

Keller aims less to supply the new concepts and words than to clear intellectual space for their arrival. Her main target for removal is the concept of the gene. According to Keller, that reductionist concept dominated the science of heredity in the twentieth century, her 'century of the gene'. In each of her four chapters, she aims to show how a certain feature of the concept emerged, and how recent discoveries about heredity, development and evolution have stretched the concept to its limits, indeed beyond them. Although she declares the concept defunct, she predicts that the word 'gene' will live on, for reasons to do with, among other things, the way its ambiguities can be exploited and contained in the cultures of individual laboratories, and its usefulness to biotech firms, which depend on gene talk to conjure reassuringly simple images of their products.

The first two chapters deal with gene structure and function, respectively. Genes retain their basic structure with remarkable fidelity over the generations. On the concept of the gene, Keller argues, genes were like atoms, and their stability taken for granted. But it now appears that stability arises through the active interplay of molecules that proof-read, repair and so on. This shift in understanding gene stability has, in turn, led to a shift in understanding gene instability. The genetic changes that feed natural selection now appear to be copying errors left untidied; it may even be that maintenance systems have evolved to become error-prone under stressful conditions (Keller borrows Richard Dawkins' phrase, 'the evolution of evolvability', to describe this possibility). As for gene function, Keller holds that the concept of the gene was guilty not so much of omission as oversimplification. Since the discovery that genes can come in parts, in exons separated by introns, the cell has been reconceived as combining transcripts of the parts in different ways, enabling it to synthesize different enzymes from the same bit of DNA, according to the needs of the organism at a particular moment. Once assembled, these enzymes can have their structures and functions further modified through the binding of other molecules.

The third and fourth chapters stay with the theme of gene function, but explore it in connection with the development of the organism. Keller argues that talk of 'gene activation' and a 'genetic programme', while going some way towards picturing genes as interacting with one another, nevertheless reinforced one of the core features of the gene concept, that chains of causation affecting development begin with the genes. In the third chapter, Keller discusses recent findings about the causal

contributions of chromatin and the cytoplasm, and urges new talk of a 'developmental programme', distributed throughout the fertilized egg. The fourth chapter makes a similarly anti-reductionist case against regarding genes as controlling the regulation of development. When genes in the developing organism are 'knocked out' experimentally, the organism often will develop just fine, thanks to the existence of lots of other genes capable of performing the same function. Such massive redundancy leads Keller to speculate that perhaps what is selected is not so much the gene or the organism but the organism's life-cycle.

Although brief, this book is packed with good things. The historical analysis is unfailingly interesting, the scientific reportage lucid. Best of all, perhaps, is the sheer excitement the book communicates about the state of genetics and the need to get that state into proper focus, using all the intellectual resources going. Whether Keller's own attempt succeeds is another matter. Like many historians and philosophers of science, I am impressed by the diversity of gene concepts contained within what Keller sees (with caveats, and apologies in the footnotes) as a single concept. Keller's position has its defenders, however, and her own contribution to the case for conceptual unity is an important one. Less fortunate is her reticence about the connections between her anti-reductionist message and the arguments on gender politics that previously sustained that message. In brief, Keller used to argue that there were ideological affinities between the reductionist concept of the gene (linear, hierarchical) and male domination of women; indeed, that the reductionist concept of the gene was a masculine concept, against which McClintock, with her woman's 'feeling for the organism', had to struggle. Perhaps Keller gestures obliquely towards this argument when she suggests in her final sentence that 'new concepts can open innovative ground where scientists and lay persons can think and act together to develop policy that is both politically and scientifically realistic.' As it stands, however, that sentence has the ring of platitude. Such an impassioned book deserved better.

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Books received

The Origin, Expansion and Demise of Plant Species. Donald A. Levin. Oxford University Press, Oxford. 2000. Pp. 230. Price £24.95, paperback. ISBN 0 19 512729 3.