that is used to refer to some thing or phenomenon in the material world, including photographs, naturalistic draw-

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ings, diagrams, graphs, tables, lists, and equations" (Johri et al., 2013, p. 8). His organic chemistry class, for example, immersed Samuel in drawing a series of diagrams (see, for example, Figure 14.1) that graphically represent the structure of common organic molecules.

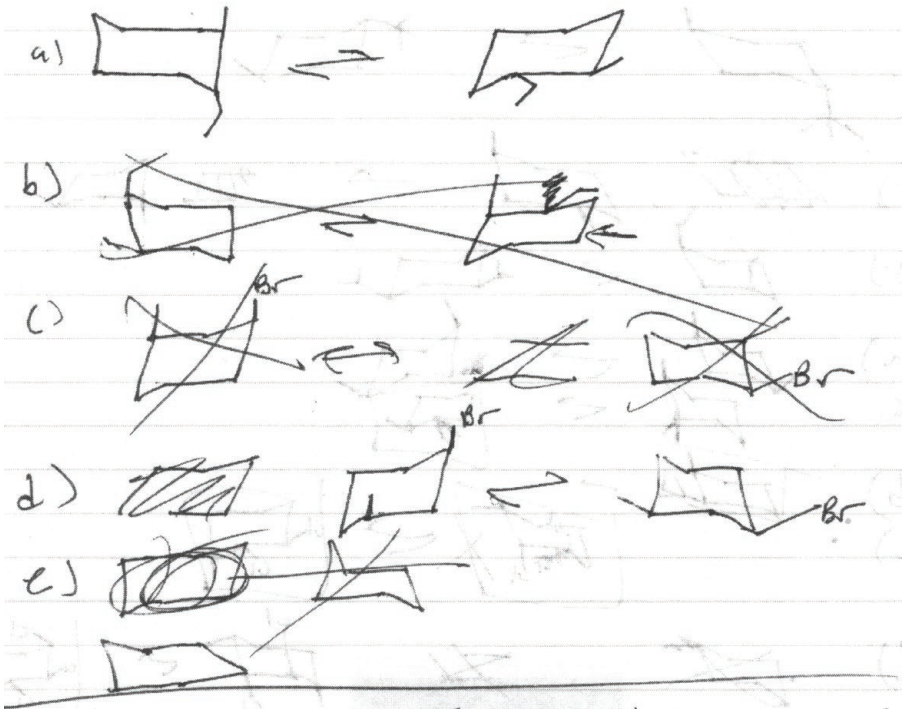

Figure 14.1. An excerpt from a page of Samuel's organic chemistry notebook showing his efforts to graphically represent organic molecules.

Working from the diagrams he copied from the whiteboard during class lectures and the ones displayed on the pages of his textbook, Samuel painstakingly drew and redrew different versions of these diagrams until they adequately made visible the molecules' key features, shapes, and arrangements, properties which cannot be seen with the naked eye or even with advanced imaging technologies.

Noting the mundane nature of inscriptions, Latour (1990) writes that they are "so practical, so modest, so pervasive, so close to the hands and the eyes that they escape attention" (p. 21), and yet, he acknowledges their vital importance to scientific ways of knowing. Articulating the centrality of inscriptions as the locus of the scientific enterprise, Latour (1990) asserts that, "Scientists start seeing something once they stop looking at nature and look exclusively and obsessively

at prints and flat inscriptions" (p. 39). What might seem like errant doodles or a simplistic shorthand are, as Latour (1990) states, "innovations in graphism" (p. 29). In learning how to see, draw, and act with these inscriptions, Samuel is acquiring what Latour (1990) describes as "the precise practice and craftsmanship of knowing" (p. 21) for chemistry. Developing a facility with producing and using these inscriptions, then, is a key part of Samuel's rhetorical education toward becoming a scientist.

Samuel's acting with these diagrams situates him firmly in the densely textual landscape of chemistry. And yet, as I have come to realize throughout my case study of Samuel's literate activities (Prior, 1998; Prior & Shipka, 2003), his encounters with these diagrams is also deeply entangled with his extensive history of engagement with religious worship. In contrast with dominant mappings of writing development within specialized communities, my analysis of Samuel's becoming as a scientist-in-the-making illuminates the ways people's disciplinary becoming emerges across the assumed boundaries of everyday, academic, and professional activities rather than from engagements within any single social world. Ultimately, this chapter argues for increased attention to what Gries (2015) refers to as "futurity" of literate action as a way of making visible the complexly historical and heterogeneous character of writing, learning, and becoming.

TRACING TRAJECTORIES OF BECOMING

In keeping with what Beaufort (2007) described as writing studies' dominant metaphor of writing development, "one of writers moving from outsider to insider status in particular discourse communities or activity systems" (p. 24), the dominant stories about disciplinary development that have emerged from writing studies' scholarship locate writers and their writing tightly within a particular disciplinary world (Carroll, 2002; Dias et al., 1999; Geisler, 1994; Haas, 1994; Poe, Lerner, & Craig, 2010; Winsor, 1996). These accounts configure histories of development in terms of newcomers entering an unfamiliar disciplinary territory and moving from the periphery toward some more central location, mostly through increasingly deeper, fuller participation with a set of core ways of writing, representing, knowing, and being shared by all full members. Viewed from this vantage point, development is depicted as a fairly straightforward process of taking up the already-established genres and identities available within the well-policed borders of an already-made social world.

These tightly situated accounts of literate development within the assumed borders of disciplinary worlds seem fairly commonplace, but only if we focus on people's participation in this single social world. Consider, though, how

such mappings sever the historical trajectories people trace as their lives play out across expansive lifeworlds, lives textured with multiple engagements that extend across multiple timescales. Studies that have attended to the trajectories people chart across their lifeworlds have illuminated the ways disciplinarity is deeply entangled with those histories (Artemeva, 2009; Chiseri-Strater, 1991; Durst, 2019; Medway, 2002; Prior, 1998, 2018; Prior & Shipka, 2003; Roozen & Erickson, 2017). All told, these perspectives suggest that when our models of development fix writers and their writing solely on what happens within the presumed borders of a particular disciplinary world and solely on people's encounters with its privileged forms of writing and knowing, we risk an overdetermined, incomplete, and ultimately very confusing account of the pathways for disciplinary development.

To sharpen our view of those dynamic processes across temporalities and spaces, I have turned to a body of theoretical approaches that addresses the complex heterogeneity and heterochronicity of human mediated action and the prominent role such heterogeneity plays in the co-development of artifacts, practices, and persons across times, places, and activities (Engeström, 1993; Latour, 2005; Scollon, 2001; Vygotsky, 1978; Wertsch, 1991, 1998). Rejecting the notion of activity as unified, Engeström (1993) writes that, "An activity system is not a homogeneous entity. To the contrary, it is composed of a multitude of disparate elements, voices, and viewpoints. This multiplicity can be understood in terms of historical layers. An activity system always contains sediments of earlier historical modes, as well as buds and shoots of its possible futures" (p. 68). The profound heterogeneity of activity means that moments of mediated action function as points of emergent, dynamic blending.

In addition to shaping action in the emergent here and now of a present moment, the interplay of heterogeneous elements also serves as the basic semiotic mechanism of development, as words, artifacts, practices, identities, and social worlds are slowly and incrementally transformed through being selectively reaccentuated and interwoven. Such transformations are vital in shaping the ways that elements might, and might not, be taken up in later activities in the near and distant future. Invested in understanding the continual becoming of semiotic resources, Gries (2015) argues for perspectives focused not on a specific element's use in any single social interaction, but rather on how an element is re-used across a historical sequence of interactions. She offers a conceptual and methodological framework for tracing the pathways of how a particular element circulates through a series of encounters, the continual re-shaping that occurs as an element is assembled with others, and the implications such re-shaping holds for an element's potential uses in the future. For Gries (2015) it is through the dynamic, ongoing process of

"rhetorical transformation" that any particular element "becomes rhetorical in divergent ways as it circulates with time, enters into new associations, transforms, and generates a multiplicity of consequences" (p. 14). In other words, elements "become rhetorical as they crystallize, circulate, enter into relations, and generate material consequences, whether those consequences unfold in conceptual or physical realms" (p. 11). What emerges from such heterogeneous associations are artifacts laminated with multiple histories heading into unknown and unpredictable futures.

In terms of understanding how people and artifacts come to be in the world, attention to the complexly laminated heterogeneity of situated action makes visible the ways artifacts, practices, and people are flexibly transformed through being entangled into heterogeneous associations as well as the long-term implications such transformations hold for their continual becoming. In this sense, the associations people build in a present moment of situated action provide the very resources people then build from as they take up newly transformed elements into later moments of action in their near and distant futures. Methodologically, attention to lamination suggests that analysis of practice should begin with people's activity in particular sites of engagement, but should also address the extensive historical trajectories that flow into and emanate from such sites. According to Gries (2015), it is only by close attention to what she refers to as "futurity," "the strands of time beyond the initial moment of production and delivery when rhetorical consequences unfold, often unpredictably, as things circulate and transform across space, form, genre, and function" (p. 14), that such histories can be disclosed and opened for examination. For Gries (2015) it is "[o]nly with an eye toward futurity" that researchers can "actually account for how things circulate, take on a life of their own, and help constitute and reconstitute collective existence" (p. 8) along a history that is "always unfolding into an unknown future" (p. 27).

DATA COLLECTION

Samuel is a Black (his chosen term) microbiology major at a large public university in the southeast. He had just started his second year of college when our study began. According to Samuel, his intense interest in science began with the inquisitive nature he displayed as a child. As he described it, "growing up I always had a love for animals and I was always the thinker, always asked a bunch of questions." He noted, though, that "growing up in the area I grew up in, it wasn't cool to really pursue that, so like in my science classes, I really wasn't that interested in that." Through his volunteer work with a pet care center and his experiences in labs for his high school science classes, Samuel grew increasingly

interested in "just finding out how something works at the atomic level and molecular level and cellular and the tissue, organs, developing into the organism and how all of that works." By the middle of high school, Samuel indicated that he "just fell in love with biology. I was able to immerse myself in it. And I'm like, 'I'm really good at this'." His engagements with animals eventually drew him toward college in pursuit of a career in veterinary medicine.

Like much qualitative inquiry, the research design emerged as the study progressed. I first got to know Samuel as a student in a class I was teaching. Over the course of that semester, Samuel indicated that he was a microbiology major engaged in a wealth of literate activity for his science coursework. The following semester, I invited him to participate in a research study to understand the textual practices for his science coursework. As the research moved forward, Samuel took up the role of "co-researcher" (Ivanic, 1998, p. 110) in the sense that, understanding the goals of the study, he brought new data in to interviews, suggested we might want to talk about this or that practice, offered his own insights, and responded constructively and critically to my emerging understandings. Initially, I collected sample texts from and conducted text-based interviews regarding his engagements with science. During our early interviews, Samuel frequently mentioned his religious faith (e.g., his knowledge of the Bible, his parents' roles in the church they attended) and his activities associated with religious worship (e.g., attending church services, studying and memorizing religious texts). Because I sensed that his faith and these activities related to his faith were important to him, and because attending church figured prominently in my own history, they became something we talked about during our interviews.

Subsequent interviews on both Samuel's activities led to more focused interviews about those textual engagements, and included collection of sample texts in whatever representational media were appropriate (e.g., hard copy and digital inscriptions). Sample texts were crucial for text-based interviews that focused on Samuel acting with specific texts and textual activities rather than on his involvement with literate activities more generally. Such interviews were often process- and practice-based in order to make visible Samuel's efforts toward creating and acting with various texts. Process-based portions of interviews involved having Samuel create retrospective accounts (often supported by texts and other artifacts) of the processes involved in the invention, production, and circulation of a particular text (e.g., the current draft of one of Samuel's chemistry lab reports), and key elements (e.g., other people or texts, inscriptional tools and technologies) involved in those processes. Practice-based portions of interviews aimed at understanding why and how such elements were employed.

I paid particular attention to moments when Samuel mentioned instances of difficulty or of learning something new. A key principle of sociohistoric research (Latour, 2005; Prior, 2008; Vygotsky, 1978, 1997; Wertsch, 1991) is that persons become much more consciously aware of action and practice during moments of genesis— when they are in the process of participating in or learning practices that are somewhat new or unfamiliar to them—and in moments of disruption—when their usual practices are disrupted. During such instances, when participation in practice slows down and persons become much more consciously aware of what they are doing, it is much easier to get a sense, from the participants' perspective, of action in-the-making (Latour, 1987).

In all, we conducted eight formal interviews, which resulted in just over 14 hours of video- and audiotape data. I supplemented the formal interviews with dozens of follow-up questions developed while I examined the interview recordings, my notes, and texts that Samuel had brought to the interviews or had emailed me. I emailed these follow-up questions to Samuel after the formal interviews and he either emailed his responses, brought them up during later formal interviews, or mentioned them during informal conversations when he stopped by my office or during chance meetings on campus.

This ongoing series of interviews provided opportunities for the kinds of "longer conversations" and "cyclical dialogue around texts over a period of time" that Lillis (2008, p. 362) identified as crucial for understanding literate practice within the context of a participant's history. They also allowed for what Stornaiuolo et al. (2017) describe as "the unprecedented, surprising, and meaningful to emerge in observations of human activity without predetermined and text-centric endpoints of explanations" (p. 78). One insight that slowly emerged from the series of interviews was Samuel's frequent use of diagrams and other inscriptions and their prominent importance in his science coursework as well as his other textual engagements. In terms of his science coursework, for example, I noticed how fully he was immersed in an extensive cascade of inscriptions for his biology and chemistry classes and labs. I also noticed how frequently talk about diagrams and other inscriptions related to his various science courses became a focal topic of our interviews. In terms of some of his other literate activities we explored, I noticed how he used inscriptions in those activities (e.g., using diagrams as a way of prompting discussion during Bible study meetings, copying Bible passages on notecards to aid in memorization). I also noticed how frequently during our interviews he would draw out the diagrams he mentioned and how quickly he generated them.

Another insight that emerged slowly during the early stages of the study was the tension Samuel felt between his deep engagement in science and his faith.

As I would eventually come to realize, the one thing that gave Samuel serious pause about pursuing a career in science was the impact it might have on his deep engagement with the church, a vital part of his upbringing and family life. Members of Samuel's family are active in the Black Presbyterian church they have attended for generations. Both of his parents hold positions in the church leadership, and Samuel and his brother have been involved with church activities since their early childhood. Recalling the tension he felt about maintaining his faith and presence in the church as his interest in science grew, Samuel stated,

> When I first started really pursuing science, I had trouble trying to see science and God in the same vein because of the way our culture works. We see them as two polarized, very opposite entities, that you can't pursue knowledge of the world or try to understand creation and God himself. . . . All of the people that I would talk to would be like either, "Yes! Science is the answer, science is the way, science gives me all of the answers that I could ever possibly need to know." And then others were like, "No, science is not this. You can't believe that all of this makes sense."

Faced with the dichotomy offered by this powerful cultural narrative, Samuel considered forsaking his interest in science for what he described as a "steady job" that would allow him to stay actively involved in his church. At the point Samuel started college, he had shifted toward a different stance, reconciling himself to pursuing a career as a veterinarian while keeping his religious engagement fairly private.

DATA ANALYSIS

In order to focus on Samuel's engagement with diagrams, analysis of the data was oriented toward understanding the histories of Samuel's use of inscriptions and inscriptional practices across multiple times, spaces, and representational media. To develop a sense of Samuel's histories with inscriptions, I analyzed these data interpretively and holistically (Durst, 2019; Miller et al., 2003). I first arranged data representations (i.e., sample texts, sections of interview transcripts, interpretive notes, copies of images, printed versions of still images captured from video, drawings Samuel had created during interviews, etc.) chronologically in the order in which Samuel engaged with them. Those data representations were examined for instances where I sensed that, or Samuel indicated that, he was acting with particular inscriptions or employing particular inscriptional practices.

This analysis of the data generated a large number of histories reaching across seemingly different literate activities. Based on those analyses, I constructed brief initial narratives of Samuel's histories with practice across multiple engagements. Those initial narratives were reviewed and modified by checking and re-checking those constructions against the data representations (to ensure accuracy and seek counter instances) and by submitting them to Samuel for his examination. At these times I often requested additional texts from Samuel, and frequently he volunteered to provide additional materials and insights that he thought might be useful in further elaborating and extending the narratives I generated. It was frequently the case that my understanding of the use of practices for these different literate activities needed significant modification as a result of closer inspection of the data, identification of additional relevant data, or discussions with Samuel during interviews or via email. Accounts of these interactions were modified according to Samuel's feedback. Finally, Samuel was invited to member check final versions of the narratives in order to determine if they seemed valid from his perspective.

To represent Samuel's histories of acting with diagrams along trajectories that flow into and emanate from his engagement with his science coursework, and also to make my own analytic practices more visible, I present the results of the analysis as a documented narrative (Prior, 1998), or what Gries (2015) refers to as a "risky account" (p. 8) rather than as a structuralist analysis. Doing so allows me to present the history of Samuel's acting with diagrams in a coherent fashion without flattening out the richness, complexity, and dynamics of their continually emergent becoming across multiple engagements.

In the sections that follow, I first examine the way Samuel's actings with the diagrams he encounters for his scientific coursework come to be deeply textured by his engagement with religion. Next, I explore how Samuel's laminated engagement with diagrams shapes his use of them for later moments of action, first for a Bible study he leads later during the semester, and then two years later as he writes his senior thesis.

MAKING PRESENT ABSENT THINGS

From the very beginning of Samuel's organic chemistry course, diagrams played an especially important role. Much of the activity centered around acting with a variety of molecular diagrams, bare-bones depictions that make readily visible a molecule's key relevant features and its spatial arrangement and allow them to be closely examined, like the ones shown on the page from Samuel's organic chemistry notebook offered in Figure 14.2.

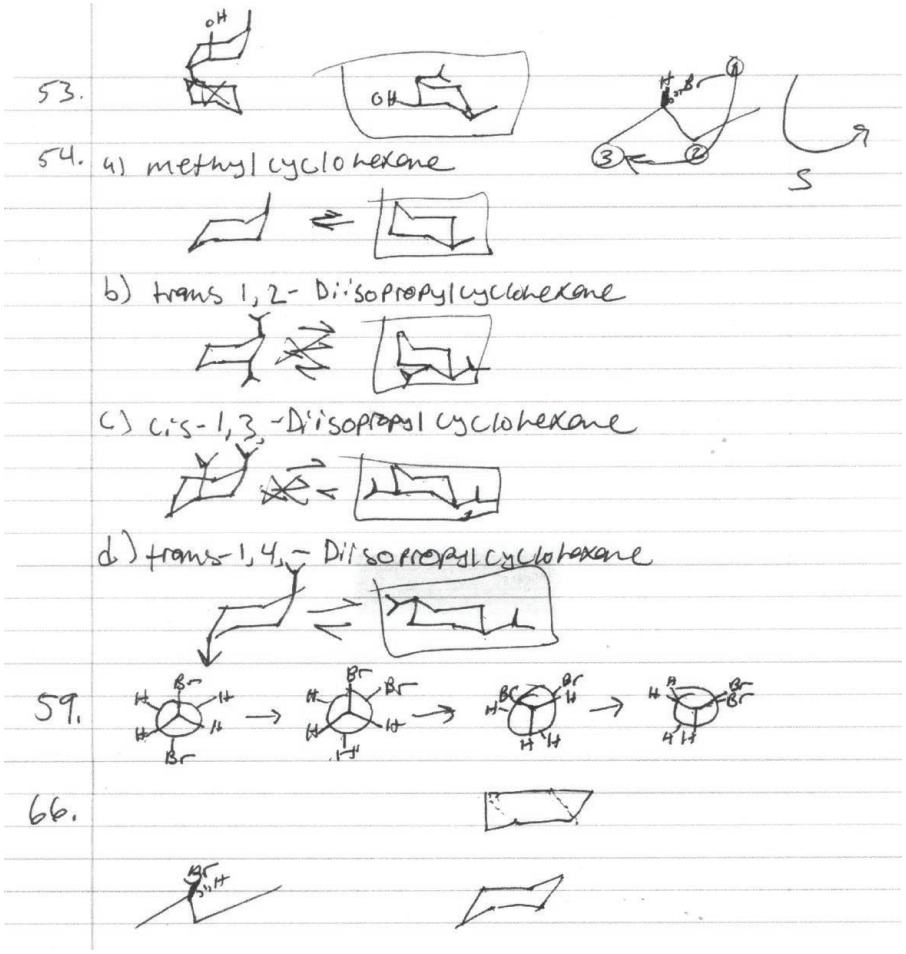

Figure 14.2. A page from Samuel's notes for his organic chemistry class.

Describing a typical class lecture, for example, Samuel indicated that his professor "doesn't write too, too much on the board unless it's drawing a structure. . . . Like a Newman projection, she'll draw that on the board. Like an organic structure she may draw on the board and then talk about chirality of a compound. 2-bromobutane is one of her favorites. At least for showing stereoisomers." Pointing to a diagram at the top right of the page from his notebook (see Figure 14.2) we were looking at, Samuel stated "This is 2-bromobutane. We were talking about chirality and how to figure out what the chirality is." Samuel indicated that he was somewhat surprised at the emphasis placed on students being able to draw the diagrams themselves. I include below a brief excerpt from one of our interviews during which Samuel describes his organic chemistry pro-

fessor's emphasis on knowing how to draw chair conformation diagrams:

> **Samuel:** I don't write very neatly and I don't draw very well. So the fact that I had to draw these chair confirmations [the diagrams in Figure 14.2 with the boxes drawn around them] in pen is just weird. Plus, like, one example of drawing them, like learning how do it . . . She taught us to set up each of these. [Samuel picks up a pen and draws the top of the two chair conformation diagrams at the very bottom right-hand side of the page shown in Figure 14.2.] Draw 2 parallel lines, set them each apart, and then draw an equilateral triangle. Well, whenever I would do it like that, my chair confirmations would come out looking like this [laughing, and pointing to the top conformation diagram he drew at the bottom of the page]. And I'm like, I don't understand!
>
> **Kevin:** I see. So you're trying to get it to look like this [pointing to one of the chair conformation diagrams in the middle of the page].
>
> **Samuel:** So I learned, ok if I do this and draw this up and draw this down, just do dramatic everything then it comes out looking like a chair conformation [drawing the chair conformation diagram at the very bottom right-hand side of the page].

In this portion from the interview, Samuel describes and illustrates two different techniques he has encountered for drawing chair conformation diagrams. The first strategy, shown to him by his professor, involves drawing two slightly offset parallel lines and connecting them with two equilateral triangles. His comments regarding the second strategy suggest that it is a version of the first technique, but involves drawing sharper, more "dramatic" triangles.

Despite their mundane and practical nature, these inscriptions allow chemists to re-represent molecules that can't be seen with the naked eye, and that are too messy and complex to make out even when made visible by cutting edge imaging technologies. Employing a few short line segments, simple geometric shapes (circles, rectangles, wedges, and arrows), and letters, these diagrams depict a neatly and precisely arranged structure. The precise ordering is what allows chemists to see features like the positioning of particular atoms and the angles of the various bonds between them. These features, in turn, afford chemists a way of understanding how bonds are likely to change in response to interactions with other molecules, or how easily bonds might be formed or broken.

While scientific diagrams certainly allowed Samuel to see the key features and arrangements of molecules, they also presented to his eye a great deal more. For Samuel, whose life history includes a deep and sustained engagement with religious worship, his ability to see, use, and construe scientific diagrams was deeply laminated with, and thus shaped by, his engagement with his faith. Over multiple interviews, Samuel routinely mentioned how these renderings illuminated God's handiwork to him. His laminated seeing of chemical inscriptions surfaced quite unexpectedly, for example, during one of our interviews while discussing some of the Bible passages he was working to memorize. I include below an excerpt from that interview where we were discussing a passage from Colossians:

> **Samuel:** So Colossians 1:17, [reading from an index card with the verse from Colossians 1:17 written on it] "He is before all things and in him all things hold together." . . . There's nothing apart from him, literally nothing apart from him because everything, institutions, atoms, subatomic particles, everything holds together in Christ.
>
> **Kevin:** I can see why you chose that one.
>
> **Samuel:** And then when people ask me why I believe what I believe or why I think the way I think I say, "Hey, well, here's what the Bible tells me" and it actually makes a lot of sense when you study like chemistry, we learn how the trend for the universe is randomness but the very nature of matter, even at the most seemingly insignificant of levels, the microscopic levels, there's organization. There's organization that we can actually notice plus there's still things that we don't understand about the organization and the structure of an atom, of the nucleus, of orbitals or electrons. We can't tell with any true 100 percent certainty where an electron is around an atom in orbit. And that becomes increasingly difficult when we talk about hybridization and the bonding that occurs between an SP3 orbital and an SP3 orbital like in ethane.

After reading the verse, Samuel elaborates the phrase "all things hold together" by emphasizing that "all things" encompasses "institutions, atoms, and subatomic particles." Following my brief comment about his decision to choose Colossians 1:17, Samuel then indicates that everything being held together by a divine maker is consistent with what the study of chemistry has illuminated regarding the ordered design of even the smallest levels of

organization for the physical world. As examples, he evokes the structure of the atom and its constituents and the bonds between the carbon atoms in a molecule of ethane, structures typically represented in the diagrams he would have encountered during lectures for his science courses, on the pages of his course textbook, and those he accessed online. For Samuel, the organization and order "at the microscopic levels" made visible by diagrams depicting the sp3 bonding in ethane, for example, evidence God's ability to "hold all things together."

To echo Latour (1990), science is not all that Samuel is seeing, or doing, when he starts looking exclusively and obsessively at the inscriptions animating his science coursework. Samuel's seeing of the ethane molecule is heterogeneously situated across and complexly mediated by his engagements with science and religious worship. In addition to Samuel's seeing with the diagrams being informed by his engagement with science, it is also deeply, densely laminated with his long history of religious worship and the texts that it involves. In Gries's (2015) terms, the diagrams have become "dynamic, complex entanglements that often change right before our very eyes as they experience new associations" (p. 13). It is through this lamination that for Samuel, these scientific diagrams take on what Gries (2015) refers to as their rhetorical "life," their "complex and intense vitality" (p. 8). One important consequence of this lamination for Samuel is that it occasions the opportunity for him to draw his faith together with his science and his science together with his faith.

As I elaborate in the two sections that follow, Samuel's laminations of science and religion do not just lead brief, fleeting half-lives in the flow of Samuel's history. Rather, these interweavings have long-term consequences for his becoming. In the next section, I examine how Samuel's laminated seeing of chemical diagrams is employed in a Bible study meeting he led midway through the semester.

"WE WERE TALKING ABOUT GOD AND WE WERE TALKING ABOUT CHEMISTRY"

During his sophomore year of college, the same semester he was enrolled in organic chemistry, Samuel and some of his friends organized a Bible study in his residence hall, and Samuel's co-organizers "volunteered" him to lead the group's meetings. While Samuel was excited, he was also "exceedingly nervous" because he hadn't had much experience leading small groups of people he knew fairly well, and because he couldn't come up some productive activities for the group's first session. He considered a fairly typical move of examining some passages of scripture, but decided against it because he didn't want to dive into verses

that participants would not have had time to read and think about beforehand. He was, as he described it to me, "freaking out." One of his co-organizers with some experience leading small Bible studies suggested that Samuel could prompt some discussion by showing participants a fairly simple diagram of a wheel representing key components of the Christian walk. Based on Samuel's account of that initial meeting, his use of this inscription worked to stimulate conversation fairly well. For leading the group's later meetings throughout the semester, Samuel typically relied upon some type of diagram (e.g., a flowchart showing the progression of Christian growth) or representation (e.g., a brief outline of the chronology of the book of John) and some selected Bible passages group members agreed to read and study beforehand.

In addition to the more immediately recognizable religious-themed inscriptions, one of the diagrams from Samuel's organic chemistry course would also find its way into the Bible study meetings he led. In the interview excerpt I've included below, Samuel starts to describe one of the group's recent meetings, one held just the day before our interview.

> **Samuel:** In the Bible study in my dorm yesterday, we were talking about God and we were talking about chemistry, this was before the study started. We were talking about order and how the smallest level that we can now possibly know of, to some relative amount, that there is order. Scientists will say that there are shell levels within the nucleus, quarks, the different types of sub-nuclear constituents, they all are organized. There's order in the nucleus. And then there's order in the electron shells. There's order in the way the molecules arrange. And so, we're talking enantiomers. [Picking up a pen and looking for a piece of paper].
>
> **Kevin:** What's an enantiomer? [Getting paper out for Samuel].
>
> **Samuel:** [While drawing the diagram in Figure 14.3]. An enantiomer is a stereoisomer, or stereoisomers that are mirror images of each other. So, I have 2-bromobutane. And then this will be my mirror plane. I have the same thing, basically. But the thing about enantiomers are that even though they're mirror images they're not superimposable. You can't put one on top of the other and have it match up. You see that we have this and this [pointing to the top and bottom diagrams on the left-hand side of Figure 14.3]. They're two different conformations.

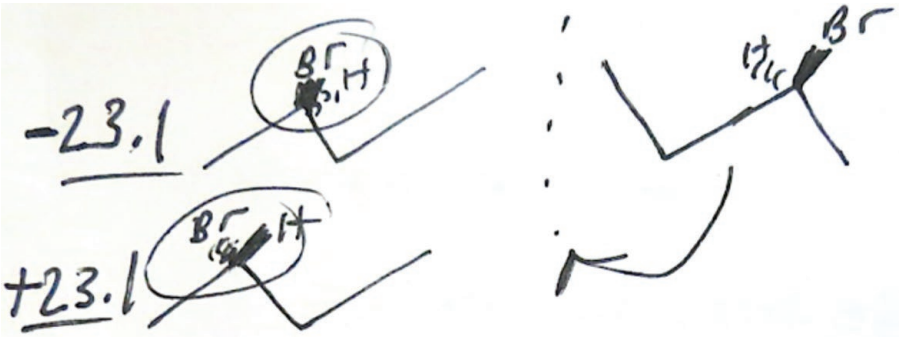

Figure 14.3. Samuel's drawing of skeletal structures of 2-bromobutane, created during our interview, that he used at his Bible study.

Samuel mentions that he and members of the Bible study were "talking about God" and "talking about chemistry" prior to the start of the meeting as part of a discussion regarding the ordered character of the universe, from the smallest nuclear and sub-nuclear particles to the molecular level, and adds that the discussion turned to enantiomers. In response to my query about what enantiomers are, Samuel explains that enantiomers are stereoisomers, molecules that have the same composition but with a slightly different arrangement, drawing two different conformations of 2-bromobutane, his professor's favorite example of a stereoisomer, as he does so. He uses the diagrams to show me that the top and bottom versions of 2-bromobutane, while seeming almost identical, differ in terms of which way the bromine (Br) and hydrogen (H) atoms are arrayed in space (depicted by his use of the wedge-dash in Figure 14.3 to indicate that the Br and H atoms are extending out of the back and front of the plane of the page). This small detail has important consequences for how the two versions react with light and with other molecules. In his very precise, meticulous fashion, over the next ten minutes of the interview Samuel offered a lengthy and detailed explanation of why this one tiny detail meant that the two versions were not superimposable, and why that made such a pronounced difference.

Curious about how he saw the 2-bromobutane connecting to the Bible study meeting he had mentioned, when Samuel ended his explanation I circled back to the topic of the Bible study meeting, inviting Samuel to say more about how it came to pass that the members of a Bible study were discussing chemistry. In the excerpt from that interview I've included below, Samuel explains how 2-bromobutane came to be entangled with the discourse of the Bible study:

> **Kevin:** You mentioned that you were talking about some of this before your Bible study started. What prompted that? Are there people in your Bible study that are chem[istry] majors or?

> **Samuel:** Chem[ical] E[ngineering]. One of them was a Chem E major and I was talking to him about it. We were just talking about order and disorder and I was like "ok, here's what I think about it. 2-bromobutane."
>
> **Kevin:** And he knew what you were talking about?
>
> **Samuel:** I mean, I just drew it out for him. I explained to him what an organic structure looked like and what all these things were, that is was a three-dimensional thing, non-super imposable, ok what are the implications of that? And then it was like ok, so, why is it that there are implications for order in design? Not just in with life, but even at the most basic of levels. The way in which inorganic, or organic in this case, materials react with things like light. The way that they polarize it or don't polarize it because this rotates polarized light at the D line of sodium. So like, 589 nanometers. It rotates it clockwise. This one does. So it does so in a negative direction. The angle of incidence from 0 is -23.1. And it's the opposite for the counterclockwise direction. So these 2 enantiomers rotate the angle of incidence at the same magnitude but where the light goes is implied based on the structure. The 3-dimensional structure.

In response to my question about how the topic of chemistry came up, Samuel indicates that one of the study members was a Chemical Engineering major. He then indicates that the discussion the two of them were having about the ordered nature of the physical world was grounded in a hastily-sketched diagram of 2-bromobutane—his organic chemistry professor's favorite molecule to draw and thus one Samuel had encountered many times in organic chemistry lectures and homework—that Samuel had quickly generated in the midst of their conversation.

When I asked Samuel how he thought the discussion between himself and the Chem E guy went, he responded by saying that:

> He was following me. I didn't add this stuff [pointing to the -23.1 and +23.1 on the diagram] in, I didn't start thinking about that until I was writing in my [chemistry] book, writing the notes and I was just like, man, even the way that these molecules, which are already structured and organized, react with light, there's a distinction and it's constant under these circumstances. It just amazes me. The fact that they are equal and opposite. He's [the Chem E guy] like, "Well it makes a

> lot of sense because of the structure" and "I'm like, ok, but it's order. At a very basic level."

From Samuel's perspective, the Chem E guy was able to understand the complex points he was working to make about the tiny differences between the two versions of the molecule Samuel had drawn and the consequences of those differences.

Based on what Samuel describes in the interview, then, he and the Chem E guy, and perhaps other participants as well, were using Samuel's quick sketch of these two versions of 2-bromobutane to "talk about God and talk about chemistry," focusing on the tiny difference between the two versions of the molecule made visible by the wedge dash projection in the diagram to talk about the order and design apparent at some of the smallest scales imaginable as a mark of God's handiwork and creativity. Samuel's comments that the numerical figures ("-23.1" and "+23.1") on the diagram are ones he added at some point after the Bible study meeting when he was writing in his chemistry notebook and engaging with his chemistry notes suggest that the discussion of 2-bromobutane during the Bible study prompted him to examine the molecule's features and properties even more carefully later that evening when he was studying his organic chemistry materials.

Having encountered scientific diagrams as a means of making visible God's handiwork in the physical arrangement of molecules to himself, Samuel deploys his quickly drawn diagram of 2-bromobutane in the space of his Bible study meeting to make God's character visible to one of the participants, a Chemical Engineering major who likely had encountered that diagram throughout his own studies. In doing so, Samuel's organic chemistry professor's favorite example to draw to illuminate differences between stereoisomers becomes a means of making God's character visible to others. Gries (2015) notes that as a visual artifact "circulates with time" and "enters into new associations," it "generates a multiplicity of consequences" (p. 14). Samuel's reuse of the 2-bromobutane diagram certainly generates a number of consequences. First, in incorporating the diagram into the discourse of the meeting, the 2-bromobutane diagram functions as an inscriptional space into which Samuel can draw religion and science together in his life. Another consequence of deploying the diagram into the space of the meeting is that it offers Samuel a means of fashioning a possibility for selfhood that he might not otherwise have had available. As the result of acting with the diagram, Samuel has the possibility of becoming a person who is more comfortable leading a Bible study for people he knows fairly well, something that he mentioned was a source of anxiety for him as he prepared to lead the meetings at the start of the semester. Finally, by sharing the diagram with the Chem E guy, Samuel is able to enjoin someone else in weaving together science and religion into their life. In these ways, Samuel's acting with the 2-bromobu-

tane diagram affords what Gries (2015) refers to as "the ability to reassemble collective existence" (p. 13).

In the next section, I examine the enduring consequences of Samuel's laminated encounters with scientific diagrams on his becoming as a scientist-in-the-making as they are described in the undergraduate honors thesis he wrote throughout his final undergraduate year.

EXPLORING "THE RELATIONSHIP BETWEEN SCIENCE AND FAITH"

To fulfil the capstone requirements for his undergraduate honors program, Samuel was required to write a senior thesis on a topic of his choosing related to his major in microbiology. For his thesis topic, Samuel opted to examine the relationship between science and religion. The initial portions of Samuel's forty-page, multi-chapter thesis explore how historical figures including Galileo and Jonathan Edwards navigated the seeming disjunctures between science and faith, but throughout the latter sections Samuel's discussion offers readers some glimpses into his own experiences navigating this relationship over his college years. In contrast to the dominant cultural narrative that understands science and faith as "mutually exclusive or at the very least thought to operate in vastly different spheres such that one ought not to influence the other," as he described it in his thesis, Samuel stated that by his senior year of college he had come to be entangled in his life to view science and faith as existing in a productive synergy. Articulating his central argument in the abstract of his thesis, Samuel writes, "the relationship between science and faith seems to be a synergistic one: the two enhance one another. As individuals study both the book of nature and the book of scripture, their love of God and enthusiasm for science are both enhanced."

In the opening portion of his thesis, Samuel indicates that he arrived at his conclusion based on his observations that science and faith had come together in a number of ways in his life as an undergraduate. Reflecting on the past four years in his introductory chapter, Samuel writes:

> As I began to grow in my knowledge of God and the Scriptures, I was also growing in my knowledge of biology and chemistry. . . . As I studied science more deeply, He seemed more fascinating, more brilliant, and more beautiful than I'd first realized. This, in turn, made me want to study science even more so that I could see more of the awesomeness of God.

Over the next thirty-nine pages of his thesis, Samuel points to a number of particular instances in which science and faith had come to be entangled in his

life, reaching back to his initial years as an undergraduate. Each of the instances Samuel describes involved his close encounters with inscriptions.

For example, in a passage from his brief concluding chapter, reflecting back over the full arc of his trajectory across the undergraduate curriculum, Samuel wrote,

> As I have studied science, from biology to biochemistry, I have become more fascinated by the God I had come to know through the scriptures. Studying His character and seeing some of His characteristics reflected through the ways in which the elegant molecular systems that allow all of life to function at times overwhelms me with elation. Many times I can barely contain my joy and awestruck wonder as more and more of the power, genius, and creativity of God become apparent through the study of the book of nature. It drives me to love and follow Him more fervently with my heart, mind, and soul, while simultaneously making me more eager to study the science through which these attributes emanate.

Here, Samuel indicates that it was through examining "the elegant molecular systems that allow life to function" made readily visible through the inscriptions he encountered in courses "from biology to biochemistry" that he became "fascinated by the God I had come to know through the scriptures." For Samuel, the "elegant systems" made visible by the inscriptions reflected "the power, genius, and creativity of God." This increased insight into the character of the Creator also motivated Samuel to engage more deeply with "the science through which these attributed emanate."

Latour (1990) notes that the mundane nature of inscriptions means that they often escape attention, but they certainly did not escape Samuel's. His seemingly mundane encounters with inscriptions held some enduring consequences for Samuel's becoming as a scientist-in-the-making. Samuel's thesis, written during his final year as an undergraduate, illuminates how his engagements with scientific diagrams have been consequential to the pace and path of his emerging disciplinary trajectory. For Samuel, multiple encounters with these inscriptions across multiple courses brought science and religion together for him. Based on what he describes throughout his thesis, the interweaving of science and religion is not just something he did initially in his early science courses and that eventually subsided as he progressed through the curriculum, and not something that faded as his knowledge of science deepened. Rather, it increasingly intensified. Over his undergraduate years, Samuel's laminated seeing of diagrams increasingly deepened and enriched not just his knowledge of science, but his enthu-

siasm for knowing more about science. In turn, that enriched view of science also deepened his enthusiasm for knowing more about God's character. To echo Engeström (1993), Samuel's laminated encounters with those mundane inscriptions in his science classes, and in the Bible study meeting as well, were the "buds and shoots" (p. 68) of his becoming as a scientist of faith.

DISCUSSION AND IMPLICATIONS

This tracing of Samuel's history of acting with scientific diagrams across multiple engagements helps illuminate the ways in which people, texts, and artifacts circulate, and, more importantly, are agentively circulated by particular actors throughout the expansive lifeworlds they navigate. As Dippre and Smith (this volume) point out, such circulations can be viewed productively as acts of contextualization, the continually emergent work of making and re-making social worlds. This analysis of Samuel's actings with inscriptions suggests that rather than focusing so intently on fixing textual action within a particular, already-made context, researchers might productively attend to people's acts of contextualization through continually tying, untying, and retying together histories of action in the emergent here and now through the ongoing repurposing of discourses, practices, and identities that have seen use across other thens and theres. In Samuel's case, consider how vitally important the continual weaving together of science and religion has been. In examining futurity in acts of meaning-making, Gries (2015) asserts the importance of addressing "what happens not only to an image but also to the people and other entities an image encounters when they all enter into complex relations" (p. 14). Over the course of this documented narrative, Samuel has shifted from a person who "had trouble trying to see science and God in the same vein" and who had opted to background his faith while pursuing a career in science to a scientist of faith. The lamination of science and faith also continued as Samuel navigated four years of veterinary school. During that time, Samuel led a large weekly Bible study for members of his cohort, and also co-facilitated a smaller Bible study as his schedule allowed. In addition, he was also deeply involved with some of the Christian veterinary organizations on his campus. Samuel graduated from veterinary school in Spring 2018 and has recently started work as a veterinarian in a large city in the same region as his hometown. He has also joined and become an active member of one of the nearby churches, and, as his busy schedule permits, he is hoping to continue his participation with the religiously affiliated veterinary medicine organizations at his alma mater.

In their discussion of the protean nature of context, Dippre and Smith (this volume) point out that addressing how writing can develop across the lifespan as

part of changing contexts, the first principle of a model of writing development articulated in Bazerman et al.'s (2018) *The Lifespan Development of Writing*, demands an approach capable of illuminating "how literate actors move, in their work of producing writing, from one moment to the next, and how they keep the work of context going in the process of that work" (p. 33-34). Attention to the futurity of acts of inscription, to their emergent circulation toward unpredictable futures, can certainly help writing researchers account for and make more fully visible the ways in which what might seem like a series of discrete, autonomous textual moments come to be entangled together across our pasts, presents, and potential futures, to compose a richly literate life.

REFERENCES

Artemeva, N. (2009). Stories of becoming: A study of novice engineers learning genres of their professions. In C. Bazerman, A. Bonini, & D. Figueiredo (Eds.), *Genre in a changing world* (pp. 158-178). The WAC Clearinghouse; Parlor Press. https://wac.colostate.edu/books/perspectives/genre/

Bazerman, C., Applebee, A., Berninger, V., Brandt, D., Graham, S., Jeffrey, J., Matsuda, P., Murphy, S., Rowe, D. W., Schleppegrell, M., & Wilcox, K. (2018). *The lifespan development of writing.* National Council of Teachers of English.

Beaufort, A. (2007). *College writing and beyond.* Utah State University Press.

Carroll, L. A. (2002). *Rehearsing new roles: How college students develop as writers.* Southern Illinois University Press.

Dias, P., Freedman, A., Medway, P., & Paré, A. (1999). *Worlds apart: Acting and writing in academic and workplace contexts.* Lawrence Erlbaum Associates.

Durst, S. (2019). Disciplinarity and literate activity in civil and environmental engineering: A lifeworld perspective. *Written Communication, 36*(4), 471-502.

Chiseri-Strater, E. (1991). *Academic literacies: The public and private discourse of university students.* Heinemann.

Engeström, Y. (1993). Developmental studies of work as a testbench of activity theory: The case of primary care medical practice. In S. Chaiklin & J. Lave (Eds.), *Understanding practice: Perspectives on activity and context* (pp. 64-103). Cambridge University Press.

Geisler, C. (1994). *Academic literacy and the nature of expertise: Reading, writing, and knowing in academic philosophy.* Lawrence Erlbaum Associates.

Gries, L. (2015). *Still life with rhetoric: A new materialist approach to visual rhetoric.* Utah State University Press.

Haas, C. (1994). Learning to read biology: One student's rhetorical development in college. *Written Communication, 11*(1), 43-84.

Johri, A., Roth, W-M., & Olds, B. (2013). The role of representations in engineering practices: Taking a turn toward inscriptions. *Journal of Engineering Education, 102,* 2-19.

Latour, B. (1987). *Science in action: How to follow scientists and engineers through society.* Harvard University Press.

Latour, B. (1990). Drawing things together. In M. Lynch & S. Woolgar (Eds.), *Representation in scientific practice* (pp. 19-68). MIT Press.

Latour, B. (2005). *Reassembling the social*. Oxford University Press.

Lillis, T. (2008). Ethnography as method, methodology, and "deep-theorizing": Closing the gap between text and context in academic writing research. *Written Communication, 25*(3), 353-388.

Medway, P. (2002). Fuzzy genres and community identities: The case of architecture students' sketchbooks. In R. Coe, L. Lingard, & T. Teslenko (Eds.), *The rhetoric and ideology of genre: Strategies for stability and change* (pp. 123-153). Hampton Press.

Miller, P., Hengst, J., & Wang, S. (2003). Ethnographic methods: Applications from developmental cultural psychology. In P. M. Camic, J. E. Rhodes, & L. Yardley (Eds.), *Qualitative research in psychology: Expanding perspectives in methodology and design* (pp. 219-242). American Psychological Association.

Poe, M., Lerner, N., & Craig, J. (2010). *Learning to communicate in science and engineering: Case studies from MIT.* MIT Press.

Prior, P. (1998). *Writing/disciplinarity: A sociohistoric account of literate activity in the academy.* Lawrence Erlbaum Associates.

Prior, P. (2008, February 22–24). *Flat CHAT? Reassembling literate activity* [Paper presentation]. Third International Santa Barbara Conference on Writing Research; Writing Research Across Borders, Santa Barbara, CA, United States.

Prior, P. (2018). How do moments add up to lives: Trajectories of semiotic becoming vs. tales of school learning in four modes. In R. Wysocki & M. P. Sheridan (Eds.), *Making future matters*. Computers and Composition Digital Press/Utah State University Press. http://ccdigitalpress.org/makingfuturematters

Prior, P., & Shipka, J. (2003). Chronotopic lamination: Tracing the contours of literate activity. In C. Bazerman & D. R. Russell (Eds.), *Writing selves, writing societies: Research from activity perspectives* (pp. 180-238). The WAC Clearinghouse; Mind, Culture, and Activity. https://wac.colostate.edu/books/perspectives/selves-societies/

Roozen, K., & Erickson, J. (2017). *Expanding literate landscapes: Persons, practices, and sociohistoric perspectives of disciplinary development*. Computers & Composition Digital Press.

Scollon, R. (2001). *Mediated discourse: The nexus of practice*. Routledge.

Stornaiuolo, A., Smith, A., & Phillips, N. (2017). Developing a transliteracies framework for a connected world. *Journal of Literacy Research, 49,* 68-91.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes.* Ed. M. Cole, V. John-Steiner, S. Scribner, and E. Souberman. Harvard University Press.

Vygotsky, L. S. (1997). *Problems of the theory and history of psychology* (R. van der Veer, Trans.). Plenum.

Wertsch, J. V. (1991). *Voices of the mind: A sociocultural approach to mediated action*. Harvard University Press.

Wertsch, J. V. (1998). *Mind as action.* Oxford University Press.

Winsor, D. (1996). *Writing like an engineer: A rhetorical education.* Lawrence Erlbaum Associates.