Biosemiotics
https://doi.org/10.1007/s12304-022-09475-x

COMMENTARY

Neither Dogmas nor Barriers are absolute: reply to commentary by Koen B Tanghe

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Received: 9 February 2022 / Accepted: 22 February 2022

Abstract

The Weismann Barrier and the Central Dogma do not protect the assumptions of The Modern Synthesis.

Keywords Weismann Barrier · Central Dogma · Modern synthesis · Transposable elements

Weismann Barrier

Whatever historical interpretation one may put on Weismann's 19th C Germ-plasm theory, the conclusion that

> "This indisputable fact that genes are exclusively derived from ancestral genes (and not from the soma) is still the main reason why somatically acquired characters or variations cannot be genetically transmitted to subsequent generations." (Tanghe, 2021)

is incompatible with recent experimental discoveries to which I drew attention in both the Target article (Noble, 2021a) and my reply to the first 20 Commentary articles (Noble, 2021b). Nucleic acid sequences developed by somatic tissues have been shown to be transmitted to the germline cells (Lavitrano et al., 2006; Cossetti et al., 2014; Chen et al., 2016; Chen, Yan & Duan, 2016; Spadafora, 2018; Zhang et al., 2018; Skvortsova et al., 2018; Noble, 2019) and, just like viral RNA or DNA sequences, there is nothing to prevent them being incorporated into the genetic inheritance of future generations. More than half of human DNA consists in Transpos-

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Published online: 11 April 2022

able Elements, TEs (Landers et al. 2001; O'Neill et al., 2020, Nishihara, 2020; Senft & Macfarlan, 2021), including elements of viral origin. What are needed now are more experiments on specific nucleotide sequences that can achieve the trans-generational transmission of maternal or paternal characteristics. A good example is the work of Zhang et al. (2018) showing the nucleotides that transmit paternally-acquired metabolic disorders. This is an important field for future work on the inheritance of acquired characteristics.

Furthermore, the Weismann Barrier doctrine was always a metazoan-specific idea, not applicable to plants, protists, and other eukaryotes that form the germline from somatic tissue. And even in animals, the germline develops from cells that have undergone an early embryonic development in which they were not segregated from the progenitors of the somatic tissues (Hikabe et al., 2016).

The Central Dogma of Molecular Biology

Similarly, however one may interpret Crick's intention in formulating (originally in 1958) and then re-formulating (Crick, 1970) his Central Dogma, his statements cannot exclude new and functionally-selected nucleotide sequences being incorporated into the genetic material by reverse transcription, or being created anew by controlling the cellular proof-reading error-correcting processes in response to environmental stress. The immune system does this all the time, while other cells and tissues do so when under challenge. This is how cancer tumours rapidly radiate their genomic forms (see references in Shapiro & Noble, 2021). All that living systems have to do to achieve this is to regulate the massively effective proof-correcting machinery in their cells to generate many new DNA variants from which they can actively select (Noble, 2018). The statement

> "genomes or organisms cannot at will generate *adaptive* genetic mutations, let alone insert in the genetic code somatically acquired variations." (Tanghe, 2021)

is therefore incorrect. Organisms can use selection within themselves to favour successful functional changes in their genomes, and they do so in reaction to environmental stress. This can form functionally useful acquired characteristics, which can then be transmitted to future generations. Genomic re-organisation in response to stress (first discovered by the Nobel Laureate, Barbara McClintock) also accounts for the progressive accretion and recombination of functional domains during evolution, first discovered by the Human Genome Project (Landers, et al. 2001, Fig. 42, see explanation in Shapiro, 2011, pp. 95–96; Noble 2016, pp 200–204). Accumulation of random small mutations could not possibly achieve this result even over the roughly half billion years since the Cambrian Explosion.

Neither Dogmas nor Barriers can be absolute in living organisms since they are open systems. The molecular level of nucleotide sequences is therefore open to environmentally-induced changes. Indeed, it is the most highly-constrained level of organisation (Noble & Noble, 2021, Fig. 3). That is why forms of inheritance of reac-

tions of the genome to environmental stress cannot be excluded, and certainly not *a priori* independently of experimental facts.

Acknowledgements I thank James Shapiro and Perry Marshall for helpful comments. I am grateful to Koen Tanghe for his insightful Commentary (Tanghe, 2021). I particularly appreciate his historical clarifications of interpretations of Lamarck. But I cannot agree with Tanghe's conclusions regarding the Weismann Barrier and the Central Dogma.

Declarations

Conflicts of interest No funding supported this work. There are no conflicts of interest.

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