Natural Genetic Engineering and Natural Genome Editing

Edited by
GÜNTHER WITZANY

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Editor

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Introduction

A Perspective on Natural Genetic Engineering and Natural Genome Editing

In 1983, when I finished my studies of philosophies of language and science—in particular pragmatic action theory—I did not know the direction my research interests would take. In the ensuing four years, I studied a number of articles concerning different subjects in biology and was struck by the key vocabulary that was used for the description of the essential activities of cellular life, such as "genetic code," "genetic information," "cell–cell communication," "nucleotide sequences," "protein coding sequences," "self/nonself recognition"—all of which connote themes of communication and exchange of information, similar to the themes I had encountered in my studies of philosophy and action theory. Of particular influence on my thinking were the articles and books of Karl von Frisch, who received the Nobel Prize for his work on the language of bees; and a book by Manfred Eigen, in which he developed a profound argument for the idea that the genetic code functions not only as an analogue of natural human language but that both the evolution of life and the evolution of the mind crucially depend on the characteristic features of languages.

According to these and many other results of the discourse in the philosophy of science in the 20th century (especially between 1920 and 1980), it was clear that if the genetic code functions like a natural language then a variety of consequences follow because several preconditions must have been met. First, considering the genetic code as a natural language requires there to be a repertoire of signs (indices, icons, symbols)[a] that can be combinatorially arranged according to syntactic rules, similar to words composed of the characters of the alphabet, to generate information. Without syntactic rules to determine correct sequence order, the combination of signs could not carry informational content, that is, meaning (similarly, if our natural language had no syntactic rules, meaning could not be ascribed to randomly generated collections of words). In other words, a coherent syntax excludes randomly derived mixtures of characters of an alphabet; and for humans, coherent syntax is generated by humans who are competent with the syntactic rules. This book, for example, could contain the same characters but in a random order; such a book would be meaningless. Without competent authors who combine the characters according to a set of coherent syntactic and semantic rules, meaning does not exist.

Signs cannot exist or function without sign-using agents, and agents generate signs to communicate. In communicative action, agents can both exchange messages about

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[a] According to the founder of semiotics, Charles Sanders Peirce, we are able to differentiate three different kinds of signs: indices, icons, and symbols. Indices are, in most cases, abiotic stimuli from the environment that are interpreted in the realm of memory, for example, a plant root identifies nutrients as being relevant, just as the plant shoot does with the angle of sunlight. Icons are biotic one-to-one signals (analogue) that need no further explanation, for example, plant cells identify auxin in a hormonal coordination process. There are also symbols, that is, signs or sequences of signs, like characters of an alphabet used to generate words, sentences, codes, which do not indicate by themselves what they mean (what their function could be) but are signs through natural or cultural conventions. Such sequences may also be sequences of behaviors, like the dance of the honey bees in colder hemispheres.