

An admiring look at *The Evolution of the Sensitive Soul: Learning and the Origins of Consciousness* by Simona Ginsburg and Eva Jablonka

Arthur S. Reber

Department of Psychology, University of British Columbia

Ginsburg and Jablonka have crafted an ambitious, well-researched, thorough, and engagingly illustrated (by artist-physician Anna Zeligowski) overview of almost everything that's been done by almost everyone who's been involved in the study of consciousness. Of the many issues, theories, findings, conflicts, and debates discussed by Ginsburg and Jablonka (hereafter G & J), the one that most intrigues me is the *origin* of consciousness: when, where, and how did consciousness, sentience first emerge? My new book *The First Minds: Caterpillars, 'Karyotes, and Consciousness* (hereafter TFM), which is reviewed by G & J in this journal, focuses on this issue within a framework dubbed the Cellular Basis of Consciousness (CBC). It differs in interesting ways from the one put forward by G & J and I'll have more to say on the point of disconnect below.

G & J's volume is far reaching (putting it mildly). They provide us with a rich and detailed history of the field of consciousness studies in all its complexity wrapping up the package in the only ribbon that works, evolutionary biology. Along the way they touch on a spiraling array of issues in the philosophy of mind, the history of psychology, the cognitive sciences, artificial intelligence, neurobiology, neuroanatomy, computational modeling, evolutionary biology, origin-of-life studies, and much (much) more. I embrace their work, enjoyed the book, and have unending respect for the range and depth of their scholarship. I also think the answer they finally arrive at, siting the evolutionary origins of consciousness at the beginning of the Cambrian period (a proposition which they share with others), isn't quite right. But, as I hope to show, the nature of the divide between us may not be all that great.

Terminological concerns: Part of the disconnect is that G & J treat cognition, sentience, consciousness, awareness, subjectivity¹ in different ways depending on the species under consideration because their approach is based on the principle that the "computational power" (for want of a better term) of each of a number of learning mechanisms is causally linked with the form of consciousness experienced (or not). Early, primitive learning in what they argue are non-sentient species is viewed as non-associative and limited to processes such as habituation and sensitization. Later in evolution a limited associative learning (LAL) mechanism evolved

¹ They are sensitive to the crazy-quilt variety of near-synonymous terms and labels in use here and avoid the philosopher's trap to "define your terms, woman!" and employ them in what is basically a "folk psychology" way. I adopted the same strategy in TFM.

which, they maintain, supports the kinds of learning seen in some forms of conditioning. The full expression of consciousness, in their terms, emerges when the unlimited associative learning (UAL) system made its appearance during the Cambrian explosion which began some 540 million years ago.

They present these distinct epistemological systems in an intriguing parallel with Aristotle's three varieties of *soul*: a) the *nutritive/reproductive* which is found in all living species and operates without awareness, sentience, or subjectivity, b) the *sensitive* which is found in all and only animals, and c) the *rational* which is unique to the language-using members of the genus *Homo*. Sentience, minds, subjectivity, awareness are found initially at the second, the level of the "sensitive soul" of the title. The framework allows them to identify three transition points which gives rise to three (bridgeable) explanatory gaps. The first is the emergence of life itself from a pre-biotic molecular slurry. The second is the transition from a nonsentient form of existence to one with awareness, feelings, a sense of self with experiential qualia – it's the one that rides on the coat-tails of UAL. The third is the shift from a relatively uncomplicated cognitive life to the rational soul, the sophisticated, epistemically rich and complex manner of thought expressed most poignantly in humans. The first and third of these transitions are nonproblematical, even if there is still much to be learned about the operative processes and mechanisms. Few doubt that life emerged from fortuitous combinations of molecular forms and that evolutionary mechanisms took over from there. Even fewer have issues with recognizing that the transition to rational mentation expressed in humans is a dramatic step beyond the cognitive processes in other species. It's that second passage, the one from a non-sentient existence to one with a (minimalist) mind where the disconnect with the CBC model occurs.

Early on G & J state that "... we cannot attribute sentience or consciousness to a motile bacterium or a ripe tomato" (p. 11) but in the final chapter, in an exchange with their fanciful Talmudic muse Ipcha Mistabra who needles G & J for denying consciousness to sea slugs and, by extension, to prokaryotes,² they write: "We have no problem ascribing minimal cognition to ... bacteria, archaea, plants, fungi, and sponges, although distinctions between levels of cognition need to be made." In G & J's framework, cognition can take place in the absence of consciousness, sentience. Ipcha – whom I came to view as my dybbuk³ – continues his inquisition insisting that cells can be conscious only to be countered by G & J who vigorously defend their model. The core thesis of TFM is the very one that Mistabra offers, that consciousness began with life, that the earliest appearing and most primitive life forms had a

² I found this chapter engaging, evocative, amusing, and insightful. But then again, I'm a sucker for Talmudists and Platonic dialogues that read like a conversation between two rabbis who just happen to have PhD's in the neuro-psycho-philosophical-biosciences.

³ In Hebraic folklore a disembodied, restless spirit, usually malicious, that can wreck havoc with the living.

rudimentary form of what we can loosely, but with confidence, refer to as a *mind*.⁴ As is noted below, the characteristics, processes, and capacities that they ascribe to species they regard as having minimal consciousness (those that reflect the operations of UAL and cause the "sensitive soul" of the title) are, in fact, found in prokaryotes. I regard these features as hallmarks of an ontologically secure sentience, the stepping off place for consciousness, minds, experience.⁵ In my framework all forms of sentience are tokens of a single type. In G & J's each is a distinct type.

Why the Cambrian? Why, I wondered, do they assume that all the species that emerged in the great Cambrian explosion of speciation have this essential cognitive capacity? Surely one or more species, ones that were tumbling along in the hot, messy, dangerous ecological setting of that time bereft of awareness, sentience, consciousness would have failed to find it and their descendants should be here today, in our ecosphere, existing as sentient-free robots, carbon-based zombies. G & J maintain that the UAL mechanism is the causal element, the underlying functional capacity that gives rise to consciousness and that any species that evolves UAL will transition into a sentient one and that all, in order to survive the Ediacaran era and evolve, had to and did.

But this move only looks like it solves the problem. It don't think it does, any more than the efforts of others such as Feinberg and Mallatt (2013a,b) or Klein and Barron (2016), or Carel ten Cate and colleagues (see ten Cate & Okanoya, 2012) all of whom point to the Cambrian as the point where genuine consciousness emerged. In these attempts, the efforts are focused on one of two parallel research programs. Either: a) identify the neurological pathways and centers that are deemed responsible for human consciousness and work backwards through the evolutionary tree to find the species that first developed these neurological components or precursors of them or, b) identify the behavioral and cognitive functions that are diagnostic of sentience in humans and search for the earliest emergence of them or their precursors or – as G & J express it, search for homologues and analogues.

I have no problem with this research. In fact, I'm a big fan of it. Those working within these traditions have produced important insights into the evolution of sensorial, perceptual, motoric, affective, and cognitive functions. They've used evolutionary biology as the scaffold for understanding how many of these species developed and how their instantiations in different forms and in different ecological settings were realized – and G & J provide us with a thorough,

⁴ Recently, similar arguments were made by Miller, Torday, and Baluška (2019) who argue that evolution is driven by a self-referencing cognitive system and was so from the first appearance of living, unicellular organisms.

⁵ As noted, TFM is receiving a parallel review in this journal by Ginsburg and Jablonka who undoubtedly will have a few things to say about how I got it wrong. This is to be expected. That's how our game is best played. My hope is that they liked my book as much as I like theirs.

careful review of this literature. But these research programs do not and, I maintain, cannot answer the question of when and how sentience first appeared because it'd been there all along – long before the appropriate analogues and homologues were identified. What we see in the complex, varied forms of sentience in the species that developed during the Cambrian isn't the *emergence* of consciousness (or, in G & J's framework, the *transitioning* to the "sensitive soul" level), it's the *modification* of it through evolutionary mechanisms in the species that appeared during this era. Again: within the CBC framework, these newly sensitive souls represent novel *types* of mental life, not distinct *tokens* of it.

Moreover, primitive living, replicating, absorbing and excreting unicellular prokaryotes⁶ display a host of behaviors that reveal the operations of what looks a lot like an associative learning mechanism. They have elaborate sensory systems and gauge the valence of their experiences. They absorb molecules determined to be nutritious and block those that are not. They learn, form memories – in some cases ones that last up to two hours which is an eternity in a bacterial life-span. They make choices, learn simple alternating patterns (ABAB), communicate with each other both within microbial mats and between separate colonies. They show a form of altruism where part of a collective will adjust cell-division and nutrient absorption rates to accommodate the needs of colony mates. They are also sensitive to anesthetics and, when stressed, secrete them (see Baluska, et al., 2016; Chamberlain, et al., 2017). It is difficult to imagine why or how a species that did not experience pain or discomfort would be so equipped.

In their final chapter, while sparring with Ipcha, G & J acknowledge many of these features of prokaryote life but resist granting unicellular species sentience. Their position shares features with others like Daniel Dennett who, in his most recent work (2017), argues that these functions in prokaryotes are not driven by experiential factors but are merely robotic-like responses that are encoded in the bacterial DNA. There are problems with this stance that are discussed in TFM and in Baluška and Reber (2019). The key issue is that the life of a unicellular organism is faced with an environment in constant flux. There is a plethora of events, objects, other organisms that must be dealt with, escaped from, avoided, learned about. A series of fixed, nonsentient, non-reflective, reflex-like functions wouldn't be able to deal with the kinds of chaotic environments that the earliest life forms were confronted with. Non-sentience is an evolutionary non-starter (see Baluška, et al., 2016 where this point is made effectively and Baluška & Reber, 2019 where we follow-up on it). What was/is needed is consciousness, subjectivity, awareness, a tiny mind that assesses the valence of objects and events in its world, makes appropriate decisions, and undertakes effective actions – in short, an organism that, in Stevan Harnad's framework, *feels* (see Harnad, 2016). Just as all forms of life, extant and extinct, evolved from this first prokaryote, so did all varieties of consciousness up to and including ours.

⁶ Today's bacteria are, of course, descendants of the original species but assuming commonality here is the standard position in cell biology.

The Final Tally: I don't want the disagreement over the ontological status of bacterial sentience to diminish in any way my respect for the remarkable book G & J have written. It is the most thorough, scholarly, informed exegesis on consciousness I've ever read. Axel Cleeremans called it "Dennett on steroids." That's a good way to put it. Their approach is also built on what for me are essential elements of doing biological science: it's mechanistic, reductionist, falsifiable and bound up with fundamental principles of evolutionary biology. No mysterianism here, no panpsychism, no dualism, no unbridgeable explanatory gaps. And thankfully, consciousness itself is treated as a singular construct and not a mosaic of distinct mechanisms.

But (there's always a "but" in these discussions), despite the depth and reach of the effort, it doesn't solve Chalmers' famous Hard Problem of how the material makes the mental (see Chalmers, 1996). Nor does it *resolve* it – though in the very last sentence G & J amusingly hope they've helped *dissolve* it. The resolution I see is to bite the existential bullet offered by the CBC model. Consciousness began with life. It is as basic and fundamental a feature of life as reproduction or absorption of nutrients. When we have the final accounting of the operations and processes that guide the emergence of life from the pre-biotic watery mix of insoluble molecules that preceded it we will, I am quite certain, also discover that we have identified the operations and processes that are responsible for this first primitive expression of sentience and, I am equally certain, we will find that the two are inextricably entwined. Life and consciousness are co-terminous.

G & J maintain that their model is eminently testable. It is, but whether the empirical investigations would be into the origins of consciousness or the manner in which it is expressed in complex, multicellular animals is, well, to be determined. In TFM I also outline a variety of ways that cell biologists will be able to test the proposals of the CBC. In a recent paper (Baluška & Reber, 2019) we take the first stab at this problem by identifying several likely candidates for such a mechanism, ones linked with processes that operate in membrane excitability. The empirical future looks most interesting from both our and G & J's perspectives.

A few tidbits:

a) Jerry Fodor is identified as "cognitive psychologist" (p. 92). He wasn't. He was one of the most influential modern philosophers, both widely admired and vigorously critiqued. As journalist Stephen Metcalf put it in an obituary, "Everyone loved Jerry, even though he was wrong about everything." In the last decades of his life he embarked on a distinctly eccentric anti-Darwinian stance – to the consternation of his colleagues. Jerry and I were friends and I was at the first talk he gave on this topic. I found it confounding and impenetrable and the book that appeared later (Fodor & Piattelli-Palmarini, 2010) equally so.

b) On occasion early ethologist Lloyd Morgan's first name is Conwy, on others Conway. The former is correct.

c) G & J have a penchant for abbreviations, some from their model, some from others. UAL = universal associative learning, CSS = categorizing sensory state, etc. I understand the reasons for this – one being that spelling them all out would have made the book (especially Chapter 7) much longer – but there are occasions where it seemed like alphabet soup had been spilled on the page. In a single paragraph we find UAL, GNW, CSS, REIU, SIU, MIU, MEMU, and AU. My eyes glazed over; I had to give up....

d) Plants and fungi go untouched except for the throw-away line about tomatoes and the passing reference in the dialogue with Mistabra. In fact they are perhaps the only organic entities on the planet that do not receive a thorough, scholarly exegesis from G & J. In their world the only true minds are those found in the animal kingdom. In TFM I declared myself agnostic on this issue but as I read further and continue my collaboration with cell biologist František Baluška I find myself moving toward treating plants as sentient. The arguments here are complex and far from resolved but I'd like to know the reasons G & J had for carving flora off from fauna other than the issue of motility – which isn't necessarily criterial since plants do move, just slowly.

e) In the give and take with their muse Ipcha, they identified an interesting problem: if individual cells are conscious how can it be that it is lost in multicellular bodies? This, they maintain, is "absurd and has no biological meaning." (p. 460) In TFM I present a plausible mechanism through which this process might happen. I hope they note it in their review for I'm interested in how they critique it.

f) G & J review two dozen or so "biological and prerequisite causes" that have been put forward to explain the astonishing rate of speciation during the roughly 60 million years of the Cambrian. (pp. 412-415) It's worth noting that the Cambrian began soon after a critical biological "problem" was solved: multi-cellularity. It took several billion years but by the end of the Ediacaran period many successful multicellular species populated the planet and the range of potential adaptations grew exponentially.

g) G & J muse – with a vague sense of bewilderment – on how behaviorism came to dominate North American psychology and suspect that anti-hereditarianism played a significant role. It did, especially after the debacle of psychologists like H. H. Goddard arbitrarily sending immigrants back to their home counties if they didn't "pass" the hereditarianism-based tests he devised. But I don't think it was the key factor. In its early days experimental psychology on the west side of The Pond was dominated by a host of "schools" including structuralism, functionalism, "act" psychology, and various spin-offs. Their preferred technique, introspection, was hopelessly subjective and personal. The data base was a shambles. Replications were rare, journal fights routine. Watson's behaviorist proposal was greeted with what amounted to a collective sigh of relief and the hope that a hard-nosed research program would result in psychology becoming a genuine science.

h) Compatibility: It's important to recognize that my CBC model is fully compatible with G & J's approach – with the understanding that their transition to the "sensitive soul" wasn't an emergent moment in evolution but a gradual shift in the form of instantiation of a self-referencing awareness that was already present. Everything else that they argue for and defend empirically holds. This is why I noted at the outset that our positions aren't that different from each other.

i) Finally, about that those "almosts" in the first sentence of this review: I was amused that while G & J and I were writing books on the origins of consciousness and had published before on the topic, neither of us ever cited the other. I can only speak for myself here but my neglect of their work, which I have now come to admire and respect, is due simply to poor scholarship on my part. See Collins and Reber (2016) for how easily this kind of disconnect can happen.

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