Jon Lieff, MD. *The Secret Language of Cells: What Biological Conversations Tell Us about the Brain-Body Connection, the Future of Medicine, and Life Itself*. Dallas, TX: Ben Bella Books, 2020. ISBN: 9781948836333. 350p. Hardcover $24.95.

Among the many positive reviews of *The Secret Language of Cells*, I have found none that commented on the ways it connects with themes in Michael Polanyi's writings. This isn't surprising since Dr. Lieff never mentions Polanyi. His book is a synthesis of recent research findings in cellular biology, but, as the subtitle indicates, he writes about the broader implications of these findings. I will focus on some ways Lieff's reporting on and interpretations of the findings connect with Polanyian themes. I will not attempt to evaluate the accuracy of Lieff's biological statements, as I am not a biologist. I do trust his biology as a result of the praise for the book by people who work in this field. The first four pages of my copy of the book include effusive statements of praise, mostly by physicians and biologists from prestigious hospitals and universities. To write the book, Lieff took a three-year break from writing a weekly blog on new findings in biology and neuroscience (https://jonlieffmd.com/blog). When I went to his blog, which he has now resumed, the first thing I saw was a set of links to "14 Podcast and YouTube Interviews on The Secret Language of Cells."

The first paragraph of Lieff's introduction reminded me of this passage in Polanyi's *The Tacit Dimension*:

> The greatest secret of modern biology, hiding in plain sight, is that all of life's activity occurs because of conversations among cells. During infection, immune T cells tell brain cells that we should "feel sick" and lie down. Long-distance signals direct white blood cells at every step of their long journey to infection. Cancer cells warn their community about immune and microbe attacks. Gut cells talk with microbes to determine who are friends and enemies. Instructor cells in the thymus teach T cells not to destroy human tissues (1).

In *The Tacit Dimension* (15), Polanyi includes unconscious events in the brain within the tacit dimension of knowing and doing. In a footnote, he proposes the following principle: "whenever some process in our body gives rise to consciousness in us, our tacit knowing of the process will make sense of it in terms of an experience to which we are attending." Whenever "T cells tell brain cells that we should 'feel sick,'" unconscious processes in our bodies give rise to conscious experiences. This connection between Lieff and Polanyi framed my reading of the rest of the book.

Marjorie Grene worked with Polanyi in the writing of *Personal Knowledge*. She said that his central argument is analogical. I say the same of Lieff's book. The title and subtitle point to two key analogies: (1) cellular language is analogous to human language, and (2) biological conversations are analogous to interpersonal conversations. Lieff, however, does not refer to these as analogies but expresses them as metaphors. I agree with Theodore Brown in *Making Truth: Metaphor in Science* (2003) that all creative scientific thinking is metaphorical. But I also agree with Stephen Turner in *Understanding the Tacit* (2014, 3) that to make sense of the tacit we need to "recognize metaphors as metaphors and analogies as analogies." I am not criticizing Lieff for not having done this; his objective was not to understand the tacit. I am saying that I must do this, given the way I have framed my reading of Lieff and my writing of this review.

Recognizing the analogical and metaphorical aspects of Lieff's use of "language," however, can

clarify some ambiguity about whether cells use one or many languages. A section of the introduction is titled "Same Language, Different Approaches." Lieff begins by listing multiple signaling devices involved in cellular conversations:

- secreted chemicals
- launched sacs filled with genetic information
- electric currents
- electromagnetic waves
- physical contact by cells
- biological nanotubes between cells

He adds, "Remarkably, all levels of cells throughout nature—humans, animals, plants, and microbes—use these same languages with the same vocabulary" (3). He is more accurate when he calls these "signaling devices" than when he calls them "languages" in the plural. These six different signaling devices are not as closely analogous to six different human languages—English, Spanish, Arabic, Hindi, Mandarin, Navajo—as they are to the signaling devices we use in our nonverbal communications—facial expressions, tone of voice, gestures, postures, odors, etc. Conversation among cells is entirely nonverbal. It is a bit misleading for Lieff to have written "these same languages with the same vocabulary." "Vocabulary" mistakenly implies that words are the units from which intercellular messages are composed.

Lieff's argument resembles Polanyi's in emphasizing the analogies between different levels of organization. He draws an analogy between the functions of organs in an organism and the functions of organelles in a cell:

> Organisms have organs—structures that perform specific functions in the body. In the same way, cells have organelles: mitochondria, nucleus, protein factories, membrane factories, and multiple large vesicles with diverse roles to play (294).

> While we don't know what life is, we do know it involves information transfer based on signaling of viruses and bacteria, signaling in complex circuits of brain cells, and signaling among human beings using language and mathematics. But we also don't know exactly what information is or how it is directed in nature at these various levels (296).

These quotations suggest some of the ways in which Lieff's book can complement Part Four of Polanyi's *Personal Knowledge*, with its chapters on "The Logic of Achievement," "Knowing Life," and "The Rise of Man."

There's another connection having to do with organization. The biological conversations Lieff describes result in what Polanyi called "spontaneous" or "dynamic" order. This was Polanyi's *ideal* type of order for both scientific and economic activities. His *anti-ideal* type for the organization of these domains was centralized planning and control. Lieff comments on the absence of centralized control of the activities of brain cells:

> Efforts to understand how human brains use information have not yet been successful: no clear source of direction for the widespread information flow in brain circuits, for instance, has been found. Attempts have failed to detect a central control module in the brain, such as a seat of consciousness and subjective experience. Instead, brain activity seems to be distributed widely among diverse cell clusters using signals that change frequently in milliseconds. During neuroplasticity from learning, multiple circuits throughout

> the brain alter themselves in different ways simultaneously, without an obvious central commanding post to direct these processes (294).

Conversations among other kinds of cells also lack any obvious central control.

A striking set of metaphors occurs early in the book in a section titled "From Birth to Graduation" (30–31). Leiff describes the thymus, a small gland located in front of the heart, as a (metaphorical) university. T cells are born in bone marrow and migrate to the thymus, where they are educated by two distinct kinds of teacher cells. "Only 2 percent graduate. The other 98 percent that do not meet the exact qualifications required by a series of checkpoints are eliminated by their instructors." (We all have had hard teachers, but none as ruthless as these!)

> …the most important part of the training is that T cells must understand not to attack normal human cells and tissues while they search the body for trouble. When T cells are able to identify the difference between "foreign" molecules and "self" molecules, they avoid causing autoimmune diseases (31).

I relate this to Polanyi's interest in different kinds of learning. "Learning," he says, "will be regarded as a sign of intelligence" (*PK* 71). However metaphorical his language, Lieff seems to be attributing some kind of intelligence to T cells and to the teacher cells in the thymus.

Lieff explicitly recognizes the limits to what we know. He acknowledges that we don't know exactly what life is or what information is, even though he is confident in saying that life is based on information transfer as well as on flows of matter and energy. I want to add that we also don't know exactly what "sense-giving" and "sense-reading" are. In his 1967 essay on these processes, Polanyi says that both of them require the integration of tacit subsidiaries into an object of focal attention. He writes of a "triad of coefficients" that are "akin to"—I would say "analogous to"—C. S. Peirce's "A stands for B to C." Polanyi amends this to "The person A can integrate the word B into a bearing on C" and adds that he means that the person A endows B with a *meaning* that points to C. But, beyond saying that it's a tacit act of integration, Polanyi never explains just how a person performs that tacit act. His analogy to Gestalt psychology's description of acts of perception is helpful, but I remain convinced that the process by which person A endows B with a meaning is a deeply tacit act, one that can't be made fully explicit. Lieff attributes similar *deeply tacit* acts of sense-giving and sense-reading to cells, organelles, and microbes.

In "Sense-Giving and Sense-Reading," Polanyi briefly mentions Golgi bodies in the context of discussing sense-reading as requiring "tacit semantic acts" (187). Lieff's reporting a recent finding adds descriptive details to a process Polanyi could only hint at, given the state of cellular biology in the late 1960s:

> Signals between the ER [endoplasmic reticulum] and Golgi regulate all lipids for membrane production and the proteins that alter these lipids, and place both of these molecules in precise membrane locations throughout the cell…. Lipid molecules are used to produce all membranes and are also used as signals for conversations among organelles and cells (245).

To say that these are "tacit semantic acts" is to speak metaphorically. Semantic acts relate *words* to meanings, but the signaling devices used by cells do not include words. The acts of sense-giving and sense-reading performed by cells relate various kinds of

nonverbal signaling devices to meanings. What *meaning* Lieff attributes to "meanings" in this context is a product of a tacit semantic act—sense-giving—on his part, just as the meanings you or I attribute to his use of "meanings" in this context are also produced by tacit semantic acts—sense-readings.

In his book—I haven't read all the entries in his blog—Lieff never mentions biosemiotics. But it seems reasonable to me to interpret the conversations he describes as involving biosemiotic communication. This is important for Polanyians who want to explore the connections between new biological discoveries and Polanyi because there have already been articles in *Tradition & Discovery* that discuss connections between his works and biosemiotics (e.g., Walter Gulick, "Polanyian Biosemiotics and the From-Via-To Dimensions of Meaning," *TAD* 39, no. 1 [2012–2013]: 18–33; Phil Mullins, "Michael Polanyi's Approach to Biological Systems and Contemporary Biosemiotics," *TAD* 46, no. 1 [2017]: 6–31). This book is not easy reading for non-biologists, but I highly recommend it for Polanyians who want to extend aspects of Polanyi's thinking in the light of some of the exciting new findings in cellular biology.

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