The Poetics of Physics in Dance

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As a dance artist who for the past five years has collaborated with a particle physicist, I see several problems in examples of dance-science exchanges that circulate in professional concert dance. The first problem is the excessively literal translation of scientific ideas, which can leave the artistic composition flat and unimagined. In an exchange we shared at Yale last fall (2015), William Kentridge noted the creative wall that literalism can quickly hit, explaining, "You're stuck running around and around your studio in circles to simulate a collider." The second danger exists when an artist is unable to bend her choreographic style to absorb the encounter with science. In this case, the spectacle of the performance overwhelms the scientific point of departure, as Kryptonite overwhelmed Superman. The only remnant of scientific reference lives in the publicity material; the dance looks like any other work by that artist. A third danger lies in representing the scientific object as a cliché: to signify the quantum world, for instance, a production turns to darkness, flashing lights, vaguely extraterrestrial-looking unitards, and trembling. This list is not comprehensive—there are other pitfalls I could mention. It is rather a starting point from which to articulate what a more successful poetics of physics in dance might look like in the twenty-first century.

One major obstacle in identifying the characteristics of a successful dance-science poetics is that different parties wish for different outcomes. On the one hand, scientists often want art to communicate effectively and accurately to a broad audience science's far-reaching questions and human impact. Engaging the public in science is key. On the other hand, dance artists desire points of departure, stimulating discussion, foreign ideas—anything to inspire new work. The publicity, grants, touring gigs, and new audiences that may follow can benefit an artist as well, especially in the scarcely resourced field of dance. Critics in turn simply wish to see good art, whatever that means.

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Aside from these pragmatic concerns, however, a more compelling question is to ask how and to what depth knowledge in one form ends up in another. To what degree of complexity is the scientific idea expressed in the new medium? To what degree has the science infiltrated and altered the artist's practice? How deeply has the dance altered and reimagined the science, showing the viewer something anew? I am less concerned with the ultimate recognizability of the science in the dance than with the potential for good art that exists in this mutual transformation of knowledge. But what does this transformation entail? And what is "good" in the best art that results? I'll first tackle the question of the transformation of knowledge.

A quick Google search turns up numerous mentions of dance-science collaboration that describe the transformational process as "science translated into contemporary dance." *The Oxford English Dictionary* defines *translation* as "the expression or rendering of something in another medium or form." Translation suggests both distance and discreteness. By definition, the word refers to a passage: something moving from here to there, from English to French, from the realm of science to the realm of art. This distance between the two terms implies separate mediums, and thus discrete boundaries: here is not there, English is not French, science is not art.

There are a number of problems with using the idea of translation as a conceit to describe dances that engage with science. Translation carves out a chasm between the disciplines, over which the artist must leap. But as historians of science have been noting for some time, the practices of science and art have more in common than many have assumed, and using the framework of translation doesn't allow for their overlap. Translation also tends to suggest a one-way road—you start here and end up there—without recognizing the back and forth that can occur, or that both disciplines can change. What about the science that translates a dance? Lastly, the concept of translation sets up the expectation that after watching the dance, something about the original scientific point of departure will be legible, and the viewer will be able to express something about the science in words. But some of the best, most subtle, and complex dance-science exchanges press the science into expressive realms so far from words that verbal language must fail.

I propose to replace the word *translation* with *intensification*, a term I am borrowing from historian of science Peter Galison's description of his collaboration with William Kentridge. In creating the exhibition *The Refusal of Time* and multimedia chamber opera *Refuse the Hour*, Galison notes that they wanted neither "science-as-backdrop" nor "art-as-illustration" of science. Instead, what they sought was "an intensification of our encounter with time." Physics and its cultural and political

history—namely, the relationship of physics to human experience—served as inspiration and source material.[1]

Replacing the idea of translation with intensification has certain benefits. For one, we lose the discreteness and apparent dissimilarity of science and art. Instead of the image of ideas moving from here to there, intensification suggests a kind of internal combustion, a process that, again by definition, "augments, strengthens, heightens, and deepens" not only the subject matter, but also both disciplines. Intensification suggests that scientific and artistic disciplines always have the potential to reveal more about their very being, and only the science-art collaboration can further this revelation. Most importantly, intensification evens out power differentials. Dance is not aping science for status, but rather it is blowing it open. In granting that the best dance *intensifies* the science, we gain the proposition that dance has the power to perceive and move with its subjects to such a degree as to reveal scientific ontologies that would otherwise be inaccessible.

With *intensification* as a goal, we have a new way to think about dance-science art. The effectiveness of the intensification hinges on the rigorousness of the artist's practice. When an artist of Kentridge's virtuosity takes up physics, through his assemblages of moving image, text, sound, and dances, choreographed by Dada Masilo, the history of physics looks and feels different. For him, time becomes visible and sensible in the moving bodies and objects, as does the physics. A whole new version of the science appears to be born.

Before I say more about Kentridge's collaboration with Galison and Masilo, some historical perspective is in order; in flurry of recent works, it's easy to forget that examples of strong dance-science exchanges can be found buried in the work of twentieth-century dance pioneers. Most of this work does not intend to be *about* science, include any scientists in the process, or claim to have anything to do with science at all. Yet an intensification of science occurs nonetheless in the complexity through which the artist reimagines scientific phenomena. Science, broadly conceived, is embedded in the poetics of a number of aesthetic innovations in the history of dance.

Trisha Brown's seminal *Man Walking Down the Side of a Building* (1970), for example, profoundly intensifies classical mechanics, especially the force of gravity, by altering the angle at which the human body walks in relation to the earth. An early film of the performance shows a man cautiously tipping over the edge of a building in SoHo. "Standing" on its surface, facing the ground, he begins to stride downward.[2] Walking is defamiliarized, becoming part normal and part strange through the man's hesitancy and wobbling. By reframing this

daily action, Brown calls out gravity and its relationship to the human body in motion. We suddenly *see* gravity and understand our life on this planet anew thanks to her reorientation of the human figure. Much of Brown's later choreography takes up this motif. When she makes visible the forces acting upon the body through off-center actions such as leaning, tipping, and falling, Brown is a roving experimental physicist.

Physics can also show up in the work of older artists by way of reference. This is usually articulated in the artist's writing or in interviews, which signal that scientific concepts have, in some way, informed the artist's thinking. Ironically, Merce Cunningham, the foremost "anti-about" purveyor of movement for movement's sake in the twentieth century, aligned his work with science publicly when he credited a physicist for his pioneering use of space in choreographic composition:

> What really made me begin to think about space and begin to think about ways to use it was Einstein's statement that there are no fixed points in space. Everything in the universe is moving all the time. His statement gave rise to the idea that in choreographing a dance you didn't have to have some sort of central point being more important than any other. You could have something happen at any point on the stage and it would be just as important as something happening somewhere else. Or I could have several groups in the space at the same time. I thought immediately that it's a remarkable way to think about the stage. So I applied it.[3]

Cunningham is referring to one of his most significant contributions to dance aesthetics: in de-emphasizing center stage, using all parts of the stage, and allowing dancers to face any direction, he revolutionized the art form. Based on this account, one might conclude that Cunningham learned about relativity and then applied the ideas to his art. Einstein would then ultimately be responsible for Cunningham's major innovation in twentieth-century concert dance.

In the context of searching for intensified physics in dance, this link feels like a "Eureka!" discovery. But on closer scrutiny, however, the history is messier. The phrase "there are no fixed points in space" is known mainly because Cunningham said it, not Einstein, at least in that form. Other accounts of Cunningham's reinvention of stage space also conflict. His leading dancer, Carolyn Brown, credits his experiments with space-to-chance operations, which began to appear in his choreographic work in the early 1950s.[4] Later, when he encountered Einstein's theory of special relativity, Cunningham may have realized that the idea of decentralized space resonated with the use of stage space that he had already discovered through his choreographic practice. Cunningham himself tells another version of the story elsewhere:

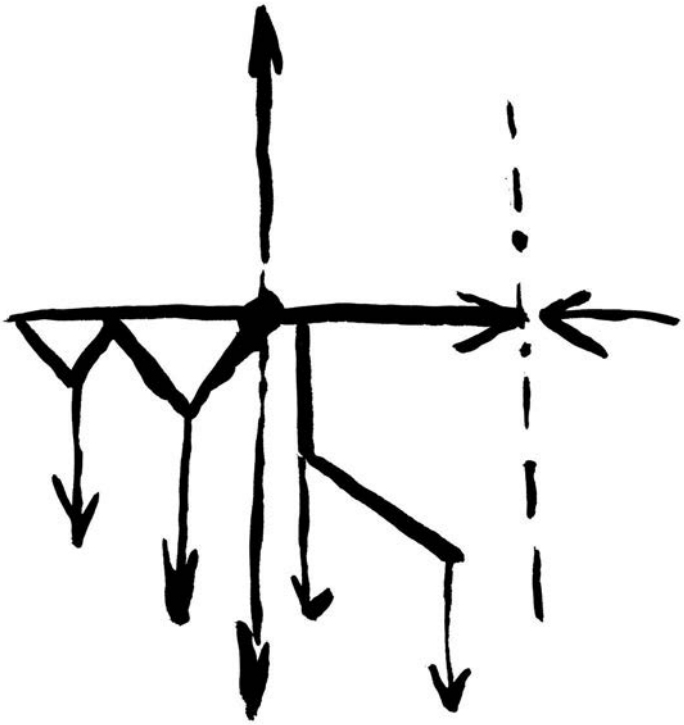
> I used to be told that you see the center of the space as the most important: that was the center of interest. But in many modern paintings this was not the case and the sense of space was different. So I decided to open up the space to consider it equal and any place, occupied or not, just as important as any other. In such a context you don't have to refer to a precise point in space. And when I happened to read that sentence of Albert Einstein's, "There are no fixed points in space," I thought, indeed, if there are no fixed points, then every point is equally interesting and equally changing.[5]

In this account, Cunningham implies a mid-twentieth century zeitgeist in which innovative ideas about space circulated across disciplines. Visual art plays a more influential role in his thinking, and Einstein's ideas offer mainly validation, not original impetus.

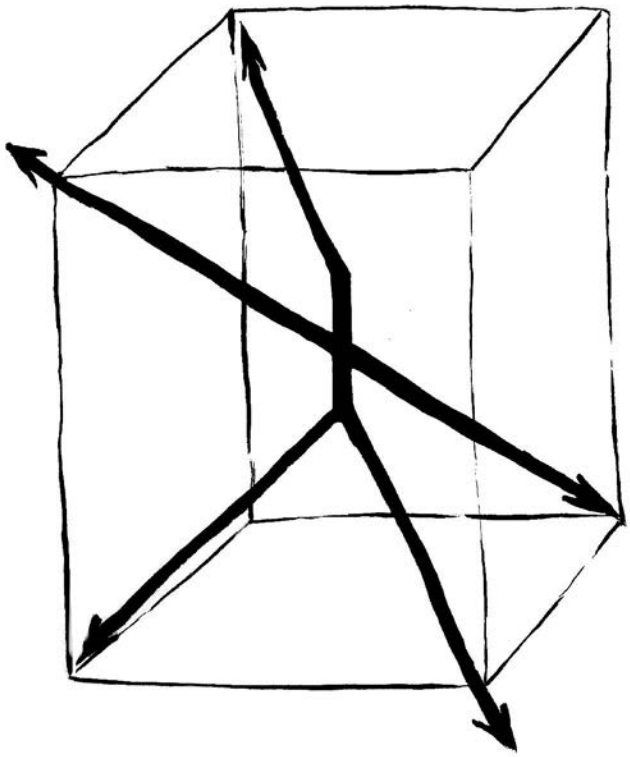
These competing narratives muddy the effort to establish influence. In bringing up Einstein so often, however, Cunningham clearly liked the *idea* of him—that is, Einstein as an iconoclast. Cunningham's comments set up a parallel between his choreographic practice and the paradigm shifts of modern physics that Einstein represents. In doing so, Cunningham implicitly recognizes that the same idea can emerge in different mediums: the physicist working mathematically, the choreographer working compositionally. Here is relativity, articulated in two different forms. In *Suite for Five* (1953–58)—to give a concrete example—created early on in Cunningham's play with chance operations, the placement and actions of the dancers throws focus around the stage like a pop-up game. Solos, duets, trios, or quartets emerge unexpectedly, forge forceful connections, and then disappear. As centralized, universalized stage focus is challenged, the spectator is invited to choose her perspective, and the gist of relativity becomes sensible through dance.

In return for the science providing a framework through which to articulate his artistic philosophy, Cunningham shows something back to the science—a poetics, if you will. I am thinking of Laurence Louppe's definition of poetics as the "ensemble of creative conducts that give birth, meaning, and sensuous existence to a work."[6] I understand Louppe's "creative conducts" to mean the set of actions that constitute an artist's process. When a dance artist refers to physics, the scientific concept instigates the creative action. In the process, dance intensifies the physics, making it able to be perceived, felt, and imagined through an alternative way of knowing. This is one of Cunningham's great, under recognized gifts to the world.

Of course, Cunningham did not set out to redefine modern physics; his ideas came first through his physical practice. This is also the case with German artist



Top: *Refuse the Hour*, multimedia chamber opera, conception and libretto by William Kentridge. Left to right Kentridge, Ann Masina, Joanna Dudley, and Dada Masilo in video. Photo: Stephanie Berger. Bottom: *Man Walking Down the Side of a Building*. Drawing by Eric Jiaju Lee © 2017.



Top: *Suite For Five* studio rehearsal with Merce Cunningham, Carolyn Brown, and John Cage at the piano. Photo: James Klosty. Bottom: Laban's Kinesphere. Drawing by Eric Jiaju Lee © 2017.

Rudolf Laban who, two decades before Cunningham, drew on ideas from science and geometry in crafting his theory of movement and dance notation. Laban's movement analyses originated out of his practices of dancing, choreographing, and teaching dance, as well as his knowledge of geometry, mathematics, physics, and human anatomy. While he attempted to bring dance and science closer together, he also championed dance's unique methods and conclusions. The dancer is so precisely tuned to the universe, according to Laban, that the artist is "even capable of communicating these laws to us more intensely than can happen in science."[7] That intensity, or intensification, has to do with the expression of the ideas in motion: scientific laws made hyper-perceptible.

Laban refers to physics throughout his writings. A physics concept, center of gravity, lies at the heart of his spatial design in his explanation of his concept of "kinesphere," a geometric organization of space that encircles the human body. Picture a cube, emanating outward from the pelvic region according to length, breadth, and depth. Each dimension runs in two directions: up and down, left and right, or forward and backward, with diagonal lines crisscrossing. Lines drawn connecting the points of the cube converge in the body's center of gravity. The vectors of the kinesphere link man to the universe. He writes: "Innumerable directions emanate from the centre of our body and its kinesphere into infinite space"[8] His kinesphere is both intimate—occurring in the space immediately around the human body—and infinite in its connection to the universe. For Laban, not only our coordinates but also the human body's range of motion within the kinesphere link directly to the motion of the planets. "Our body," he explains, "is the mirror through which we become aware of ever-circling motions in the universe with their polygonal rhythms."[9] An individual's dance taps into the beating, roundabout rhythms of the cosmos.

Whereas Laban's intensification of physics signifies grand scales, Steve Paxton uses physics in a much more intimate way. In the early 1970s, at Oberlin College, Paxton, a former member of Merce Cunningham's company, turned modern dance's play with gravity into a social structure when he and a group of performers developed the dance form Contact Improvisation. In Contact, dancers explore gravity and other principles of classical mechanics through dancer-to-dancer interactions, in contrast to the solo action implied by the kinesphere. In a short transcript that Paxton wrote for a video retrospective of Contact, later published in *Contact Quarterly*, he aligns his movement discoveries with advancements in physics:

> When an apple fell on his head, Isaac Newton was inspired to describe his three laws of motion.

> These became the foundation of our ideas about physics. Being essentially objective, Newton ignored what it feels like to be the apple.
>
> When we get our mass in motion, we rise above the constant call of gravity toward the swinging, circling invitation of centrifugal force.
>
> Dancers ride and play with these forces.[10]

The story that Newton had a breakthrough realization after an apple hit his head, spawning his Laws of Motion, has been passed on over the centuries like a game of telephone. The unreliability of this historical anecdote, however, matters less than the work that Newton and physics do in Paxton's practice. In noting that Newton ignores "what it feels like to be the apple," Paxton critiques detached observation over experience. Dance fills in the gaps where Newton's imagination leaves off. Through learning how to fall, swing, ride, and leap into interactions with each other, the dancers appear to escape gravity's downward pull. Setting aside for a moment questions about the apple's worldview—do apples have nervous systems?—Paxton's dance inspires the ultimate empathy not only with other people but also with objects. While this perspective is on a markedly more intimate scale than the planetary reach of Laban's movement analysis or the modern physics-like decentralization of space in Cunningham's aesthetic, the vision of dance filling in understanding where the science stops short is the same.

In keeping with the 1960s democratic ethos in which he had emerged as an artist, Paxton wanted to create a more democratic, socially rooted means of crafting dance. The dancers who worked on Contact Improvisation early on undertook their research in social environments, often living together communally. As Contact Improvisation continued to evolve, Paxton fought against interpretive approaches to the form that brought in a kind of pseudo-spiritualism in favor of ones that remained close to the physical sensation of natural forces.[11] The research into natural forces and the aesthetics of sociality were thus interrelated. Near the conclusion of his short essay, Paxton frames this social dimension of Contact Improvisation according to physics:

> It seems that what has emerged is two bodies acting as one within the domain of the physical forces. Newton proposed ideas about the forces and their interaction. In addition, Contact deals with ideas or images which are sensations first, then felt by the mind.[12]

The "two bodies acting as one" are at once social and scientific. Once again, here is an understanding of natural forces through different mediums: Contact Improvisation through sensation, Newton through quantification. Paxton's physics lends to Contact Improvisation concrete elements: a disciplined structure, a

research focus, and a method of relating to others. In his alluring poetics, physics is social, and sociality is expressed through physics.

Magnesium, the seminal dance created by Paxton in 1972 that is widely credited as the origin of Contact Improvisation, carries these ideas in the flesh. In a video of the performance, a group of sweaty, relaxed dancers with reedy muscles whip each other around, slide off each other's backs, and collapse onto other performers nearby. Their bodies in interaction make the basic idea of physics-on-earth not only acutely visible but also emotional. A dancer never dances alone for long. The community manufactures gravity, friction, angular momentum, kinetic energy, and torque together, as if these forces were entirely human-made. At the end of the dance, the dancers stand still for five minutes, scattered around the space. This gesture balances the energetic flurry of the first section with calmness and isolation, revealing the choreographic mind behind an otherwise largely improvised dance. The dancers' upright stillness highlights the preceding swinging, energetic, "spherical space" of the dance, as Paxton has described Contact Improvisation. In setting up these dynamic contrasts, Paxton's composition intensifies the viewer's experience of the laws of physics by making those laws sensible.

The artists I have touched on have shattered paradigms in the history of dance. Most noteworthy about each of my examples so far is the artist's ability to skirt excessively literal translations of scientific concepts through sophisticated compositional thinking. Their compositions, in turn, alter the way the physics is perceived. I was thinking of Brown, Cunningham, Laban, and Paxton's physics when I saw *Refuse the Hour* at the University Theatre in New Haven, CT, in the fall of 2015. Kentridge appears in the performance delivering episodic, poetic meditations on time, fate, and the laws of the universe. Every now and then, he joins in a dance. A team of collaborators developed the production, including composer Philip Miller, video designer Catherine Meyburgh, and dancer-choreographer Dada Masilo—a rising figure in the international contemporary dance world from the Johannesburg township of Soweto.

Refuse the Hour swallows the science whole, transforming concepts such as entropy, relativity, collisions, black holes, and time into prolific imagery, which has a non-clichéd freshness that one might imagine characterizes scientific discovery. The images are signature Kentridge. In the production's most effective moments, his assemblages reorder perception: the physics changes, and the viewer is made to feel that change as a by-product of his handmade art. Contradictorily, the images that alter the physics on Earth are the most sensorial and human. Pieces of paper delicately ascend into the air; thrown books are deftly restored to their starting place; a dancer transmogrifies into a coffee pot. These unfolding images

gave me a peculiar, vertiginous feeling, a sensation that my everyday experience with natural forces cannot conjure.

Galison's description of the production noted earlier as "an intensification of our encounter with time" uncannily echoes Laban's vision of dance as capable of intensifying scientific principles. *Refuse the Hour* accomplishes this intensification by not remaining beholden to dutiful, linear explanations of science. Instead, the science becomes fuel for the artists' compositional imaginations. The content of the piece is more or less overtly inspired by the history of science, while also veering off into lush collages of image, music, and dance. Conventional theatrical direction holds everything together in the form of changes in tone, rhythm, and environment, which should not be seen as a critique but as an appreciation of an essential element in the work's cohesiveness.

Strong theatrical tactics are required in order to represent so many different temporalities, between the live bodies, films and animation, sculpture, and live music. One such section is titled "Here I Am," in which Kentridge ponders the concept of entropy. He writes the very process of forging associations between his studio and the science into his script. He explains, "The studio becomes a head. The steps in the studio, the ideas in the head, trying to connect." As he speaks, a film loops on the back scrim, apparently situated in his home studio. In one scene, Kentridge walks and Masilo follows. Both carry books on their head. He appears to toss her a book that she catches, her arm bearing backward from the momentum, before returning it to her head. But the physics are not quite right. How could she catch the book, remaining so upright and stable, with little effort showing in her body? It appears the film has been run backward, a retrograde that makes the viewer focus intensely on the reversal of an action and the odd physics that result. The film repeats this weird reversal over and over again, giving the viewer many times to observe the action through repetition.

These repetitions become a new mechanics, and what results is not that we intellectually process entropy but that we are made to feel its opposite, a return to order. Over and over, the books restore to the top of the dancer's head. The universe is for that moment set in retrograde, continuously moving from disorder to order. On top of this manipulation, the black-and-white film makes the actions appear quicker than in real life, as if in a silent film. The allusion to an older technology adds to the poetics of the vignette. You feel that it's not quite the way events actually happen. Having existed in one form, as a definition and a formula central to thermodynamics, the idea of entropy finds a new, more perceptible resonance through Kentridge's art. While he is not known as a dance artist, the choreographic qualities of his imagination, operating across mediums, intensifies these physics.

What does the actual *dance* do in this extended meditation on scientific time, the history of physics, and fate? Based on her omnipresence in his images, Kentridge is clearly captivated by the dancer Dada Masilo. She is a muse for the twenty-first century, which is to say, she is also a creative collaborator. Her choreographic compositions help to multiply time. While her choreography supports the layered vignettes of the chamber opera, however, it's her presence that matters most of all. Masilo's economy of movement plays a vital role in making the odd mechanics not only visible but also politicized. When she is carrying the books on her head in the film, she signals a common carrying method in certain African cultures, particularly for women. Kentridge carries books on his head, too, which makes for a notable substitution: the white man places himself in the representational shoes of another race and gender. Nothing about Masilo's physical presence suggests conformity to social imperatives, however. She bristles with energy and wherewithal, in contrast to Kentridge, who paces through his ideas and the studio, metaphorically and literally, in a more lumbering gait.

Masilo's energy is central to other key images in the production. Near the end of the performance, Kentridge meditates on black holes, an anti-entropy. Titled "The Full Stop Swallows the Sentence," the vignette depicts a world in which all things—events, objects, songs, images, dances—that have just transpired and those that have yet to transpire end up dismantled and absorbed into the black hole. Objects are no longer themselves; their very being unravels. The event is "unsaved"; it "unhappens." All things are, Kentridge explains, transformed into strings that are "cat's cradles of information, vibrating at the edge of the event horizon." The images that follow on the stage depict a dark march of humanity, which is frenetic and bleakly hopeless at once, a funereal march of laborers descending into Hades. In the projected film, small bits of black paper blow in suspiciously non-gravity-bound directions. Into this undoing dances Masilo, turning elegantly, right arm raised, scattering the pieces of paper in the film as it loops. She seems to be responsible for the disintegration of the image. The projection cross-fades into the march and darkens gradually until the stage becomes entirely black.

This is a stage picture of black holes, a phenomenon that no human being will likely ever experience and live to create art about. It is also Kentridge's most literal of interpretations: the blackening out of the scrim evokes the lightless suck of the black hole. Everything that he has referred to during the performance disappears: thoughts, stories, and human lives are on an even plane with "a suitcase of teeth and glasses" and an "old stone discus." All depart into the event horizon. What else to do when faced with existential oblivion but literalize the picture? Make the viewer feel a metaphoric wipe out and rebirth. Kentridge's images show us the poetics of black holes, if not their perceptible reality.

The Kentridge-Galison collaboration differs from the other dance-science examples I have mentioned in its sheer multitude of representational possibilities and expressive mediums. In particular, the technology of Kentridge's moving images has the potential to alter the laws of physics altogether. In contrast, Paxton's whirling, weight-sharing dancers of the 1970s seem hopelessly earthbound and, as a result, perhaps even more heroic. Kentridge's imagery is also, in some ways, less ambiguous. His drawings and the sculptural objects in the space can allude to historical time and place in a way that abstract dance mostly cannot. For better or for worse, dance can be difficult to read. And Galison is a historian of science, and not foremost a scientist, which means the human dimensions of the science in *Refuse the Hour* did not have to be pulled forth by the artist. As a humanist, Galison brought this sensibility to the table from the get-go.

Despite these differences, Galison and Kentridge's idea of intensification has something to offer the field of dance-science exchange, as a guide for practical creation. Translating science invites skimming the surface of a science for choreographic structures or danceable images. Intensification, in contrast, asks more of an artist. It demands she have a kind of X-ray lens into the poetic nature of the science and that she use her full range of compositional tools to probe the scientific ideas. In my collaborative work with particle physicist Sarah Demers, aiming for the intensification of our disciplines has been most valuable to me. I knew from the outset that I didn't want to make interpretive dances about science. Instead, we have worked in different mediums: lectures, writing, video, visual illustration, and performance. In each medium, we try to craft collages that pressure the physics and the dance into new forms. Some of our juxtapositions are purely fanciful, such as imagining director Robert Wilson, with his love of durational presence, auditioning a muon, a particle whose lifespan is a mere ten to the minus six seconds. ("Stay put, Muon!" he commands futilely over the god mic.) Others are more pointed: in our science-art video, *Three Views of the Higgs and Dance* (2013), we bring to light the gestures with which physicists imagine the Higgs boson particle. In *Incarnations* (the performance I am currently creating), Demers "physics-casts" by rapidly calling out every physics principle she can spot in my performance of Jacques D'Amboise dancing the male solo in Balanchine's *Apollo*. No matter what medium we are working in, we try to create juxtapositions that reveal our respective disciplines in new lights. Both disciplines (and collaborators) must be open to transformation.

Ultimately, a process of intensification means contextualizing knowledge that might otherwise appear to float above lived reality, an effect that Donna Haraway has called science's "god trick" of "seeing everything from nowhere."[13] *Refuse the Hour* exemplifies the tactic of situating science in context. Created in the

twenty-first century, the performance comes into being in a very different world than the worlds of Laban, Cunningham, Paxton, and Brown. Fear of social and planetary annihilation pervades this historical moment. South African colonialist history and apartheid haunt the performance. Kentridge's representation of a black hole-as-March-to-Hades feels like deep grief for the irreconcilable nature of racial politics, if not for all life on Earth. The scene would conclude the performance in utter despair, but for the final projected silent film of a man in an inflated suit, dancing ridiculously to an unheard beat, with Masilo prodding him on. *Refuse the Hour* ends on an awkward upswing.

I began this essay by asking how knowledge in one form ends up in another and by querying what is "good" in the best art that results. In each of my examples, knowledge is intensified and transformed through a "bodying forth" of the science through art, to use a phrase coined by poet MC Richards.[14] The art gives bodily form to the physics through tactile encounters: Laban's kinesphere touches the planets; Brown's performer treads down a reconfigured horizon line; Kentridge and Masilo lob flying books in reverse. In the best dance-science exchanges, the sensuous fusion of content and form can be so complete that it can be difficult to say whether the encounter with science gives birth to the artist's forms or the artistic forms give birth to a new version of the science.

There is another kind of intensification going on here that has to do with the conversation between the scientific ideas and an implicit (or sometimes very explicit) politics in the art. Cunningham's relativistic, decentralized use of stage space, for instance, topples spatial hierarchies, a subliminal call for a more democratic ethos. In contact improvisation, Steve Paxton draws a parallel between dancing with the forces of nature and the sociality of dancing with others. In *Refuse the Hour*, Kentridge and Galison tell a story of modern physics by highlighting onstage the colonized subject, women, non-Western societies, those whose perspectives have been historically left out of the knowledge-making machine. Drill far enough down into the existential natures of science and dance and you inevitably hit the political implications of all knowledge. When scientific knowledge assumes *bodily* form—unlike, say, using a scientific concept to inspire a musical score or visual design—the unavoidably human source of science becomes poignantly clear.

Physicists can explain four percent of the universe. Ninety-six percent remains unknown. That human beings, working within our limited form, have figured out even 4% is mind-boggling. Dance artists of the twenty-first century can do good work returning that knowledge to human form—casting, in essence, who gets to play god.

NOTES

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12. Paxton, 39.

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