35 Platonism and biology

(Adapted from a chapter of the book Infinity put to the test by Antonio León[1])

Abstract.-A short discussion about the incompatibility of Platonism with neuroscience and evolutionary biology.
Keywords: Platonism, neuroscience, evolutionary biology, extravagances, abstract ideas.

35.1 Living beings as extravagant objects

1. In 1973 Dobzhansky published a celebrated paper whose title summarizes modern biological thought [16]:

> Nothing in Biology Makes Sense Except in the Light of Evolution.

I think it would have been more appropriate to write *reproduction* in the place of *evolution*[2] because, on the one hand, evolution is powered by reproduction; and on the other because only reproduction can account for the extravagances of living beings.

2. Living beings are, in fact, extravagant objects, i.e. objects with properties that cannot be derived exclusively from physical laws. To have red feathers, or yellow feathers, or to move by jumping, or to be devoured by the female in exchange for copulating with it, are examples (and the list would be interminable) of properties that cannot be derived exclusively from the physical laws but from the peculiar competitive and reproductive history of each organism. Thus, living beings are subjected to a biological law that dominates over all physical laws, the Law of Reproduction: *Reproduce as you might.*

3. The informational nature of living beings [31] and the law of reproduction make it possible the fixation of arbitrary extravagances. The success in reproducing depends upon certain characteristics of living beings that frequently have nothing to do with the efficient accomplishment of physical

[1] Next publication

[2] Of course, evolution is a natural process and denying it is so stupid as denying photosynthesis or glycolysis. Other thing is its theoretical explanation. As any scientific theory, the theory of organic evolution remains unfinished and currently opened to numerous discussions. See for instance [56], [6], [60], [45], [49], [38], [17], [44], [8], [22], [48], [7] etc

laws but with arbitrary preferences such as singing, or dancing, or having brilliant colors.

4. Although, on the other hand, to achieve reproduction is previously necessary to be alive, which in turn involves a lot of functional abilities related to the particular ecological niche each living being occupies. But this is in fact secondary: adapted and efficient as an organism may be, if it does not reproduce, all its physical excellence will be immediately removed from the biosphere. The Law of Reproduction opens the door to innovations in living beings, and then almost anything can be expected. Even writing this.

35.2 Biology and abstract knowledge

5. Living beings are topically viewed as systems efficiently adapted to their environment. No attention is usually payed to their extravagant nature, although being extravagant is a very remarkable feature. We, living beings, are the only (known) extravagant objects in the Universe. By the way, those extravagances could only be the result of a capricious evolution, not of an *intelligent design* as creationists defend. Capricious evolution restricted by the physical laws governing the world.

6. One of the latest extravagances appeared in the biosphere is the consciousness exhibited by, at least, most of the human beings. Surely, that sensation of individual subjectivity is responsible for some peculiar ways of interpreting the world, as platonic essentialism, the belief that ideas do exist independently of the mind that elaborate them.

7. Animals do have the ability to compose abstract representations of their environment, particularly of all those objects and processes involved in their survival and reproduction. A leopard, for instance, has in its brain the (abstract) idea of gazelle, it knows what to do with a gazelle (as is well known by gazelles), whatsoever be the *particular* gazelle it encounters with. The abstract idea of gazelle, and of any other thing, is elaborated in the brain by means of different components (the so called atoms of knowledge) that not only serve to form the idea of gazelle but of many other abstract ideas.

8. And not only ideas, sensorial perceptions are also elaborated, by similar processes, in atomic and abstract terms,[3] which surely also serves to filter the irrelevant details of the highly variable and useless information

[3] [66], [41]

coming from the physical world, and thus to identify with sufficient security the (biologically) significant objects and process that form part of their ecological niches.

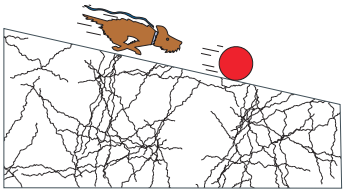

Figura 35.1 – The dog *'knows'* the logic of the physical world; the ball does not.

9. To have the ability of composing abstract representations of the world is indispensable for animals in order to survive and reproduce, And a mistake in this affair may cost them the higher of the prices. A ball rolling down towards a precipice will not stop to avoid falling down; but the dog running behind it, will do; dogs *know* gravity and its consequences. Animals interact with their surroundings and need to know its singularities, its peculiar ways of being and evolving, i.e. its physical logic, and even its mathematical logic.[4]

10. Animals need abstract representations of the physical world, and that is not a minor detail (the maintenance and continuous functioning of this internal representation of the world consumes up to 80 % of the total energy consumed by a human brain [43].) It must be an efficient and precise representation, if not animal life would be impossible. It is through their own actions and experiences, including imitation and innovation[5] that they develop their neurobiological representation of the world in symbolic and abstract terms. The cortex behavior depends more on the neuronal circuits developed through the history of stimuli each individual receives than on the activity of this or that gene in this or that area of his brain [18], [30]. Is is then clear that:

> Abstract knowledge built on individual actions and experiences is indispensable for animal life.

11. Perception and cognition are constructive neuronal processes in which elementary units of abstract knowledge are involved. The processes take place in different brain areas, as we are now beginning to know with certain

[4] Primates and humans could dispose of neural networks to deal with numbers [14], [15], [25].
[5] [28], [21], [46], [64]

detail.[6] This way of functioning seems incompatible with platonic essentialism. Accordingly, concepts and ideas seem to be brain elaborations rather than transcendent entities we have the ability to connect with. Through our personal cognitive actions and experiences (that, in addition, have a transpersonal cumulative potential through cultural heritage and cultural networks) we have end up by developing that great cognitive system we call science.

12. The consciousness of ideas and the ability of recursive thinking (perhaps an exclusive ability of humans[7]) could have promoted the raising and persistence of platonic essentialism. But that way of thinking is simply incompatible with both evolutionary biology [40] and neurobiology. It seems reasonable that Plato were platonic in Plato times, but it is certainly surprising the persistence of that old way of thinking in the community of contemporary mathematicians. Though, as could be expected, a certain level of disagreement on this affair also exists.[8] It is remarkable the fact that many non platonic authors, such as Wittgenstein, were against both the actual infinity and self-reference [39], two capital concepts in the history of platonic mathematics.

13. The reader may come to his own conclusions on the consequences the above biological criticism of platonic essentialism could have on self-reference and the actual infinity. Although, evidently, he can also maintain that he does not know through neural networks and persists in his platonic habits. But for those of us that believe in the organic nature of our brains and in its abilities of perceiving and knowing modeled through more than 3600 millions years of implacable organic evolution, platonism has no longer sense. The actual infinity and self-reference could lose all their meaning away from the platonic scenario

14. In my opinion, the actual infinity hypothesis is not only useless in order to explain the physical world, it is also annoying in certain disciplines as quantum gravity and quantum electrodynamics (renormalization[9]). Physics[10] and even mathematics[11] could go without it.[12] Experimental

[6] [47], [10], [55], [11], [29], [12], [51]
[7] [9], [25]
[8] [35], [32], [36], [4]
[9] [20], [27], [34], [65], [50], [59], [2].
[10] [52], [54]
[11] [42], [53]
[12] Except transfinite arithmetic and other related areas, most of contemporary mathematics are compatible with the potential infinity, including key concepts as those of limit or integral

sciences as chemistry, biology and geology have never been related to it. The potential infinity would suffice.[13] Even the number of distinguishable sites in the universe could be finite [26]. Matter, energy, and electric charge seem to be discrete entities with indivisible minima; space and time could also be of the same discrete nature, as is being suggested from some areas of contemporary physics.[14]

15. Beyond Planck's scale nature seems to lose all its physical sense. As the actual infinity and self-reference, the continuum spacetime could only be a useless rhetorical device. The reader can finally imagine the enormous simplification of mathematics and physics once liberated from the burden of the actual infinity and self-reference. Perhaps we should give Ockham razor a chance.

[13] Some contemporary cosmological theories, as the theory of multiverse [13] or the theory of cyclic universe [61], make use of the infinity in a rather imprecise way

[14] [23], [24] [63], [19], [57], [3] [58], [1], [37], [62], [5], [33], [5], [62]

Chapter References

[1] Jan Ambjorn, Jerzy Jurkiewicz, and Renate Loll, *El universo cuántico autoorganizado*, Investigación y Ciencia **384** (2008), 20–27.

[2] Charis Anastopoulos, *Particle or Wave. The evolution of the concept of matter in modern physics*, Princeton University Press, New Jersey, 2008.

[3] John Baez, *The Quantum of Area?*, Nature **421** (2003), 702 – 703.

[4] Mark Balaguer, *Platonism and Anti-platonism in Mathematics*, Oxford University Press, New York, 2001.

[5] Jacob D. Bekenstein, *La información en un universo holográfico*, Investigación y Ciencia **325** (2003), 36–43.

[6] Ernest Boesiger, *Teorías evolucionistas posteriores a Lamrck y Darwin*, Estudios sobre la filosofía de la biología (Francisco J. Ayala and Theodosius Dobzhansky, eds.), Ariel, 1983, pp. 45–74.

[7] Sean B. Carroll, Benjamin Proud'home, and Nicolas Gompel, *La regulación de la evolución*, Investigación y Ciencia **382** (2008), 24–31.

[8] Carlos Castrodeza, *Los límites de la historia natural. Hacia una nueva biología del conocimiento*, Akal, Madrid, 2003.

[9] Michael C. Corballis, *Pensamiento recursivo*, Mente y Cerebro **27** (2007), 78–87.

[10] Antonio Damasio, *Creación cerebral de la mente*, Investigación y Ciencia (2000), 66–71.

[11] Antonio Damasio, *El error de Descartes*, Crítica, Barcelona, 2003.

[12] ———, *Y el cerebro creó al hombre*, Destino, Barcelona, 2010.

[13] P. C. W. Davies, *Multiverse Cosmological Models*, Mod. Phys. Lett. A **19** (2004), 727–743.

[14] Stanislas Dehaene, Nicolas Molkoand Laurent Cohen, and Anna J. Wilson, *Arithmetic and the Brain*, Curr. Opin. Neurobiol. **14** (2004), 218–224.

[15] Stanilas Dehane, *Bases biológicas de la aritmética elemental*, Mente y Cerebro **25** (2007), 62–67.

[16] Theodosius Dobzhansky, *Nothing in biology makes sense except in the light of evolution*, American Biology Teacher **35** (1973), 125–129.

[17] Niles Eldredge, *Síntesis inacabada. Jerarquías biológicas y pensamiento evolutivo moderno*, Fondo de Cultura Económica, Mexico, 1997.

[18] Michael J. Hawrylycz et al., *An Anatomically Comprehensive Atlas of the Adult Human Brain Transcriptome*, Nature **489** (2012), 391–399.

[19] José L. Fernández Barbón, *Geometría no conmutativa y espaciotiempo cuántico.*, Investigación y Ciencia (2005), no. 342, 60–69.

[20] Richard Feynman, *Superstrings: A Theory of Everything?*, Superstrings: A Theory of Everything? (Paul Davis and Julian Brown, eds.), Cambridge University Press, Cambridge, 1988.

[21] Valeria Gazzola, Lisa Aziz-Zadih, and Christian Keysers, *Empathy and the Somatotopic Auditory Mirror System in Humans*, Curr. Biol. **19** (2006), 1824–1829.

[22] Stephen Jay Gould, *Acabo de llegar: el final de un principio en la historia natural*, Crítica, Barcelona, 2003.

[23] Brian Greene, *El universo elegante*, Editorial Crítica, Barcelona, 2001.

[24] ———, *The Fabric of the Cosmos. Space, Time, and the Texture of Reality*, Alfred A. Knopf, New York, 2004.

[25] Marc D. Hauser, *Mentes animales*, El nuevo humanismo y las fronteras de la ciencia (John Brockman, ed.), Kairós, Barcelona, 2007, pp. 113–136.

[26] Craig J. Hogan, *El libro del Big Bang*, Alianza, Madrid, 2005.

[27] Gerard't Hooft, *Partículas elementales*, Crítica, Barcelona, 1991.

[28] Evelyne Kohler, Christian Keysers, Alessandra Ulmitá, Leonardo Fogassi, Vittorio Gallese, and Giacomo Rizzolati, *Hearing Sounds, Understanding Actions: Action Representation in Mirror Neurons*, Science **297** (2002), 846–848.

[29] Dharshan Kumara, Jennifer J. Summerfield, Demis Hassabis, and Eleonor A. Maguire, *Tracking the Emergence of Conceptual Knowledge during Human Decision Making*, Neuron **63** (2009), 889–901.

[30] Ed Leind and Mike Hawrylycz, *The genetic geography of the brain*, Sci. Amer. (2014), 71–77.

[31] Antonio Leon, *Living beings as informed systems: towards a physical theory of information*, Journal of Biological Systems **4** (1996), no. 4, 565 – 584.

[32] Bernard Linsky and Edward N. Zalta, *Naturalized Platonism vs Platonized Naturalism*, J. Philos. **XCII/10** (1995), 525–555.

[33] Seth Loyd and Y. Jack Ng, *Computación en agujeros negros*, Investigación y Ciencia (Scientifc American) (2005), no. 340, 59 – 67.

[34] Jean Pierre Lumient and Marc Lachièze-Rey, *La physique et l'infini*, Flammarion, Paris, 1994.

[35] Penelope Maddy, *Perception and Mathematical Intuition*, The Philosophical Review **89** (1980), 163–196.

[36] ———, *Naturalism in Mathematics*, Oxford University Press, New York, 1997.

[37] Shahn Majid, *Quantum space time and physical reality*, On Space and Time (Shahn Majid, ed.), Cambridge University Press, New York, 2008.

[38] Lynn Margulis, *Teoría de la simbiosis: las células como comunidades microbianas*, Evolución ambiental (Lynn Margulis and Lorraine Olendzenski, eds.), Alianza, Madrid, 1996, pp. 157–182.

[39] Mathieu Marion, *Wittgenstein, finitism and the foundations of mathematics*, Clarendon Press Oxford, Oxford, 1998.

[40] Ernst Mayr, *The Growth of Biological Thought*, Harvard University Press, Cambirdge MA, 1982.

[41] Francisco Mora, *Cómo funciona el cerebro*, Alianza, Madrid, 2007.

[42] Jan Mycielski, *Analysis without actual Infinite*, The Journal of Symbolic Logic **46** (1981), no. 3, 625 – 633.

[43] Marcus E. Raichle, *The Brain's Dark Energy*, Science **319** (2006), 1249–1250.

[44] Robert J. Richards, *El significado de la evolución. La construcción morfológica y la reconstrucción ideológica de la teoría de Darwin*, Alianza, Madrid, 1998.

[45] Mark Ridley, *La evolución y sus problemas*, Pirámide, Madrid, 1985.

[46] Giacomo Rizzolati, Leonardo Fogassi, and Vittorio Gallese, *Neuronas espejo:*, Investigación y Ciencia **364** (2007), 14–21.

[47] Adina L. Roskies, *The Binding problem*, Neuron **24** (1999), 7–9.

[48] Javier Sampedro, *Deconstruyendo a Darwin*, Crítica, 2007.

[49] Máximo Sandín, *Lamarck y los mensajeros. La función de los virus en la evolución*, Istmo, Madrid, 1995.

[50] Bruce A. Schumm, *Deep Down Things. The Breathtaking Beauty of Particle Physics*, The Johns Hopkins University Press, Baltimore, 2004.

[51] Sebastian Seung, *Connectome. How the brain's wiring makes us who we are*, Houghton Mifflin Harcourt, New York, 2012.

[52] Hourya Sinaceur, *Le fini et l'infini*, Infini des mathématiciens, infini des philosophes (Fran çoise Monnoyeur, ed.), Belin, Paris, 1992.

[53] ———, *¿existen los números infinitos?*, Mundo Científico(La Recherche) **Extra: El Universo de los números** (2001), 24 – 31.

[54] Hourya Sinaceur and J. M. Salanski(eds.), *Le labyrinthe du continu*, Springer-Verlag, Berlin, 1992.

[55] Wolf Singer, *Consciousness and the Binding Problem*, Ann. N.Y. Acad. Sci. **929** (2001), 123–146.

[56] J. Maynard Smith, D. Bohm, M. Green, and C. H. Waddington, *El status del neodarwinismo*, Hacia una Biología Teórica (C. H. Waddington, ed.), Alianza, Madrid, 1976, pp. 295 – 324.

[57] Lee Smolin, *Three roads to quantum gravity. A new understanding of space, time and the universe*, Phoenix, London, 2003.

[58] Lee Smolin, *Átomos del espacio y del tiempo*, Investigación y Ciencia (2004), no. 330, 58 – 67.

[59] ———, *The trouble with physics*, Allen Lane. Penguin Books, London, 2007.

[60] Steven M. Stanley, *El nuevo cómputo de la evolución*, Siglo XXI, Madrid, 1986.

[61] Paul Steinhardt, *El universo cíclico*, El nuevo humanismo y las froteras de la ciencia (John Brockman, ed.), Kairós, Barcelona, 2008, pp. 363–379.

[62] Leonard Susskind, *Los agujeros negros y la paradoja de la información*, Investigación y Ciencia (Scientifc American) (1997), no. 249, 12 – 18.

[63] Gabriele Veneziano, *El universo antes de la Gran Explosión*, Investigación y Ciencia (Scientifc American) (2004), no. 334, 58 – 67.

[64] Klaus Wilhelm, *La cultura entre los primates*, Mente y Cerebro **29** (2008), 66–71.

[65] F. J. Ynduráin, *Electrones, neutrinos y quarks*, Crítica, Barcelona, 2001.

[66] Semir Zeki, *Una visión del cerebro*, Ariel, Barcelona, 1995.