

Ute Deichmann, Ben-Gurion University of the Negev: “The Concept of the Causal Role of Chromosomes and Genes in Heredity and Development and its Opponents from Darwin to Lysenko”

ABSTRACT: In 1865 Mendel laid down the basis of modern genetics by empirically relating discrete and blending phenomena of heredity to the combination of elements in the cell in a statistically predictable way. Three years later, 1868, Darwin proposed his speculative theory of Pangenesis, a comprehensive theory of heredity and development. Pangenesis, by attributing a causal role for heredity and development to the environment, was a materialistic theory for so-called Lamarckian inheritance.

Despite its fruitfulness for future genetic research, the notions of independent genes and randomness appeared unappealing and insufficient to many for explaining complex biological phenomena, such as development. I show that philosophical outlooks played a significant role in scientists’ rejection of genes as causal factors. Among them were widespread "Lamarckian" and holistic predilections as well as vitalistic assumptions of the existence of a pre-established design and non-material guiding principle. Apart from very few scientists, prominent among them Boveri and Wilson, mechanistic biologists, too, refrained from dealing with the role of genes in development or relativized it. A long conceptual gap between genetics and developmental biology ensued.

The strongest attack on the causal role of genes was launched by agronomist and politician Lysenko in Stalinist Russia. Brushing aside "Mendelist-Morganist" methods and the notion of randomness therein, he put forward a holistic concept of heredity, which incorporated development and heritable responses to environmental conditions, in fact, not altogether dissimilar to Darwin's Pangenesis, though of course some sixty years later. As is well known, Lysenko's pre- and antiscientific views became the official genetic doctrine in the Soviet Union for decades.

This paper will review the fertility of approaches based on the causal role of genes, and competing approaches, in early research on heredity and development and

analyze the motivations behind them. I argue that the recognition of genetic causality was a prerequisite for fruitful experimental research related to heredity and development. Significantly, this role was not called into question by the recent systems approaches based on embryological gene regulatory networks founded by Davidson in the late 20th century. “Epigenetic” changes, too, were recently shown to be dependent on the genomic sequence, i.e. they are controlled by sequence specific DNA recognition events and transcriptional networks.