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What if plants compute?

Commentary on **Segundo-Ortín & Calvo** on *Plant Sentience*

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Abstract: The unexpended cognitive capacities of plants suggest the possibility of combining them with advances in computation. It is important to explore such a new field of research despite the incompleteness of the empirical support for it.

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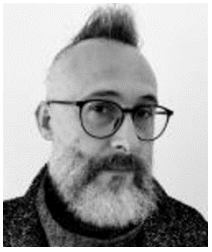

The new discoveries about the cognitive capacities of plants need to be connected with contemporary advances in the power of computation (Baluška & Levin, 2016). Do plants themselves compute? Or can they provide mechanisms for computing? Adamatzky et al. (2017) have shown that plants can provide a reliable way to design computational systems. It might be possible to combine them with computation following engineering principles because of their intrinsic mechanistic properties. Adamatzky (2019) suggests that using action potentials as multi-functional signals in plants, through their vascular network, specifically those of their leaves, can be implemented as a complete set of Boolean functions by selecting locations for stimulating and recording electrodes.

Unconventional computing establishes bridges on both sides: (1) applying engineering mechanisms to raw biological materials and (2) reverse-engineering how such biological systems are built to process complex information. Very basic and classic examples of bioinspiration for computational purposes are neural networks, genetic algorithms, neurochips, neuromorphic computing, and swarm intelligence, among a lost list. On the other side, the recent creation of xenobots based on Deep learning analysis of biological data (Kriegman, et al, 2020), reservoir computing with plants (Pieters, 2022), and mycelium computing using mushrooms all show that it is possible to implement not only computation but basic logic and belectronic circuits with mycelium (Adamatzky, 2018; Adamatzky et al. 2020).

I can still recall the surprise and dismissal occasioned by Paco Calvo's first ideas about plant cognition. After further reading in several fields, my interests converged on minimal cognition and plant cognition. Now there is the study of artificial cognition and the use of biologically inspired design in new computational systems such as those created in the past decade in the UWE Bristol Unconventional Computing Laboratory. The phylogenetic perspective of cognitive complexity has revealed mechanisms in minimal cognitive systems such as slime moulds (Vallverdú, 2018), that could be applied to other cognitive systems, such as the human one, or to designing for scientific purposes, as in network design (Tero et al, 2010). Minimal

cognition may provide a key to understanding complex cognitive systems, natural, mixed, or artificial.

References

Adamatzky, A. (2018). Towards fungal computer. Interface focus, 8(6), 20180029.

Adamatzky, A. (2019). Plant leaf computing. Biosystems, 182, 59-64.

Adamatzky, A., Tegelaar, M., Wosten, H. A., Powell, A. L., Beasley, A. E., & Mayne, R. (2020). On boolean gates in fungal colony. Biosystems, 193, 104138.

Adamatzky, A., Harding, S., Erokhin, V., Mayne, R., Gizzie, N., Baluška, F., Mancuso, S., & Sirakoulis, G. C. (2017). Computers from plants we never made: Speculations. In Inspired by Nature: Essays Presented to Julian F. Miller on the Occasion of his 60th Birthday (pp. 357-387). Cham: Springer International Publishing.

Baluška, F., & Levin, M. (2016). On having no head: cognition throughout biological systems. Frontiers in Psychology, 7, 902.

Kriegman, S., Blackiston, D., Levin, M., & Bongard, J. (2020). A scalable pipeline for designing reconfigurable organisms. Proceedings of the National Academy of Sciences, 117(4), 1853-1859.

Pieters, O. (2022). Reservoir Computing with Plants (Doctoral dissertation, Ghent University).

Segundo-Ortin, Miguel & Calvo, Paco (2023) Plant sentience? Between romanticism and denial. Science. *Animal Sentience*, 33(1).

Tero, A., Takagi, S., Saigusa, T., Ito, K., Bebber, D. P., Fricker, M. D., & Nakagaki, T. (2010). Rules for biologically inspired adaptive network design. Science, 327(5964), 439-442.

Vallverdú, J., Castro, O., Mayne, R., Talanov, M., Levin, M., Baluška, F., Yukio Gunji, P., Audrey Dussutour, Zenil, H. & Adamatzky, A. (2018). Slime mould: the fundamental mechanisms of biological cognition. Biosystems, 165, 57-70.