Article

Stimulacrum: virtual perception and real desires

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Abstract From metaphor to changes of scale, from anamorphosis to assemblage, the '*stimulacrum*' – that space that stimulates through simulation – expands human perception. We explore three entities: the Staffordshire Hoard, which lay hidden for hundreds of years to be reconstituted as a collection; Holbein's *Ambassadors*, filled with objects that project human perception into the stars and across the ocean to the so-called New World; and proteins, whose folding occurs faster and in greater multiplicity than any recording device of human manufacture could capture. All three twist and fold and writhe in the *stimulacrum*.

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Welcome to the *stimulacrum*, the domain of thought in which models of perception represent to us what we cannot perceive. There is pleasure here: the joy of seeing the unseeable, perceiving the imperceptible, observing what slips beneath the realm of the visible. And there is fear: the model is both our access and our limit, a passageway to another realm and a boundary to it, a mercy to and a mockery of human perception. The *stimulacrum* is a crowded nonplace: it is filled with ideas and prototypes and replicas and mockups – it houses a hoard. This is a hoard that shifts our perception beyond human empiricism into scientific simulation, and that oscillates within the possibilities created by computation and aesthetics. We propose to take three perceptual models from

Figure 1: *The French Ambassadors*. Hans Holbein, 1533. Oil on oak; 207 cm × 209.5 cm (81 in × 82.5 in). National Gallery: London.
Photo: © National Gallery, London/Art Resource, NY.

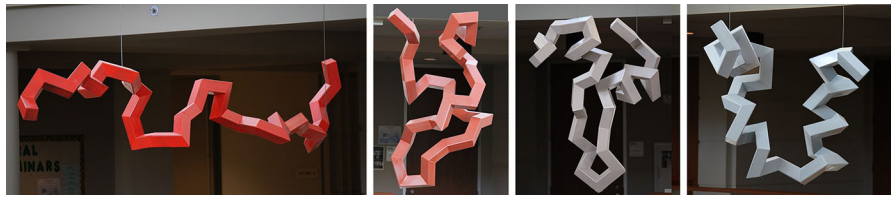

Figure 2: *Villin Headpiece Folding*. Julian Voss-Andreae, 2011. Steel, aircraft cable, paint; longest object length 11' (3.30 m). DePauw University: Greencastle, Indiana.
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the *stimulacrum* – the Staffordshire Hoard, Holbein's *Ambassadors* (Figure 1), and the folding of a protein molecule (Figure 2) – and put them into interaction with each other. Each plays around the boundaries of the visible, each offers a view of what would otherwise remain unseen.

Hoard, painting, and protein emerged in exploratory conversations between us (a biochemist and an art historian) as entities that present ways of seeing what we cannot perceive: the Hoard speaks to its hidden past; Holbein's *Ambassadors* projects death; and the folding of proteins defy capture in time. All three jumble within the *stimulacrum*, shifting in time, space, and scale. They bump into each other, and hook up on the pleasure and fear of display, on measurement and melancholy, and on matter and metaphor. Everyone's experience contains a

Figure 3: Inscribed band [K0550]. Staffordshire Hoard, 7th–8th century. Silver gilt; 89.5 × 15.8 × 2.1 mm. Birmingham Museum and Art Gallery.
Photo: Portable Antiquities Scheme, licensed under CC BY-NC 2.0 https://creativecommons.org/licenses/by-nc/2.0/) For another view of K0550, see Figure 4, Mittman and MacCormack, in this volume.

stimulacrum filled with things that can collide to reveal both the limits of our perception and how we defy those limits.

The Staffordshire Hoard lets us see the intersection of treasure and terror. Twisted bands of precious metal, empty fixtures of wrenched gems, elegant zoomorphic elongations crushed and strained. Was it after the battle, once the torcs and crosses had been ripped from pleading fingers and dead bodies, that the chattel was stashed and buried in the smoking fields of Hammerwich? Or perhaps the sword hilts and pieces of face armor were accumulated over time – quietly, methodically, in victory – to become a monument, buried in the name of a plunderer. 3,500 objects; five kilos of gold, almost one and a half kilos of silver. We will keep asking how the Hoard came to be buried and blunted, thinking through the specific object of the band twice inscribed with a Biblical quotation (Figure 3), which is now folded, conjuring up for us the folding of a protein.

If a *stimulacrum* is a space of stimulation and simulation for human perception, the anamorphic skull of Holbein's *Ambassadors* is an apt place to begin our discussion of perceiving the imperceptible. The strange, pale slash in the bottom quarter of the painting can be corrected to reveal a skull when the viewer is positioned in parallel with the visual field (as opposed to our usual perpendicular position). If you approach the painting from the side, so that your body and, importantly, your eyes are in parallel with it, then the slash corrects to the shape of a skull. Your ideal position is close to the painting, with your head above the skull, and one eye closed. For a painting nearly seven feet square, and which hung in private domiciles for most of its existence, these requirements surely made for interesting viewing conditions. (Today, you can replicate those conditions by looking at any printout of the painting.)

Holbein's *Ambassadors* has become the darling of medievalists studying troubadours and courtly love under Lacan's tutelage precisely because of this skull, stretching luxuriously at the men's feet. In considering 'Courtly Love as Anamorphosis' in *The Ethics of Psychoanalysis*, Lacan corrects himself from a previous lecture in which he'd placed *The Ambassadors* at the Louvre. The painting is, in fact, housed in the National Gallery in London (Lacan, 1992, 135). But Lacan loves his mistake and sees the disorienting work of anamorphosis at play in the displacement. The distortion of the anamorphosis becomes a performance of our twisted psyche as we insistently crave, barely perceive, and ultimately always lose (sight of) the Thing. Here, of all the things it could be, the Thing could be death: the uncanny juxtaposition of the lush robes of ambassadors Jean de Dinteville and Georges de Selve, the warm wood of their scientific instruments, and the fascination of a slouching death's head slip eternally from our perception. We want to enjoy the hoard of objects arranged upon the table, the host of computations that the objects promise and contain, but can we ever fully? The *stimulacrum* revels in the anamorphic view; it shifts scale and sensation with analogy: it initiates, through thrill and realization, a perception initially limited, amplified by the desire to see. Numbers dance through analogy here; molecular time slips through the distortions of anamorphosis.

The Staffordshire Hoard and *The Ambassadors* extrapolate our limited perception into other worlds. So, too, do the in silico experiments of computational biology that bring the unfathomable into focus through the lens of mathematics. Proteins exist, in each of us, in hordes of unimaginable magnitude, far surpassing the number of stars in a billion galaxies.[1] They are the machinery of life, and for over half a century we have understood that the designs for these machines are encoded in the tangled, twisting strands of our DNA. We can read the language of DNA – spell out the ingredients of each molecular machine – and yet we know surprisingly little about the machines themselves. How, for example, do these proteins fold up to become functional? It is a question central to our understanding of health and disease, one that can only be answered through experiment and observation. The movements inherent in the 'folding' of proteins, however, are mostly too fast to observe, the rules governing their behavior too complex to codify completely (at least as of now). At this molecular level, it's not just space we have to scale but time as well. Our vision clouds where our instruments fail. So we guess. We take what we know, what we can 'see' – instructions revealed by genetic sequencing, a shape revealed by a blast of X-rays. We apply Newton's laws of motion (proteins are just barely big enough for us to avoid the weirdness of quantum mechanics), and we peek at the space *between* the 'pictures' derived from direct experimentation.

1 This and other estimates of cellular and molecular quantities and are derived from Milo, R., et al. (2010) http://bionumbers.hms.harvard.edu/.

Display: Pleasure and Fear

'Display' is the process of making something visible. Its etymology is vigorous, physical: found in Middle English to mean 'unfurl,' and linked to the Medieval French 'deployer' which in turn becomes to 'deploy' in modern English. The *stimulacrum* deploys the content it renders visible. It presses entities forward, pushing through the fear of being unable to see something, into the pleasure of the readily visualized. Susan Stewart's notion of the collection, articulated in *On Longing*, is helpful here: 'The collection is a form of art as play, a form involving the reframing of objects within a world of attention and manipulation of context' (Stewart, 1993, 151).

The Staffordshire Hoard did not long remain a gnarled mass once it had been discovered; Holbein paints just enough of the *Ambassadors'* instruments that you can read their measurements; the meanings of a molecular simulation are tangled in a mass of raw data. There are two phenomena to consider: the impulse to display, or to put on display; and the effect of display, of the unfurled object stilled for viewing and collection. Display-as-an-unfurling is a countermeasure to the fear of furled things: of hidden hoards, meaningless measurements, and infinitesimal origami. We unfold, unfurl, and disclose – acts of manipulation and perception. But the display, all that unfurling, has an effect on us as well: a stimulation of our sense of sight, a simulation of our sense of order. Part of the work of this essay is to see the movement in display, to capture the play before display.

It is crucial to the Hoard's play on our imagination that it was hidden for hundreds of years. Its invisibility, its buried state, its status as almost-lost to our vision, makes it a treasure. Its inaccessibility to human experience for all that time, so deep in that place, is part of its wonder. If we think of the farmers and soldiers who trod above it for hundreds of years, unknowing of its existence, we exist in a radical break with the entire stretch of time between ourselves and the moment of the Hoard's burial. It is something (haunting?) to think of the dirt loosened or compacted by footsteps a mere foot above the Hoard's gold, to think of existence and unknowing, to think of the plowing of hundreds of years slowly scattering the Hoard over a 30 by 43 foot area (Leahy and Bland, 2009, 6). We now have the Hoard in common with the Anglo-Saxon(s) who buried it. We see a version of what he/she/they saw.

One response has been to put the Hoard on display, and to deploy an extensive visibility. The visualization of the Hoard tends towards isolated close-ups, panoramic views of the large parts of the Hoard meticulously aligned in careful rows, and, increasingly, items of the Hoard being viewed through scientific equipment. Hoard, painting, and protein share the visualization space of instrumentation – a key component of the *stimulacrum* and of the modern urge to display, to deploy visualization. Embedded in this visualization is a

history of display. The Hoard's history begins on bodies and books, swords and helmets. These early days of brilliance and splendor were those of the Hoard before its coming-into-being, when all of its parts glinted separately. In thinking of the connections between the Hoard, *The Ambassadors*, and a dynamic molecule, moments like these – in which parts of a whole that are yet to come together can be apprehended – are crucial. What is the Hoard before it is the Hoard? And *The Ambassadors*? And a folded protein? Disparate parts gleaming separately – a helmet cheek piece, an artist and two sitters, a string of amino acids. Let's go further: alloyed gold, a Baltic-Polish oak panel, a chemical bond. Further still? Intergalactic dust, crushed vermillion, subatomic particles. In its most breathless moments, the *stimulacrum* is an ever-expanding universe of parts that eternally recede from each other – and are brought back together in the rush of our desire to see.

This is what we know of *The Ambassadors*. That the year of its making was 1533, that it was spring, that it was England, and that it was cold. That Jean de Dinteville, a French ambassador to Henry VIII's court, commissioned the painting, and that work on it was begun during the visit of de Dinteville's 'intimate friend' ['intime amy'], Georges de Selve, a bishop and himself sometimes ambassador to the papal court in Rome; that after de Selve's departure, de Dinteville described himself in a letter to his brother as 'the most melancholy, weary, and wearisome of ambassadors' ['le plus mélancholique, fasché et fascheux ambassadeur'] (Hervey, 1900, 20 and 80).[2] That de Dinteville commissioned the artist Hans Holbein to paint the picture during an embassy prompted by the divorce of Henry VIII from Catherine of Aragon, and subsequent marriage to Anne Boleyn, an embassy prolonged by the announcement of the new queen's pregnancy. That the slashing shape in the bottom of the painting corrects to a perceptible image of a skull if you look at it from a disorienting point of view.

2 Kenaan asks after the very idea of a double portrait of two men and, in looking to the language of de Dinteville's letters, states, 'I find it reasonable to think of Dinteville and de Selve as sharing a "forbidden" intimacy' (Kenaan, 2002, 71).

And so scholars have plotted and calculated and charted and corresponded with the painting. Jurgis Baltrušaitis works out the measurements of the shifts in scale and perspective provoked by the pull of the anamorphic perspective (Baltrušaitis, 1977, 91–114); Elly Dekker and Kristen Lippincott calculate the precise places and times projected by the terrestrial and celestial globes, the pillar dial, the universal equinoctial dial, the horary quadrant, the polyhedral dial, and the torquetum (Dekker and Lippincott, 1999); the restoration team of the National Gallery, led by Martin Wyld, cites the specific edition of the Lutheran hymnal open on the bottom ledge, as well as the page that the *Merchants' Arithmetic* book is open to (Foister et al. 1997, 40–41). *The Ambassadors* presents a hoard of knowledge, and gathers a horde of knowers. Would we be as curious without the skull? The anamorphic skull is both the pleasure and the fear of the painting – the delight in seeing what was imperceptible, the fear at realizing what it is.

The etymological gap between 'deploy' and 'display' is the phenomenological gap of a protein. Proteins deploy their crucial actions (in a bewildering multiplicity of manifestations that result in our survival) on a scale and with a rapidity that makes display a phenomenal challenge. These molecules are tiny and frenetic, measured in the billionth of a meter, twitching and tumbling millions of times per second. A single human cell holds billions of proteins, and each of us has trillions of cells. Trillions of cells, each containing billions of proteins, exuberantly throw open the doors of the *stimulacrum*. Computing this deployment is one thing; understanding it is another; intervening in it yet a third.

Biochemists revel in the laws of physics, which allow them to model and predict the actions of proteins. The laws allow for a simulation of the molecular machinery, the swirls and eddies of associations, the attractions and repulsions of matter, Empedocles's Love and Strife (Inwood, 2001, 109–48). Molecular dynamics simulations intertwine with the Second Law of Thermodynamics' assertion that any favorable process tends towards a universal increase in disorder. *How* it tends, the path of that tendency, is where things get interesting – where universes get created, life emerges, and multiplicities ensue. It is where the concerted effort of living takes place. Although chaos is the inevitable end of all order, things don't head straight for chaos. If a universe, a life, or a protein is a ball, the simplest way to understand its move from order to chaos is to drop it in a straight line. But that's not right at all – the better metaphor is a ball in a Rube Goldberg machine, taking multiple twists and turns on its way to the inevitable: a planet here, brown hair there, a particular bond everywhere.[3]

The laws of physics simultaneously assert that we all die, that the concerted effort of our living will end (that the trillions of cells in our bodies stop operating in concert, as proteins degrade and the molecular machinery wears down), that indeed death is dis-concerting, *and* that the concerted effort of our living is wondrous beyond measure or explanation. Not that that will stop us from trying to see and know. Biochemists are haunted (or motivated) by the reality that the molecules that make life possible, indeed the molecules that are the literal matter of life, are unseeable, unfathomable, and forever outside our perception. There is always a buried part, a death's head stretched anamorphically across the surface of representation.

So how to put all this on display? How to see without direct observation? Julian Voss-Andreae is a coordinator of collaborative scientific and artistic frameworks. He joined biochemistry students with sculpture students to create the *Villin Project* at DePauw University (Voss-Andreae, 2000). The project seized on four data-rich snapshots from a simulation of the ultrafast folding protein villin and translated them into four 80 lb. steel sculptures (Gurnon et al. 2013). Today, 320 lbs. of steel remain suspended in the Julian Science and Mathematics Center; the folding of a protein in seven millionths of a second is stilled for display in a medium that will take eons to succumb to the inevitable chaos and degradation of the Second Law of Thermodynamics. In

3 Rube Goldberg, an American cartoonist and engineer, delighted in making contraptions in which the path from point A to point B was as complex as possible.

the *stimulacrum*, display is a concerted effort to manipulate time and safeguard our seeking to know.

The Measurement and Melancholy of Human Perception

Measurement might seem a poignant exploit in the face of the unknowns of the Hoard, the anamorphic skull of *The Ambassadors*, and the folding of a protein. Poignancy trumps futility, though, and we have hoards of measurements to think through. The objects of the Hoard seem more physical in being twisted and bent, less decorative, and more engaged in history; they are measured and weighed and themselves are a measure of their time. *The Ambassadors* is filled with measurements that contradict each other and are further undone by the anamorphic skull. Attempting to measure the temporal scale of proteins in fempto- and picoseconds is the most dizzying activity of the *stimulacrum*. These measurements are made of 'numbers so unapproachable that someone had to invent idiot names to represent the arrays of ones and zeros and powers and dominations because only the bedtime language of childhood can save us from awe and shame' (DeLillo, 2011, 103).

The weight of objects from the Hoard is catalogued 'before treatment,' which means that the weight of the soil which clung to them even after being unearthed was part of their measurement in the museum's lab: history measured not in time but in supplementary weight. Item K0550, the 'Band with Biblical Inscription' (Figure 3), weighed 80 grams before treatment.[4] It folds back upon itself, its silver gilt darkened by silver niello to mark the letters of the inscription on what is presumed to have been its external face.[5] We are drawn to the band by its words, but we – us, *specifically* – realize that we were probably also drawn to it for its folding, for its ability to visualize the discussions we'd been having about the folding of a protein. It is not a replica of the protein's folding process, but a resonance – a moment of ideas 'bumping into' each other, a moment of making connections.

This doubling out of inscriptions is a measure taken for mastery. For the words are powerful and would have emboldened the master of the object this band girded. The words are those of Numbers 10:35: 'Rise up, Lord, and may your enemies be scattered and may those who hate you be driven from your face.' They come from a passage in which the Israelites are on the move, gathering forces under the leadership of Moses. God tells Moses to hammer out two silver trumpets and sound the call – and one thinks of those reverberations reaching the silver gilt band, assimilating material to mission. We can only guess whether it was sword or plowshare that pried the band from its object, that excised the garnet, and bent the band back on itself as the limit of every mastery involved: ours certainly, that of the original owners, that of the Bible itself. Measurement can be mastery, but it can also be melancholy.

4 See http://www.staffordshirehoard.org.uk/staritems/the-biblical-inscription.

5 For more on the inscribed band and the transcription, see Mittman and MacCormack in this volume.

We can take melancholy seriously in *The Ambassadors* not only by de Dinteville's self-identification as 'the most melancholic ambassador,' but also by experiencing the pull of anamorphic perspective as a temporal one: the painting knows time. Multiple scales of melancholy exist in the passage of time witnessed by the painting, including the painting's melancholic knowledge of a catastrophe ranging beyond the personal across a tremendously variable scale. Upon the terrestrial globe in the painting, which is turned here for our legibility, a line stretches across the Atlantic Ocean, up the west coast of Africa and down the east coast of what is now known as South America (Figure 4). Identified as 'Linea Divisionis Castellanoru[m] et Portugallen[ium],' this fine line demarcates the division of New World territories between Spain and Portugal as decreed in the Treaty of Tordesillas of 1494 and sanctioned by Pope Julius II in 1506 (Dekker and Schmidt, 1999, 31–32). This first cut, this first etching upon the globe, is the initiating measurement within unprecedented scales of conquest and crisis. It signals the transition to the New World; it persists as silent witness on an intimate scale of the soon-to-come ecological catastrophe of empire, and the continuing ecological crisis of globalization. In the pristine and exact line of the Treaty of Tordesillas, we find the melancholy of measurement: the resolute and precise representation of reality coupled with the desire of erasure, of representing a different world.

Figure 4: Tordesillas Line, detail from *The French Ambassadors*. Hans Holbein, 1533. Oil on oak; 207 cm × 209.5 cm (81 in × 82.5 in). National Gallery: London.
Photo: © National Gallery, London/Art Resource, NY.

The Ambassadors projects the melancholy of its represented objects in multiple temporal directions and on a wild variation of scale: the past, present, and future of de Dinteville and de Selve, as well as the fantasy and empire of a New World. In these intermingled ontologies and epistemologies, we can ask what the work of art *and any other environment we want to perceive* knows.[6] The answers will be anamorphic and elusive, fluctuating in and out of coherence.

The spatial and temporal work of the Staffordshire Hoard and *The Ambassadors* prepares us for that of proteins in that we are ready to think about the measurable relationships of time and space. Figure 5 is an attempt to catch a glimpse of one protein as it writhes across one billionth of a second. Inspired by the photographs of Harold Edgerton, the image depicts the first moments of a 'folding' event, during which an unstable strand, driven by the laws of physics, rapidly folds into a functional shape. Proteins fold in complex multiplicities of time that constantly demand the invention of new words. The vibrations of individual atoms (oscillating across a few tenths of a billionth of a meter) occur on a timescale of femptoseconds to picoseconds. Concerted movements of larger structural elements happen on the order of nanoseconds to picoseconds and span distances ranging up to around a nanometer.

6 In discussing the axis and rotation of the anamorphic skull, Lyotard speaks of the rotation as 'an ontological act which inverses the relationship of the visible and the invisible, of the signifier and the signified' (Lyotard, 2009, 62–64; trans. Anne Harris). We might take this to refer to the axis and rotation around the Tordesillas Line as well.

Figure 5: 1 Nanosecond. Gurnon et al. 2013. A compilation of protein movements spanning one billionth of a second of real time, taken from a 7-microsecond simulated protein folding trajectory. Data courtesy of Klaus Shulten and Peter Freddolino, University of Illinois.
Photo: Dan Gurnon.

Large-scale motions typically occur on the microsecond timescale. Language here becomes the (only) measurement of a reality we can't perceive: micro is 'a millionth of,' nano is 'a billionth of,' pico is 'a trillionth of,' and fempto is 'a thousandth of' a pico. A thousandth of a trillionth. Imagine that.

Can we? Measurements of molecular time begin in fractions of the blink of an eye, movements that to us occur at such a rapid blur as to be imperceptible. But even these large-scale movements – an enzyme closing its jaws on a metabolite, for example – are themselves excruciatingly slow relative to the frenzied vibrations and rotations of protein side chains, slipping beneath what Stephen Millhauser has drawn as the 'surface of the visible.' Millhauser's short story 'In the Reign of Harad IV' chronicles the dizzying demise of a court miniaturist who makes smaller and smaller wonders for his patron: a palace the size of a thimble, thirty-nine gardens so small they could be swept away by a breeze, a toy palace of 600 rooms that fit into the eye of a needle. Apprentices sing his praises but can no longer see anything, and the miniaturist returns to his work never to participate in the visible world again: 'and as he sank below the crust of the visible world, into his dazzling kingdom, he understood that he had travelled a long way from the early days, that he still had far to go, and that, from now on, his life would be difficult and without forgiveness' (Millhauser, 2006). A melancholy end to the master miniaturist's ever-smaller measures.

Millhauser gives us a way to think through the multiplicity of physical scales, down to the embroidery of sheets in a closet in an invisible kingdom. At the end of the story, time begins to stretch out as well, and the miniaturist is lost in the play of temporal scales. Thinking with a protein requires an extrapolation back out from the protein time scale of 'a thousandth of a trillionth' of a second to the human time scale of one second. Let us take the *Villin Project*, the four steel beam structures that mark an event that takes seven millionths of a second to occur. If a millionth of second became a whole second, villin would fold in seven seconds. On the same temporal scale, the blink of an eye would take four days. But there are multiple time scales *within* a protein to consider. A protein might writhe and twist on the order of millionths of a second (microseconds), but all the while its individual atoms are vibrating rapidly back and forth on the order of a thousandth of a trillionth of a second (femptoseconds). If we slowed down time again, but this time so that a femptosecond stretched out over a whole second… a blink of an eye would last ten million years. The folding of a protein simultaneously contains a four-day *and* a ten-million-year blink of an eye.

Stimulacrum: Between Matter and Metaphor

The Hoard will continue to exist between matter and metaphor. Its gold and garnet are both stuff and symbol of the glories of an Anglo-Saxon past. In citing modern hoarders 'not as bearers of mental illness but as differently-abled bodies

that might have special sensory access to the call of things,' Jane Bennett allows us to consider the relationship of the Hoard and the Hoarder, both past and present (Bennett, 2012, 244). The Hoarder(s?) of the Staffordshire Hoard felt the 'call of things' powerfully enough to safeguard them in burial, to secret away six and a half kilos of gold and silver.

The endurance of the materials of *The Ambassadors* defies the metaphor of the painting as a meditation on death. These materials witness extended histories and ephemeral moments both; in them, the painting is as well versed in molecules as it is in mimesis. The air around the painting, as its linseed oil took its days to dry into the oak wood, may have been disturbed by the fluttering wings of the mosquito carrying the parasite that would infect de Dinteville with a tertian fever. The molecules of sighs and the air disturbed by mosquito wings are not the stuff of history from a human point of view: they cannot be measured or proven, plotted or fixed within a linear perspective.

While it's tempting to dismiss the importance of an event that is over before we can blink, the alien timescales of biomolecular action are directly relevant to understanding and improving human health. The stakes are high: the suffering of Parkinson's, Alzheimer's, and Huntington's disease all emerge from the

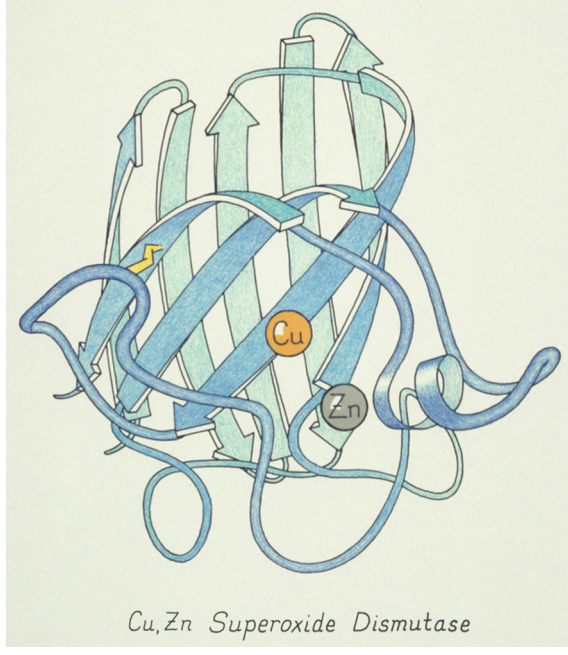

Figure 6: Cu, Zn Superoxide Dismutase. Jane Richardson, ca. 1980. This hand-drawn image is one of the first examples of the ribbon-style representation of protein structure.

misfolding of proteins, the result of an error somewhere along the way between genome and structure. Here metaphor plays a necessary but dangerous role: it brings clarity or a level of comfort to the thing it seeks to explain, but it necessarily changes what that thing truly is. For example, if you ask biochemists today to close their eyes and picture a protein, it's a good bet they will imagine an elegantly twisting ribbon. But a biochemist of the 1970s would have imagined an indecipherable jumble of atoms – visually closer to the truth, perhaps, but useless for understanding the nature of a protein. The now ubiquitous ribbon diagram (Figure 6), first hand drawn in the early 1980s by structural biologist Jane Richardson, simplifies the key features of proteins to reveal patterns hidden in the chaos (Richardson, 1981).

Be aware of your metaphor, for your metaphor is your path. The *stimulacrum* calls for us to hover in between matter and metaphor: to display and unfurl the objects of the Hoard while simultaneously holding them together as a critical mass; to take the measure of the world with Holbein's *Ambassadors* but also the measure of its melancholy; to think with the folding of proteins as far as our measurements can take us, and then to trust calculations well beyond the empirical – the *stimulacrum* invites us not to decide between matter and metaphor, but to hold the temporal and spatial oscillations of objects we will never entirely perceive but will always explore in our imagination.

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Dan Gurnon is an Associate Professor of Chemistry and Biochemistry and Director of the Science Research Fellows program at DePauw University. In collaboration with undergraduate students, his research focuses on the molecular causes of rare genetic disease and methods of visualizing protein structure. He was named the 2015 Indiana Professor of the Year by CASE and the Carnegie foundation (E-mail: danielgurnon@depauw.edu).

Anne F. Harris is a Professor of Art History and Vice President for Academic Affairs at DePauw University, and a founding member of the Material Collective. A fascination with the material production and experiential reception of multiple media in medieval art guides her work. Her publications on manuscripts, ivory, wood, stained glass, and alabaster explore the interactions of materiality, art, and audience and the tendency of materials to shape human responses both medieval and modern. Her current book project is entitled *The Raw and the Wrought: the Persistence of Natural Matter in Medieval Art* (E-mail: aharris@depauw.edu).

References

Baltrušaitis, J. 1977. *Anamorphic Art*, trans. W.J. Strachan. New York: Harry M Abrams.

Bennett, J. 2012. Powers of The Hoard: Further Notes on Material Agency. In *Animal, Vegetable, Mineral: Ethics and Objects*, 237–69, ed. J.J. Cohen. New York: Punctum Books.

Dekker, E. and K. Lippincott. 1999. The Scientific Instruments in Holbein's *Ambassadors*: A Re-Examination. *Journal of the Warburg and Courtauld Institutes* 62: 93–125.

Dekker, E. and R. Schmidt. 1999. The Globes in Holbein's Painting, 'The Ambassadors'/ Die Globen Auf Holbeins Gemälde, 'Die Gesandten'. *Der Globusfreund* 47/48: 19–52.

DeLillo, D. 2011. *The Body Artist*. London: Picador.

Foister, S., A. Roy and M. Wyld. 1997. *Holbein's Ambassadors: Making and Meaning*. London: National Gallery Company, Ltd.

Gurnon, D., J. Voss-Andreae and J. Stanley. 2013. Integrating Art and Science in Undergraduate Education. *PLoS Biology* 11(2): e1001491.

Hervey, M. 1900. *Holbein's Ambassadors*. London: George Bell and Sons.

Inwood, B. 2001. *The Poem of Empedocles: A Text and Translation with an Introduction*, vol. 3. Toronto, Canada: University of Toronto Press.

Kenaan, H. 2002. The 'Unusual Character' of Holbein's Ambassadors. *Artibus et Historiae* 46(XXIII): 61–75.

Lacan, J. 1992. Courtly Love as Anamorphosis. In *Ethics of Psychoanalysis 1959–1960; the Seminar of Jacques Lacan Book VII*, ed. J. Miller, trans. D. Porter, 139–54. New York: W.W. Norton & Company.

Leahy, K. and R. Bland. 2009. *The Staffordshire Hoard*. London: British Museum Press.

Lyotard, Jean-François. 2009. Discourse, Figure. In *Les Plus Beaux Textes de l'Histoire de l'Art*, ed. P. Sterckx, 62–65. Paris, France: Beaux-Arts.

Millhauser, S. 2006. In the Reign of Harad IV. *The New Yorker*, April 6.

Milo, R., P. Jorgensen, U. Moran, G. Weber and M. Springer. 2010. BioNumbers—the database of key numbers in molecular and cell biology. *Nucleic Acids Resarch* 38(suppl 1): D750–D753. http://bionumbers.hms.harvard.edu/.

Richardson, J. 1981. The Anatomy and Taxonomy of Protein Structure. *Advances in Protein Chemistry* 34: 167–339.

Stewart, S. 1993. *On Longing: Narratives of the Miniature, the Gigantic, the Souvenir, the Collection*. Durham, NC: Duke University Press.

Voss-Andreae, J. 2000. Protein Sculptures: 'Villin Project.' http://julianvossandreae.com/works/protein-sculptures-villin-project/.