Raphael Falk, *Genetic Analysis: A History of Genetic Thinking*, Cambridge: Cambridge University Press, 2010 (paperback), 344 pp

Many histories of genetics have been written by (former) geneticists (Sturtevant 2001 [1965]; Dunn 1965; Stubbe 1972) and this book follows this tradition. Its author worked in the field for several decades before he turned to the history and philosophy of biology. Nevertheless, this book is far from being the kind of history of heroic discoveries that scientists write in order to maintain the social order in their field, demarcate their discipline or underline claims of priority (see Abir-Am 1982 for such strategies). Indeed, Raphael Falk´s writing in the history and philosophy of biology in general and on genetics in particular was characterized by a critical attitude from the beginning. He scrutinized central concepts, such as the gene (Falk 1986), or dominance (Falk 1991) that have been taken for granted by practicing scientists and sometimes also by philosophers and historians, and he showed through historical analysis how they acquired their status as apparently self-evident building blocks of biological knowledge. This book continues this thread, without, however, being a mere collection of previously published articles. Instead, in the book Falk weaves a longue durée history of genetic thinking that not only presents new material, but also points out relations between developments he has described in earlier works.

The question is rather how the book relates to the many other histories of genetics that have accumulated since the mid of the 20th century. While many books in the field are either restricted to (roughly) the period from Mendel´s experiments (or their rediscovery) to the molecularization of genetics in the 1950´s (Carlson 1966; Bowler 1989) or concentrate only on the molecular era (Morange 2000; Kay 2000), others set the focus on particular events such as Crick and Watson´s formulation of a model for the structure of DNA in 1953 (Olby 1974) or the elucidation of protein synthesis in the 1950s (Rheinberger 1997). Falk´s book, instead, covers the ground from Mendel to modern genomics, paying attention to the effects of genetic thinking on evolutionary and developmental biology as well.

While other recent long term histories of genetics broaden the perspective towards the prehistory of Mendelism as well as the cultural background and repercussions of genetic knowledge (Müller-Wille and Rheinberger 2009), Falk´s narrative remains within the more narrowly defined boundaries of scientific developments. It is, however, neither a history of ideas, nor a history of objects. It is a book on the history of scientific practice in genetics, but not in the sense of what came to be called

the material practice of science, the building blocks or representational output of experimental systems. The book rather follows the history of what can best be described as a research methodology: genetic analysis.

The shortest definition of this methodology that can be found in the book states that "Genetic analysis is the art of analyzing the phenomena of heredity by hybridization" (4). The book "presents the study of inheritance as a conception directed by a methodology. As such the book is organized as a historical study of the design of experimental evidence and its application to genetic theories" (4).

The book is structured in seven parts, which in turn comprise several chapters. The parts do roughly cover successive periods in the history of genetics, but, since they focus on different aspects of genetic analysis, they partly look at the same series of developments from different angles, which results in a rich and complex picture of genetic thinking.

The first part concentrates on the distinction between the hybridist and morphogenist traditions in natural history. According to Falk, the former is associated with Linnaeus and utilizes hybridization of plants and animals to determine the types of beings given in nature, while the second is rather associated with Buffon, Lamarck and Darwin and characterized by a nominalist account on classification and the acknowledgement of change in the forms of organisms. Falk then continues by explaining Mendel´s approach as being rooted in the hybridist tradition. The second part shows how the persistence of the two traditions structured the negotiations concerning the relations of Mendelian factors and observable characteristics of organisms in the beginning of the 20th century. The third part describes the interaction of genetics and cytology, that resulted in the chromosome theory of inheritance in the hands of the Morgan school. It becomes clear that cytological findings do not only explain genetic problems, but that genetic analysis can be used to study cellular structures. Part IV reconstructs the attempts to move from an instrumental to a material understanding of the gene, in particular in the context of mutagenesis experiments by Muller and others. The fifth part elaborates the transition (though not paradigm shift) from classical genetics to molecular genetics, in particular in the context of bacteria-phage systems. Part VI shows how the picture of gene function became increasingly complicated, especially in the context of developmental biology. The seventh part, finally, discusses how, even if conceptual reductionism was overcome, genetic analysis as a methodology remains an integral part of biology in the genomic and post-genomic era.

Even if the history of genetic thinking is told in adequate complexity, such a history necessarily has to suffer from the fact that the focus on one aspect of biological thinking results in a somewhat biased view. Since the

gene has become such a central concept in biology, historians and philosophers have paid much attention to its genesis. In this way, by analysing and at times criticizing the genocentricity of biologists, historians and philosophers have become somewhat genocentric themselves. For instance, the mere fact that there are more histories written on genetics than on embryology makes the latter discipline look marginal, which reinforces the view that biology became dominated by genetic ideas. In a way this book reinforces this trend. But as I said, every history must be selective and at least this leaves space for further explorations in the history of biology.

There are two related historiographic themes that structure the historical analysis of genetics. One concerns the dialectic between methodological reductionism and conceptual reductionism. The other deals with the alleged break between classical and molecular genetics.

With respect to the first theme, Falk observes that genetic analysis is "characterized by methodological reductionism, the assumption that empirically following single variables is the effective way to bridge realms" (4). This does not imply, though, that genetic analysis entails conceptual reductionism, which holds that phenomena are determined and thus can be explained through the individual action of, or interaction between components on a more basic level. Indeed, geneticists who embraced conceptual reductionism and those who denied it could work together under the same methodological reductionist research agenda as exemplified by Thomas Hunt Morgan and his student Hermann Muller. While Morgan restricted himself to methodological reductionism and thus conceptualized the gene as an instrumental variable, Muller pushed towards a material understanding of the gene, which entailed conceptual reductionism (see esp. Parts III and IV). And even if conceptual reductionism dominated for some time, epitomized by Francis Crick´s Central Dogma, which states that the nucleotide sequence of DNA determines the sequence of RNA, which in turn determines the sequence of amino acids in protein synthesis and that no information can travel back from protein sequence to DNA sequence, researchers today, working under a more integrative conception of the genome can utilize the results produced under the assumption of conceptual reductionism, because to a large extent they share with earlier generations the basic reductionist methodologies of genetic analysis (see esp. Parts VI and VII).

Concerning the role of reductionism, one of Falk´s strongest contributions to the history and philosophy of genetics is to point out that there is a host of concepts such as dominant and recessive traits/alleles (Ch. 19), expressivity and penetrance of alleles (p. 210), pleiotropy and epistasis or phenocopy (216), as well as junk DNA (250ff.), that function "not as explanations of gene actions, but rather as formal devices to overcome inconsistencies in the determinist 'genocentric' conceptions of genetics in

the 1920s to 1940s" (216). While others have written much about the concept of the gene, other central concepts in genetics have often been taken less critically, although Falk´s writing makes clear how the gene concept is construed through its relation to these other concepts.

Concerning the second major theme, Falk describes the book as "an argument against a conceptual discontinuity between 'classical' and 'molecular' theories of genetics" (4). He writes: "I propose that it is more meaningful historically and more helpful scientifically to view these not as two theories, but as one continuous theory that deals with the same array of problems at different levels of resolution" (3). Falk thus contrasts the consensus of discontinuity histories that describe the shift from classical to molecular genetics as a relatively sharp break – which either results in a successful reduction of the former to the latter or leaves us with two Kuhnian paradigms – with a picture of continuity in the methodology. The transition is rather to be described as a move from phenomenological genetic analysis to molecular genetic analysis. But the basic structure of the method remains the same, for instance when in "modern genetic analysis, SNPs (single nucleotide polymorphisms) replace wrinkled peas and the white-eyed flies as markers" (156), or when hybridization is performed on the level of DNA and RNA molecules (Ch. 17). In general, the history of genetic analysis is depicted by Falk as a history of increasing resolving power, moving from phenomenological traits of organisms to behaviors of unicellular organisms, to proteins, to DNA itself (SNPs) on the side of the markers that indicate the genotype and from factors in the constitution of the germ cells to hypothetical genes, to loci on chromosomes, to DNA on the side of the units of genetic transmission.

A final remark that can be made is that Falk´s argument resonates interestingly with an article by the philosopher Ken Waters in which he asks "What was classical genetics?" (Waters 2004). Waters argues that the focus on theory and explanation in science by philosophers (and to some extent also by historians) led to the view that classical genetics was concerned solely with the explanation of patterns of inheritance of traits, whereas this was the aim only in an early phase of genetics. From the 1920s onwards, instead, geneticists rather used these explanatory patterns to investigate a wide range of basic biological phenomena, including development. Waters points out that also historians who focus on the material practice of genetics (in particular Kohler 1994) are unable to see how established theory and material practice interact in the study of unknown realms, because they neglect the role of theory. According to Waters – and this likens his account to Falk´s – one has to focus on the investigative strategy, what he calls the "genetic approach," in order to see how genetics as a " conception directed by a methodology," to use Falk´s words, became an instrument in biology.

Even though Falk´s account on genetic analysis is much broader than Waters´s and extends the analysis to the developments in the second half of the twentieth century up to today´s post genomic research agendas, both works can be seen as forming a new attempt to integrate the history of theories and concepts and the history of experimental practice. In this sense the book is genuinely innovative.

To conclude, the book will be useful for those working in the history not only of genetics but in the history of biology in the 20th century in general that is to a large extent influenced by genetic thinking. Furthermore, philosophers engaged in the analysis of genetic concepts will benefit from the historical reconstruction as well as from the more philosophical remarks embedded in the historical narrative.

The book is at times quite technical with respect to the biological detail, to an extent that is not always justified by the main historiographic argument that is developed. While this not much of a problem for those familiar with the field and even an advantage for those who are interested in the particular histories of those findings which are discussed in more detail, it does not recommend the book for undergraduate courses in the history of biology, though it might be suitable for advanced biology students. Apart from that, the book is well written and properly edited.

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Theodore Sider, *Logic for Philosophy*, Oxford: Oxford University Press, 2010, 304 pp.

Sider's book is a welcomed addition to the series of logic textbooks published by Oxford University Press, taking its place as a good introduction aiming to provide a great supportive textbook for students of philosophy from the beginning of their education to the very end, and serving as a valuable handbook afterwards helping them in their research in areas of philosophy which employ a considerable amount of formal logic, including, but not limited to, metaphysics, epistemology, philosophy of language and philosophy of science.

It is interesting to notice that the book was dedicated to perhaps one of the most influential contemporary philosophers, Ed Gettier, and, while this is not worthwhile information per se, it sets the tone for the entire