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She Says, He Says: "What Do You Mean?"

Sandy Feinstein and Bryan Wang

"Words, words, words" *Hamlet*, II.ii.192

- 1 Twenty-five years ago, I argued with a colleague in biology about his use of the word "success." "Success," he said, refers to reproduction, a species' survival. The word choice, I said, was telling; it reflected a particular attitude to reproduction, and to those responsible for it, namely women. "It's just what it means," he countered. "There is no 'just what it means,'" I growled.
- 2 Biologists name things in Latin, a language few of them now study. Blame it on Linnaeus who ordered the world in Latin binomials. Modern scientists, however, no longer have a classical education; they are not usually trained for the Church. Not surprisingly, their pronunciation of the species they name can be head-turning to those who have studied the language, for being not quite classical Latin and not at all Medieval Latin.
- 3 "Success" is derived from Latin in pronounceable modern English; the word appears in the 16th century during what was once called the English Renaissance, where Latin would be "reborn" in a putative return to the classical forms that would increasingly limit its use.
- 4 "Coronavirus" is another word derived from the Latin, coined much later, in 1968, with charming self-consciousness: "In the opinion of the eight virologists, these viruses are members of a previously unrecognized group which they suggest should be called the coronaviruses" (*OED*). "Suggest" and "should" — quite a juxtaposition to characterize the appellation: insinuation with necessity, Latin and Middle English. The virologists' reasoning is based, as the quotation continues, on the virus's "characteristic appearance," namely of the "solar corona." Metaphors are dangerous. Latin is not a dead language.
- 5 The coronavirus has been extraordinarily successful. It doesn't breed like the creatures understood by Linnaeus and Darwin. Neither did they imagine it. Not Linnaeus in his

"Paradoxa," not Darwin in his evolutionary tree. New pictures and graphs and models now give the word, coronavirus, authority.

- 6 It all begins with letters — DNA and RNA, signifying Deoxyribonucleic Acid and Ribonucleic Acid — their transcription and translation, mutations: *litterae*, *transcriptio*, *translatio*, *mutatio*. The coronavirus is relentless in its replication: A, C, G, T into A, C, G, U, color coded, not quite 30,000 of them copied over and over. A reading that reads itself, its microscopic text barely legible. Only a select few can see what can't be seen and understand what they do see. Metaphors mean something to those who make them: to Jacob and Monod, for two, who explained, "A gene participates in two distinct chemical processes. In the first, for which the term *replication* should be reserved, [...] an identical sequence or replica of the original sequence [is formed]" (Jacob & Monod 1961: 193). "Replica," also Latin, is literal, to the letter. The letters in "the second process, which we shall call transcription, [allow] the gene to perform its physiological function" (*OED*). The process does the work; the scientists provided a name for it. Were I a scientist, I might know, and could say, "The way the coronavirus copies its genome challenges and stretches these definitions — Jacob and Monod didn't account for RNA as possible genetic material." But those are not my words, they are Bryan Wang's, another biologist who checks my accuracy, adds meaning I wouldn't, couldn't, make. I only transcribe his words, copy and paste, wonder at biologists as lexicographers.
- 7 Translation is an older word than transcription, one more intimate, or confident, with language. Translation converts letters — whether Arabic *alefto* "A" — or (l) combinations of symbols, whether words or, starting in the 1950s, DNA or RNA, into another language or state. Bryan tries to make me understand the usage as biological process. He says, "The code in nucleic acids is 'read' to generate proteins, which enact the function of the gene. Thus is the gene 'expressed.'" He has used these words in class, and each time he does I think about the words while our students absorb the lesson without dwelling on expression; his efforts to draw their attention to the word wink at me, the English teacher, but are obviously not the point. I dwell on the word, "expressed," a term of alchemy, here an extraction by my hand from his keypad into the margins of my manuscript, letters added to letters, transcriptions to transcriptions, translation to translation.
- 8 But "mutation"? The Anglo-Norman word "change" might be more to the purpose. The translation comes weighted like "success," no matter the intended literal meaning. The success of the virus is in how its characteristics differ from its "parents" or in the marked alteration of its genome and its translation. But to refer to those changes as mutations conjures the related word "mutant," with all its sci-fi negative connotations, as if there were an ideal original, a perfect, intended, First Being. Change is never welcome.
- 9 "Mutation" is, or was, a term in linguistics. Even so, when it comes to the metaphor introduced with the letters of DNA, I prefer scribal error, a literal wandering by the transcriber from the text, perhaps as a misreading that, in turn, compensates for what the illegible or smudged letter must be, or, perhaps, presumes, a "better" one based on a problematic reading. Mutation shifts the focus from the elegant metaphors of language, transcription and translation, to a process eluding control. Mutability herself is a figure who when "she at first her selfe began to reare, / Gainst all the Gods, and th'empire sought from them to beare" (Spenser, *FQ.VII.vi.1.9*). She embodied disruptive

powers well before Linnaeus imposed order and Darwin explained it. The poet Spenser is unequivocal:

For, she the face of earthly things so changed,
That all which Nature had establisht first
In good estate, and in meet order ranged,
She did pervert, and all their statues burst:
And all the worlds faire frame (which one yet durst
Of Gods or men to alter or misguide)
She alter'd quite, and made them all accurst[...]. (Spenser, *FQ.VII.vi.5.1-7*)

- 10 Mutability is the change of a green leaf to a falling one. Birth ends in death under her rule. Her curse is the unexpected, an inexplicable plague, an unimagined effect, of a flea, of bacteria, of a virus.
- 11 In the context of DNA's metaphors of literacy, mutation shifts the burden of understanding from the hand that transcribes and translates, the expressions of figural control, to the potential havoc wrought by what resists control, from Medieval and Renaissance humanist rhetorical tropes to modern sci-fi dystopia.
- 12 Social distancing avoids metaphor altogether. Though still Latinate, it is a modern expression, originally coined by sociologists in the last century to refer to both physical and emotional remoteness, later to be adopted by the press in the present century to refer to keeping a distance from others to avoid disease (*OED*). Its meaning has subtly mutated. The negative connotation of keeping apart, whether intended or not, is the subtext. "Social distancing" is the language of sociologists. But what does it mean to others? It imposes distance through its academic sounding clumsy construction. In the 1950s, it likely reflected the illusion of objectivity once promulgated and argued as possible in every field. Now that effect, and its affect — of academic condescension or dissociation — may undermine its present purpose, to keep people at a distance to avoid infection.
- 13 To keep cars and trucks from tailgating, the traffic sign does not say, "Vehicular Distancing in Effect." To get your kids' attention — students or children — it's unlikely you use a multi-syllabic compounding of an abstract adjective and noun.
- 14 Stay away from me. Keep your distance. 6 feet, no closer. Mask.
- 15 Mutants penetrate air, time, space. Mutability dictates change, in what words mean, in what happens everywhere, in nature, in a body, and in a cell.

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Figure 1: **LEFT.** Painting and Letters (Partial Transcript) of the Novel Coronavirus Responsible for COVID-19. **MIDDLE.** Electron Micrographs and Partial Translation of the Coronavirus and Trimeric Spike Protein. **RIGHT.** Mutability Overseeing a Phylogeny (Evolutionary Tree) of Coronavirus Strains, Colored According to their Host Species

Sources: Painting by David S. Goodsell, RCSB Protein Data Bank; doi:10.2210/rcsb_pdb/goodsell-gallery-019 used under a CC-BY-4.0 license. Sequences from NCBI Nucleotide database, reference sequence NC_045512.2, nucleotides 21563 to 23018 and translation of nucleotides 21563 to 25384, <https://www.ncbi.nlm.nih.gov/nucore>. Background image from Manuscripts and Archives Division, The New York Public Library, (1550) Towneley Lectionary [blank page], retrieved from <http://digitalcollections.nypl.org/items/510d47e3-c71c-a3d9-e040-e00a18064a99>. EM illustration of the virus by Alissa Eckert, MSML, and Dan Higgins, MAMS, Centers for Disease Control and Prevention, retrieved from <https://phil.cdc.gov/Details.aspx?pid=23312>. Images of the spike protein from the RCSB PDB (rcsb.org) of PDB ID 6VXX: (Walls *et al.* 2020). Image of "Mutabilitie" adapted from Walter Crane's cover illustration of Spenser's *Faerie Queene. A poem in six books; with the fragment Mutabilitie*, edited by Thomas J. Wise, 1897, accessed from <https://archive.org/details/spensersfaeriequ01spenuoft/page/n7/mode/2up>. Phylogeny adapted from Nextstrain data and image used under a CC-BY-4.0 license, <https://nextstrain.org/groups/blaib/sars-like-cov>. (Hadfield *et al.* 2018).

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- 16 As a graduate student in biochemistry in the 90s, I studied proteins, the molecules that provide much of the form and the function necessary for living things (and almost-living things, like viruses) to go about the business of life (and near-life). Two problems fascinated me. First, I wondered how the proteins observed in nature came to be — I say "observed" and not "seen" because the molecules are too small to be analyzed except by indirect means. Second, I wanted to explore the possibility of creating new proteins for new practical applications. Without belaboring the training or the anxiety and heartache that attended those long years, my project eventually "succeeded." By generating a large population of potential proteins, selecting those few individuals endowed with a desired trait, subjecting the survivors to mutation, and preferentially replicating descendants with even higher fitness — that is, by rudimentarily mimicking evolutionary processes on the molecular scale, I created (or found) a set of completely new proteins, a half dozen in all.
- 17 When scientists discover something new, they name it. The biologist Michael Ohl says, "It is through its name that the individual is bestowed with meaning, and it is through its naming that it becomes a part of our perception of nature" (2018: vii). And, on a more basic level, a name lets us speak about it.
- 18 "My" new proteins worked in concert with a class of proteins called zinc fingers — so named because they contain the metal zinc along with multiple appendage-like regions

linked in tandem, like the fingers of a hand. What I had engineered were smallish protein bits (or peptides) that induce zinc finger proteins to pair up, or dimerize. Unimaginative but sensible, I proposed naming them simply "zinc finger dimerizing peptides": ZFDP1, ZFDP2, etc.

- 19 My thesis advisor, however, disagreed, and he suggested we instead name them peptide 1, peptide 2, and so on. Although I felt his nomenclature unimaginative and *insensible* (how could others refer to what we'd discovered?), I didn't protest. Unlike Linnaeus, who not only named multitudes of organisms but also sorted each into its own cell within a grid of neatly nested taxonomic boxes, my advisor apparently didn't want to stake a claim, and I guessed there was a reason behind his reluctance. Perhaps he felt this territory insignificant, undeserving of title. Perhaps he saw arrogance in the very act of naming and the assumption of ownership it implied. Perhaps he was trying to avoid inadvertent implications.
- 20 A name makes sense. Like a metaphor, it carries meaning, establishes connections from the named object to the word that is the name. A name may be more descriptive, or less (at least at first), but in either case, the name eventually promotes associations, further discussion, and inquiry. When virologists named the coronaviruses (Almeida *et al.* 1968), they were emphasizing an aspect of viral morphology as determined by electron microscopy: the fringe of 200-angstrom-long projections that to them resembled the solar corona. Scientists now refer to those projections as the spike protein, and in current models of the virus's lifecycle, the spike protein mediates entry of the virus into host cells, where it replicates and causes disease.
- 21 Scientific names may describe more than outward appearances. When applied to an organism, a name indicates all sorts of features shared with other kinds of organisms while also locating that organism within the hierarchical categories of Linnaean classifications. The same is true for viruses. Biologists categorize coronaviruses in the taxonomic family *Coronaviridae*, within the order *Nidovirales*, in the class *Pisoniviricetes*, the phylum *Pisuviricota*, the kingdom *Orthornavirae*, the realm *Riboviria*. These identifiers describe the genetic material of the viruses, how they replicate, the hosts that unwittingly help them reproduce. The agents responsible for COVID-19, the SARS outbreak of 2003, and the MERS epidemic of 2012 are all named as coronaviruses, implying similarity in these essential facets of their biology. Since the time of Darwin, taxonomic names also have indicated presumed evolutionary kinship: COVID-19, SARS, and MERS viruses likely derive from an ancestral lineage whose offspring mutated over generations to yield these three distinct types of successful pathogens — each of which represents its own lineage subject to further mutation as the populations grow and spread, yielding distinct strains that may ultimately prove more (or less) durable, infectious, deadly.
- 22 Scientific models are like scientific names. They're metaphorical; they embody and describe; they establish connections and carry meaning. Models may take the form of images, graphs, abstract diagrams — of data, ideas, objects — and communicate information, efficiently and (sometimes) elegantly. A phylogeny sketches the evolutionary history of viral strains as the branches of a finely detailed tree. One may assert that a curve has been flattened (or not); an accompanying plot of the daily death rate over the course of a pandemic event shows it. It's one thing to allude to the sun's corona; it's another to sculpt the molecular surface of the pyramidal spike protein, the

protrusions to which protective antibodies might attach, the clefts and cavities in which therapeutic drugs might nestle.

- 23 Models don't merely communicate meaning; as Theodore L. Brown (2003: 26) says, they are "extended metaphors that have the potential to guide thinking about a system under investigation, suggesting new directions for research." They can be used to *construct* meaning. Models provoke questions. Regarding the coronaviruses' evolutionary history, what types of mutations in the viral genome correlate with changes in host susceptibility? Models provide tentative explanations. Changes mapping to the surface of the spike protein, as indicated by the graphical rendering of the virus particle, may permit the virus to switch from one host (say, a bat, or a pangolin, or a mink) to another (say, a human). Models are structures upon which to design and build experiments. Let's alter the spike protein and see if the resultant virus retains the ability to infect human cells; let's engineer an agent that occludes the spike protein and determine if that agent ameliorates the viral disease; let's use genetic material encoding the spike protein to stimulate the production of antibodies that may prevent an invading virus from infecting cells in the host — that is, let's try to make a vaccine.
- 24 Models simplify communication and enable thinking, but they are approximations. As early as 1666, Margaret Cavendish warned how microscopy and its images distort our perception of the natural world. Today, when we look at structures of the coronavirus and its molecular components, we're not seeing the things themselves. "What does *seeing* mean to you?" interrupts my coauthor (and sometime co-teacher) Sandy Feinstein, an English professor. I find the question both penetrating and unsettling. I understand that light rearranges cellular proteins in the eye, that those movements produce nerve impulses that the brain processes as vision. I understand that this doesn't adequately explain what *seeing* is. But I also know that the molecular representations of coronavirus are reconstructions assembled by means even less direct than those that concerned Cavendish. They're models built from the detection of electrons or X-rays, beams of radiation human eyes cannot behold. They're calculated models, not sights, models with descriptive and explanatory power, but models that nevertheless are approximations, incomplete.
- 25 Perhaps this points to reasons for skepticism of science. Like a Latinized, italicized, nearly unpronounceable name, a glossy picture of a virus appears — at first — definitive. To many, seeing is believing. The models, integrating zillions of measurements, depicting something almost inconceivably small and, therefore, abstract and arcane, may seem beyond the reach of the non-specialist and thus are accepted without question. Until they're not. It takes time and care as well as expertise to appreciate a model's assumptions and limitations — that the phylogeny is a tentative explanation of observations, not an historical record; that a molecular structure averages many structures, and perhaps not the relevant ones; that projecting infections and deaths represents the scientists' best prediction given the data collected so far, given our current epidemiological understanding, given the *conditions* as they stand today. Science is conditional, and the nuance and uncertainty in scientific models and the fact that science seeks continually and iteratively to refine its understanding of the world do not sit comfortably in the *Too Long; Didn't Read* era. It's much easier to simply declare that if the model was wrong, the science must be wrong, too.

- 26 *Wrong*: another word to examine. The data may be inconsistent with the hypothesis; the model may need refinement or replacement. To a scientist, such a situation would suggest more work to be done, additional terrain to explore. But, as Sandy reminds me, "wrong" to Peter Navarro, an economist and assistant to President Trump, means that Anthony Fauci, a medical doctor and Director of the U.S. National Institute of Allergy and Infectious Diseases, knows nothing, is a failure, is ruining the country (Navarro 2020). To one, "wrong" is an avenue of research; to the other, it's a political weapon.
- 27 So perhaps my advisor was instructing me to be careful with my words, and with other models, too, to examine and re-examine what they mean and don't mean and what I mean and don't mean, and to understand and explain the subtlety and the changing nature of the meaning. The questions, and how to answer them, may appear straightforward. *Should I wear a mask? Should I take hydroxychloroquine? Should I vaccinate?* Or they may not be straightforward at all. *Why should I believe "the science"? Is that the truth? Really?*
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ABSTRACTS

"She Says, He Says" is a rumination on some of the words that have dominated the conversation on the Coronavirus Disease 2019 (COVID-19) pandemic. It begins with a personal essay that interrogates different ways of reading, starting with biological "success" and ranging to the language of DNA. This first point of view, from a humanist, focuses on how scientists and social scientists appropriate and redeploy words. A second perspective, from a scientist, reconsiders the usages and purposes from both a personal and professional point of view. Both sections address metaphors, or models as metaphors, to represent what and how words may mean.

"Elle dit, il dit" est une réflexion sur certains des mots qui ont dominé les discussions sur la pandémie de Coronavirus (COVID-19). Il commence par un essai personnel qui interroge différentes façons de lire, en commençant par le terme "succès" en biologie et en allant jusqu'au langage de l'ADN. Ce premier point de vue, celui d'une humaniste, se concentre sur la façon dont les scientifiques et les spécialistes des sciences sociales s'approprient et redéploient les mots. Un second point de vue, celui du scientifique, réexamine les usages et les finalités d'un point de vue à la fois personnel et professionnel. Les deux sections abordent les métaphores, ou les modèles en tant que métaphores, permettant de représenter ce que les mots peuvent signifier et comment ils le font.

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Mots-clés: COVID-19, coronavirus, mutation, transcription, traduction, gestes barrière, métaphore, modèle

Keywords: COVID-19, coronavirus, mutation, transcription, translation, social distancing, metaphor, model

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