Zeitschrift: gta papers
Herausgeber: gta Verlag
Band: 5 (2021)

Artikel: Syncytium
Autor: Jones, Caroline A.
DOI: https://doi.org/10.5169/seals-976209

Syncytium

Caroline A. Jones

Let us praise the *syncytium*—syn + cyte = "together cell," a single cytoplasmic mass with many nuclei—for the syncytium makes the placenta, and us mammals, possible. [1] fig.1 Why is the syncytium not the most theorized part of the body's architecture? [2] Although philosopher Peter Sloterdijk comes close to asking this question, when he acknowledges his fantasized *ur-architektur* as "not so much a mother/child but a child/placenta relationship," [3] he nonetheless reverts to the more familiar womb or uterus as the privileged "shell" that colonizes his architectural imaginary: "The construction of shells for life creates a series of uterus repetitions in outdoor milieus. Architects must understand that they stand in the middle between biology and philosophy. Biology deals with the environment, philosophy with the world." [4]

Likewise, Buckminster Fuller conjured notions of a telepathic "worldaround Wombland" of chatty, protesting fetuses refusing to come out of their shells, since "Wombland" protected them from a polluted world, circa 1970. [5] These metaphors of original architectures—indeed, the entire genre of biological just-so stories about mimesis or the New Swarmism [6]—miss the most useful lessons architecture might draw from contemporary genomics about how life actually works.

This essay is not in pursuit of a new "primitive hut." The syncytium instead teaches the ongoing, future-facing lesson of viruses: you do not have to live anywhere in particular (you do not even have to be "alive") to affect how things get built. You do not need a shell, or the fiction of "individuals," to perform certain evolutionarily significant *functions* in life systems. The virally propelled syncytium teaches that mediating the exchanges across boundaries may be the defining role of "architectures" in life.

Dear readers: we do not need to be feminists or equipped with ovaries to understand the stakes here. Let's start with the basics. The uterus or womb is a stretchy, muscular cavity (Indo-European *udero*, belly or stomach; Germanic *wamb*, belly) possessed by female mammals. It begins in the embryo as an

Caroline A. Jones teaches art history, runs the Transmedia Storytelling Initiative, and serves as Associate Dean for the School of Architecture and Planning at the Massachusetts Institute of Technology.

1 I am grateful for the lively (and nourishing) feedback from the editors of *gta papers*. Jeffrey Fraser Landman helped with the Sloterdijk, and his sourdough starter is still keeping me going in the pandemic. Publications by biologist of symbiosis Scott Gilbert, and our conversations, have been inspiring; Stefan Helmreich is also a treasured interlocutor.

2 In addition to the mammalian placenta, syncytia are also found in mammalian cardiac muscle cells and certain smooth muscle cells that have the capacity to be synchronized electrically (as in the heart muscle). The term can broadly refer to tissues showing many nuclei but no cell walls, the result of fusions from uninuclear cells, a process often propelled by viral proteins whose remnant DNA can be identified in the biotic material. We will explore in this essay the intriguing electrical potential for signaling that syncytia make possible, even in a syncytial deep ocean sponge.

3 Peter Sloterdijk, "Talking to Myself about the Poetics of Space," *Harvard Design Review* 30 (Spring/Summer 2009), n.p., http://www.harvarddesignmagazine.org/issues/30/talking-to-myself-about-the-poetics-of-space (accessed December 15, 2020). There is also this astonishing pronouncement: "Women's bodies are apartments!"

4 Sloterdijk, "Talking to Myself."

5 Buckminster Fuller, introduction to *Expanded Cinema*, by Gene Youngblood, 50th, Anniversary ed. (New York: Fordham University Press, 2020), 16–17.

6 For "Swarmism" en route to "Tectonism," see Patrik Schumacher, "The 'Digital' in Architecture and Design," *Architectural Association Files* 76 (Summer 2019), n.p.

invagination (a folding of tissue to enclose a space) that comes with gonadal differentiation (in the gestational stage of nine weeks), when the female-hormone-cued fetus begins to develop future eggs (protected in an ovary) along with a place to put them once they are fertilized (the uterus). [7] The uterus thus already exists at the earliest stage of the anatomy of the embryonic mammalian female. Yet the placenta is generated by any mammalian fetus before it even has a sex. What the fetal cells build is a flat, spongy, layer-cake (Greek *plakuos*, Latinized as "placenta") connected on the one side to the uterine wall and on the other to the embryo—soon linked by a busy umbilicus constantly pulsing with fluids going in both directions. The placenta begins to develop immediately upon fertilization, as the outer layer (called the "trophoblast") of the fertilized egg differentiates itself from the inner layer, which will become an embryo. That outer layer gets busy producing an organ outside the fetus that will mediate between developing embryo and maternal life support; the developing placental membrane allows the rapidly dividing egg cells to "implant" themselves into the wall of the uterus before the umbilicus forms. The trophopart of the blastula is what expands into the "flat cake" that will provide "nutrition, gas exchange, waste removal, a source of hematopoietic stem cells, endocrine, and immune support for the developing fetus." [8] The placenta "belongs" to the developing embryo, and will be expelled from the uterus as soon as the fetus is. If we were to construct architectural metaphors, the uterus is framing, the placenta, temporary plumbing.

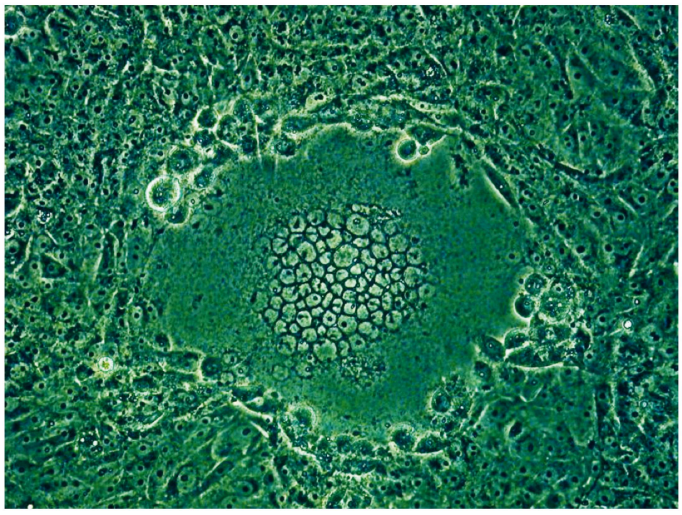

fig.1 Syncytium of fused cellular tissue, formed through the virus HSV-1 (herpes simplex) interacting with the artificial cell line known as "Vero" Source: Wikimedia commons

Plumbing, waste, nutrition, and gas exchange are the onerous parts of architectural design, but their management inside the maternal body, rather than in an extruded egg, was an essential precondition for mammalian evolution and clearly a driver for mammalian reproductive success. That the uterine, in both Fuller's and Sloterdijk's imaginary, presents the ideal manifestation of the (Leon Battista) Albertian ideal of *commoditas*, suggests a placental hauntology—its lowly functions of maintenance and care sublimated into elevated notions of comfort. Most likely these architecturally minded types think of the flexible uterus as commodious because the mechanics of life support (heating, ventilation, and

7 Mark A. Hill, "Embryology: Uterus Development," *University of New South Wales Embryology*, April 5, 2020, https://embryology.med.unsw.edu.au/embryology/index.php/Uterus_Development#Uterine_Development_Movie (accessed December 15, 2020).

8 Mark A. Hill, "Embryology: Placenta Development," *University of New South Wales Embryology*, September 13, 2020, https://embryology.med.unsw.edu.au/embryology/index.php/Placenta_Development (accessed December 15, 2020).

air conditioning; electricity; and plumbing) are both sub-contracted and automated in bodies, as they are in modern architectural practice. [9]

Sloterdijk's conversion of the uterus into a shell (an invagination transformed into an extrusion) needs some comment. We could wonder whether Sloterdijk is at least historically accurate—did architects become obsessed with shells? Is the uterine-as-shell appealing because of its paradoxical combination of stasis and portability? The shell gives us a metaphor that is clean and inert, seemingly permanent, growing ever whiter in the sun. Is Sloterdijk's strange inversion of the folded (uterine) into the deposited (shell) a privileged "shell-imagining" that allows technology to conceive a tidy, separable, indeed discardable box-like unit under the command and control of its maker? A shell that survives beyond the death of its occupant? Or, finally, were Sloterdijk and Fuller simply inheriting that epistemology of Western science that relies on dead specimens and skeletons, making it difficult even to conceive of the pulsations of syncytia (such as the myocardial tissues that propel the action potentials of our own hearts)?

Thinking about how syncytia come to be in biological assemblages through viral agents might help architects move beyond the limits of shells as animal "property," not to mention that domain of the *tektōn* (carpenter), "tectonics." Doing so would allow us to engage the functional tangles of actual life systems—as in the placental *villi* that Leonardo da Vinci drew in the corner of his drawing dominated by a violently opened womb. **fig. 2** In this telling detail, the artist seeks to understand, by pulling apart, the entwined intra-active surfaces of placenta and uterus to enable the classic view in which there is an "invasion" of the maternal uterine wall, now penetrated by placental "fingers" (*villi*). [10]

In place of the static, portable, and no longer biotic "architectural members" of tectonics and shells, let us think of the enmeshment of membership. This demands that we conceive the with-living entities that participate in the ubiquitous condition of symbiosis, a polemic I have begun to call symbiontics. [11] It is biologist Lynn Margulis who inaugurated this

9 Namely in building information modeling and the "autonomic" nervous system.

10 The language of "invasion" is still operative in embryology: "[fetal] cytotrophoblastic cells proliferate and differentiate into an *invasive phenotype* that *invade* ... the maternal decidual stroma," Hill, "Embryology," my emphasis. Note that da Vinci had difficulties obtaining gravid but dead female bodies, and made do in some instances with the uterus of a domestic animal: "one of the most significant errors of the studies of the walls of the human uterus is Leonardo's inclusion there of cotyledons that are present in ungulates such as the cow ... but not in humans," Kenneth David Keele and Jane Roberts, *Leonardo Da Vinci: Anatomical Drawings from the Royal Library, Windsor Castle* (New York: Metropolitan Museum of Art, 1983), 57. The drawing illustrated here is numbered 19A in this monograph; the cow "cotyledon" is visible in the detail to the right of the opened womb.

11 Symbiontics is a portmanteau developed to incorporate notions of symbiosis found in Lynn Margulis's work with the "ontics" of technical philosophy (that which is): symbiosis-as-that-which-is**.** So far, the sites in which "symbiontics" has been seeded include *Olafur Eliasson, Symbiotic Seeing*, exhibition at Kunsthalle Zurich (2020); Jenna Sutela, *NO/NO/NSE/NSE*, exhibition at Kunsthall Trondheim, Norway (2020); Caroline A. Jones, "Virions: Thinking Through the Scale of Aggregation," *Artforum* 58, no. 9 (May/June 2020), 98–101, notes on 196; Caroline A. Jones, "Symbiontics: A View of Present Conditions from a Place of Entanglement," *Brooklyn Rail* (July/August 2020), n. p.; Stefanie Hessler and Jenny Jaskey, eds., *Agnieszka Kurant: Collective Intelligence* (Berlin: Sternberg Press, forthcoming 2021), and various online forums. My polemic deeply respects and joins forces with concepts already in circulation, such as Donna Haraway's "sympoiesis," which in turn draws on Scott Gilbert's "symbiopoiesis." For my part, because I am after broad cultural change, I want to lodge my polemic directly inside ontology (the study of what it is to exist) rather than theoretical biology. See Donna J. Haraway, *Staying with the Trouble: Making Kin in the Chthulucene* (Durham, NC: Duke University Press, 2016), and Scott F. Gilbert et al., "Symbiosis as a Source of Selectable Epigenetic Variation: Taking the Heat for the Big Guy," *Philosophical Transactions of the Royal Society B: Biological Sciences* 365, no. 1540 (February 2010), 671–78.

fig. 2 a, b Above: placental villi from *Studies of the Foetus in the Womb*, Leonardo da Vinci, ca. 1510. Recto: Red chalk and traces of black chalk, pen and ink, wash. Right: full sheet
Source: Royal Collection Trust

revolution, recognizing in 1967 what could only be confirmed by genomics decades later: we are symbionts all the way down, into deep time when "endosymbiosis" (the incorporation of symbiotic others into a single cell) created the first mitosing cells and bequeathed us multi-cellular beings with cellular "power plants" (mitochondria) derived from engulfed cyanobacteria. [12] The presence of bacterial DNA in our mitochondria reveal a presumably random coupling that turned out to convey explosive evolutionary advantage (the benefits of symbiosis).

A long time later, these enhanced cells merged into multi-cellular organisms, and later still they incorporated the clever trick of viral proteins in dissolving (*lysing*) those very cell walls and/or membranes for yet further evolutionary twists and turns. [13] Triggered for the highly successful family of mammals by lysogenic viruses long since incorporated into our cell lines, the syncytium is made of those fused cells (many nuclei, no membranes) that comprise the flat cake of the placenta. To restate: the ability to form the flat cake of the placenta can be traced back to DNA appropriated from a lysogenic virus. That virus was capable of creating syncytia (many nuclei, no membranes), but that ability is now entirely enlisted in our reproductive lives. (The viral trace is only a fragment; it can no longer escape to move freely.)

The incorporation of this viral DNA into our cell lines is a defining moment in the differentiation of the class of mammals from other vertebrates. But it is not the "cake" that nourishes the fetus, rather this temporary organ induces the body of the host to provide what is needed. The placenta produces flows of chemicals such as oxytocin that make its host happy to have it. Flows of gonadotropin thicken the uterus with increased blood vessels, enabling the nourishment of the guest. Flows of lactogen make sure the host body correctly prepares further nourishing secretions, to feed the helpless infant animal upon exit. We know, as da Vinci did not, that the placenta begins as a few alien cells that the host might otherwise expel. Crucially, the cells are disguised, because that two-week-old fertilized blastula uses its lysogenic tools to generate an outer layer whose cell walls have fused (via those viral genes)—first gluing themselves to themselves, and then gluing to the nearby tissues of the mammalian host (with the right chemical supplementation and invaginated space, it could be a male or female body doing the hosting). The new organ is characterized by these undifferentiated, fused cells that then defend the new occupant against annihilation by the host's immune system, which literally cannot "recognize" the alien-cells-without-walls.

Some have characterized the fetal occupier as a parasite, shielded by its virally camouflaged "cake" so that it can summon

12 Will the ubiquitous novel coronavirus jumping out of bats transform the human genome? The "long-haulers" may be experiencing profound disruptions to their immune systems, but the virus would have to be passed on with ova or sperm to be truly endo-symbiotic.

13 Lynn Sagan, "On the Origins of Mitosing Cells," *Journal of Theoretical Biology* 14, no. 3 (March 1967), 225–74. After her divorce from Carl Sagan, Lynn Margulis (née Alexander) made common cause with James Lovelock in launching the Gaia theory, for which see James E. Lovelock and Lynn Margulis, "Atmospheric Homeostasis by and for the Biosphere: The Gaia Hypothesis," *Tellus* 26, nos. 1–2 (February 1974), 2–10.

nutrients and recruit support from the unwitting host. I choose to describe the embryo and its organ as "guests" of the hosting body. [14] No doubt, these guests are demanding. But the systems they install do much of the work during their visit. Bringing in oxygen and carrying away waste CO_2 from the rapidly multiplying cells of the embryo, the mammalian placenta is the ultimate "machine for living," but in place of that industrial engineering metaphor, let us instead imagine the chemical flows, interdependencies, endocrine affects, and epigenetic responses characteristic of the with-living flux of symbiosis.

Are we merely substituting for the sheltering hut, cave, shell, or muscled uterus a membranous tent or "tympanum" whose stretchy layer is all about communication, food logistics, and a kind of camouflage? There is indeed a kind of biosemiosis in symbiontics, but it is not the tidy signaling of Jakob von Uexküll's separated creaturely *Umwelten*. It is rather the second-order cybernetics in which "the operational closure of autopoiesis demands that the organism be an open system." [15] In symbiontics, the "organism" is never the fictive individual but always contains multitudes. An architecture aware of this would have to enter a space of permanent and ongoing cooperation, finding different metaphors for the production of symbiotic flourishing.

It is this surfing on intra-active conviviality that might productively inspire architecture. Nesting networks of vivid interdependency replace the bony carapaces of mollusks or the inert materials of the builder. I do not absolve my feminist heroes from architectural obsessions with the structure or the shell rather than the all-important flow. But at least when Luce Irigaray theorizes the primordial architecture of our philosophies, she knows that the cave and the womb are also sites of *functions* she identifies as "matrixial." Irigaray celebrates how *la matrice*—the matrix—translates an ancient Greek word for womb, and traces this "metra" into material and matter. [16] I am tempted to find, in the inexhaustible Irigaray, an explanation for the ubiquitous celebration of tectonics as the scattered "parts" that must always remain separated for picking up by "others" (*tektōns*) to build with, a process of "assembling" revealed by her to be a "dissembling" of the primordial force that is the matrixial:

"[Woman] is not uprooted from matter, from the earth, but yet, but still, she is already scattered into x number of places that are never gathered together into anything she knows of herself, and these remain the basis of (re)production—particularly of discourse—in all its forms." [17]

We should not romanticize this originary force of procreation, least of all through masculinist views of primordia (invariably,

14 The politics around pregnancy discourses are intense, woven into choice/abortion debates. "Guests" might indicate my position, for guests can be politely shown the door. For an early medical view, see Donald J. Naismith, "The Foetus as a Parasite," *Proceedings of the Nutrition Society* 28, no. 1 (March 1969), 25–31.

15 See Bruce Clarke and Mark Hansen, eds., "Introduction," in *Emergence and Embodiment: New Essays on Second-Order Systems Theory* (Durham, NC: Duke University Press, 2009), 1–25, esp. 9–12, in which they explore these issues. (The phrasing is by Evan Thompson, cited on page 10). The concept of life systems and semiotic systems are further explored by sociologist/media theorist Niklas Luhmann in "Self-Organization and Autopoiesis" (from Niklas Luhmann, *Einführung in die Systemtheorie* (1991), trans. Hans-Georg Moeller and Bruce Clarke), in Clarke and Hansen, *Emergence and Embodiment*, 143–56.

16 See Irigaray's reading of Plato's *Hystera* in *Speculum of the Other Woman,* trans. Gillian C. Gill (Ithaca, NY: Cornell University Press, 1985), 243–364. On the matrixial as a force within art, see Catherine de Zegher, *Inside the Visible: An Elliptical Traverse of 20th Century Art in, of, and from the Feminine* (Cambridge, MA: MIT Press, 1996). This materializes important thinking by psychoanalyst Bracha Ettinger regarding "matrixial borderspace," for which see Bracha Ettinger, *Matrixial Borderspace* (Minneapolis: University of Minnesota Press, 2006). This is further developed in Irina Aristarkhova, *Hospitality of the Matrix: Philosophy, Biomedicine, Culture* (New York: Columbia University Press, 2012).

17 "Volume-Fluidity," in Irigaray, *Speculum*, 227–42.

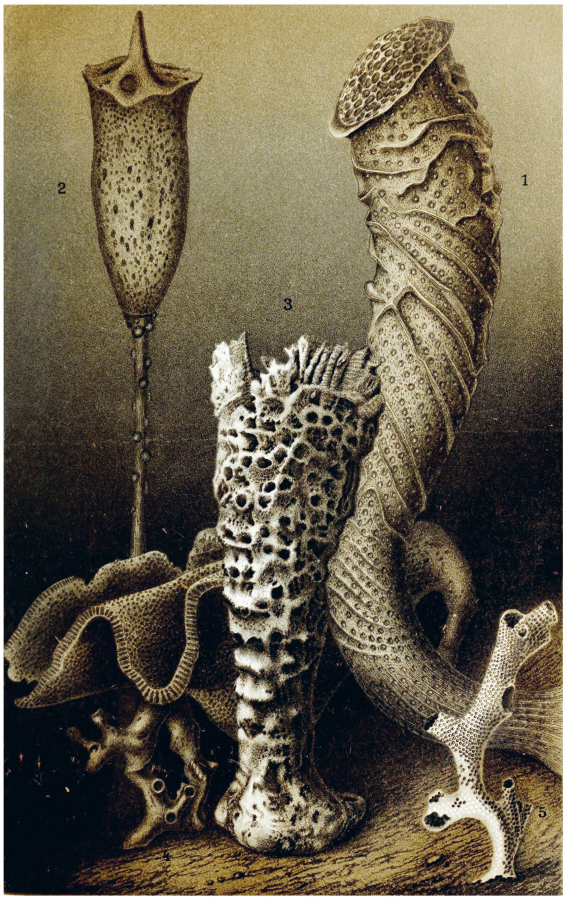

fig. 3 Sketches of various *Hexactinellid* sponges, Franz Eilhard Schulze
Source: *Brockhaus' Konversations-Lexikon,* vol. 8. (Leipzig: F.A. Brockhaus, 1892)

women lose out in that rumination). Science of the syncytium helps release us from the rigidities of human ontogenies and their tectonic discourses (*homo faber* needs to navigate towards a bit of other-than-human thinking). Mind you, we need to pick and choose our syncytial science. Ernst Haeckel's "recapitulation" theories of embryology managed to erase both fetal agency and that of the maternal host, creating developmental sequences out of doctored photographs that erased not only the placenta but different embryos' membranous shrouds, tails, and other creaturely flourishes. fig. 3 Such prevarication allowed Haeckel to insist on a grand evolution of forms (a tectonic parade fueling a teleological Great Chain of Being.) [18] Cleaning up the ragged edges of embryos rather than dealing with the bewildering variations in placentation (mammalian placentas vary more than any other single organ), [19] Haeckel ignored what I am here insisting upon: the syncytial encourages us to think of architectures pulsing within, not abstracted from, living systems.

Sciences of the syncytium are not without their tectonic beauties. (Without mammalian skeletons to hold them, symbionts seek other structuring relations.) Think of the elegant and mysterious deepwater Glasschwämme or *Hexactinellida* family of "glass" sponges. These looked redoubtably tectonic to the nineteenth-century biologist F. E. Schulze, who made them more so by combining the soggy individual specimens he received into a cluster of pert structures dwelling together. Their chimneys, swirls, cups, and pipes appear in his work as a fantastic metropolis, stretching up from the ocean floor. Writing from Berlin for the British expedition publishing these specimens in 1887, Dr. Schulze characterized the rare sponges' "fine central canal ... [as] surrounded by numerous concentrically arranged layers of a solid substance [resembling] glass so closely that it has been ... spoken of as *vitreous fibre*." [20] Contemporary chemists reveal these to be, indeed, silicon dioxide—glass formed throughout the sponge body by a continuous mass of cytoplasm with many

18 Many thanks to Adam Jasper for insisting that the gorgeous and faked images by Haeckel be part of this tirade. On Haeckel's telos-obsessed cheating, see Nick Hopgood, *Haeckel's Embryos—Images, Evolution, and Fraud* (Chicago: University of Chicago Press, 2015).

19 See the online atlas *Comparative Placentation* by medical pathologist Kurt Benirschke, maintained by the University of California at San Diego, http://placentation.ucsd.edu/homefs.html, last updated January 19, 2012 (accessed January 31, 2021)

20 F. E. Schulze, "Report on the Hexactinellida Collected by H.M.S. Challenger during the Years 1873–76," *H.M.S. Challenger Reports*, vol. 21 (Edinburgh: Adam & Charles Black and Douglas & Foulis, 1887), 27, http://www.19thcenturyscience.org/HMSC/HMSC-Reports/Zool-53/htm/doc.html (accessed January 29, 2020). In his section on the skeletal, Schulze recognizes that little is known of the development of these remarkable silica structures and the soft mass that connects them in the center of the sponge.

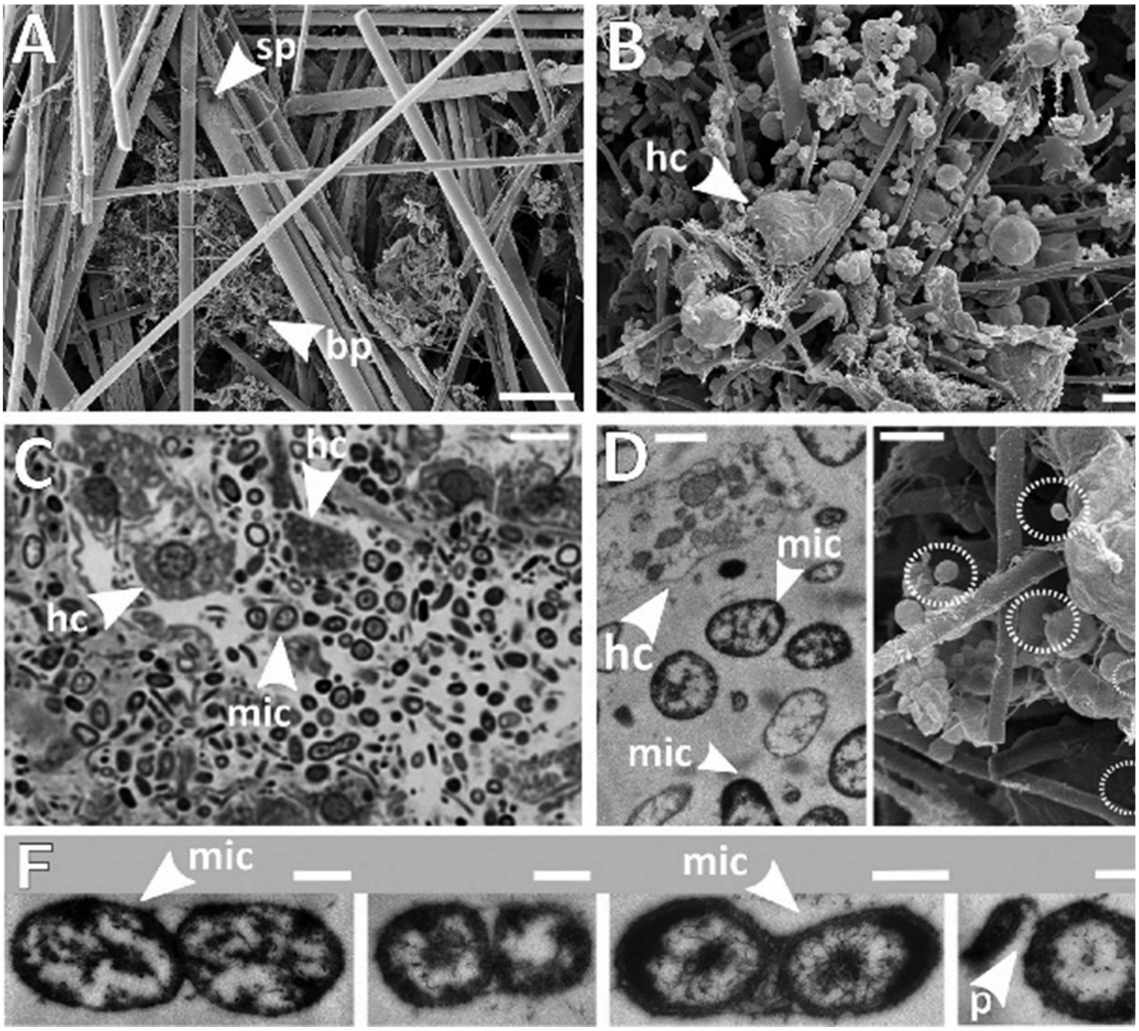

fig. 4 Scanning electron microscopy, in Cristina Bayer et al., "Microbial Strategies for Survival in the Glass Sponge *Vazella pourtalesii*," *Msystems* 5, no. 4 (August 2020), fig. 2. Original caption describing the complex symbioses found within a glass sponge reads: "Microscopy of Vazella pourtalesii tissue. (A) Scanning electron microscopy overview of spicule scaffolds (scale bar, 75 _m). (B) SEM closeup image of a biomass patch (scale bar, 3 _m). (C and D) Light microscopy image (scale bar, 5 _m) (C), and TEM image of the same biomass patch (scale bar, 1 _m) (D). (E) SEM closeup presumably showing smaller microbes attached to larger ones by stalk- or filament-like structures (scale bar, 1 _m). (F) TEM images of adjacent microbial cells (scale bars, 500 nm)."

nuclei—a syncytium—taking up silicon to make spicules, replacing the normal epidermal cells that other kinds of sponges possess. In place of those conventional, contractive spongey cells with their tidy membranes, these silica builders craft a rigid syncytial net of amoebocytes (doubtless propelled by lysogenes taken from viruses) supported by glass spicules. Uniquely, the glassy fretwork of the *Hexactinellida* allow these deep ocean dwellers to conduct electricity rapidly throughout their bodies, a signal system "used by the sponge to shut down its food-filtering system [via flagellar arrest] ... when conditions outside risk the system becoming damaged." [21] This syncytial dynamic also collaborates with the sponge's numerous microbial companions (a "consortium of bacteria, archaea, unicellular algae, fungi, and viruses" [22]) to form one of the most ancient structural testaments to symbiosis.

Contemporary microbiologists have the tools to probe the interior of Glasschwämme to see these "microbial strategies" in action. [23] In the 2020 scanning electron microscopy images published by Kristina Bayer and her collaborators, "bp" indicates syncytial biomass patches in which the sponge cells lose their membranous walls (that evolutionary lysing program that viruses are so good at), becoming dedifferentiated platforms nesting

21 Eleanor Lawrence, "Nervous Sponge," *Nature Briefing*, April 15, 1999, https://www.nature.com/news/1999/990415/full/news990415-5.html (accessed December 15, 2020).

22 Nicole S. Webster and Torsten Thomas, "The Sponge Hologenome," *mBio* 7, no. 2 (March/April 2016), e00135-16. The authors write of a "paradigm shift" in biology as symbiotic relationships appear active in all living organisms, now understood to be part of a "hologenome" comprising the genome of host and all its symbionts.

23 Kristina Bayer et al., "Microbial Strategies for Survival in the Glass Sponge *Vazella pourtalesii*," *mSystems* 5, no. 4 (July/August 2020), e00473-20.

in scaffolds of silica and hosting bacterial partners who do the work of secreting the amino acids that keep the sponge alive in its deep, low-oxygen, lightless environment. **fig. 4**

This digression into an alien species' syncytium concludes the more-than-human polemic I have launched here. Astonishing forms are possible from the symbiotic engagement of cell and not-cell, working together in a synchrony of productive guests and adaptive hosts: not spheres and shells but syncytia and systems, not husks or rinds but interdependent matrices and meshworks, not tectonics but symbiontics. **24** Architecture can flourish like the adaptive, hospitable systems featured here, recognizing that it is already suffused by flows and linked by interrelations at every scale.

24 The editors ask, "does symbiontics cause us to reimagine housing, or airports, or mortgages?" Obviously, I hope it can—and welcome the collective needed for this reimagining. Keller Easterling, *Medium Design: Knowing How to Work on the World* (London: Verso, forthcoming 2021), has some suggestive outlines of one kind of adaptive, flexing, collaborative, guesting and hosting—in which architectural systems (mortgages no less than airports) must acknowledge aspects like the waste, nutrition, and gas exchange that support their emergence. "Solutions" for Easterling are often counter-intuitive and indirect, depending on attending to feedback loops of care and maintenance rather than driven by black boxes, debt loads, or shell construction.