Studies in History and Philosophy of Biological and Biomedical Sciences 49 (2015) 66–69

Contents lists available at ScienceDirect

Studies in History and Philosophy of Biological and Biomedical Sciences

journal homepage: www.elsevier.com/locate/shpsc

Essay review

What's all this fuss about the gene?

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The Science of Human Perfection: How the Genes became the Heart of American Medicine, Nathaniel Comfort. Yale University Press, New Haven (2012). 336 pp, Price $ 25.00 cloth, ISBN: 970300169911

A Cultural History of Heredity, Staffan Müller-Wille, Hans-Jörg Rheinberger. The University of Chicago Press, Chicago (2012). 288 pp, Price $45 cloth, ISBN: 9780226545707

Genetic Explanations: Sense and Nonsense, Sheldon Krimsky, Jeremy Gruber (Eds.). Harvard University Press, Cambridge (2013). 384 pp, Price $ 45.00 hardcover, ISBN: 9780674064461

The three books under review here have in common that they address aspects of the history of genetics and all include discussions of issues arising out of genomic and post-genomic researches. *The Science of Human Perfection* focuses upon medical and human genetics and their relation to eugenics. *A Cultural History of Heredity*, as its title suggests, has a broader context, using the word culture to apply to the practice and context of science as much as it does to the fine arts or to technology. The word heredity in the title signals the inclusion of pre-Mendelian science, and takes us back to the first use of this word in a biological sense before the end of the eighteenth century. Major attention is devoted here to the circumstances in which the concepts of "heredity", "*hérédité*" and "*Vererbung*" were introduced in the biological sense. *Genetic Explanations,* a multi-author work, is given to a series of critical examinations of the primacy of the gene, and hence of DNA. Here we find critical discussions of the very concept of the gene in the wake of recombinant DNA technology and the human genome project. In what follows I will discuss each book in turn, then offer some historical reflections on the sources and significance of the change of focus, in the second half of the twentieth century, from the gene to the genome.

1. The Science of human perfection

In this work Nathaniel Comfort seeks to show that human genetics in American medicine today, not unlike that espoused in the 1930s and before, still has eugenic aims, both *positive*—enhancing the genetic constitution of humankind—and *negative*—reducing the presence of undesirable hereditary qualities. Where these aims differ from eugenics of the past lies chiefly in the methods deployed to achieve those ends, and the legal limits restricting their application. In short, coercion has given place to persuasion.

Human Perfection begins with Galton, author of the term "eugenics", and then moves on to Garrod who reinterpreted "diatheses" in chemical terms. Next, Comfort explains how the establishment of human genetics in medical schools in America provided the context in which the transition from coercion to persuasion could occur. He admits that Victor McKusick, who headed the new Department of Human Genetics at Johns Hopkins University in 1957, is usually identified as the "father of medical genetics". But Comfort draws attention to the earlier history of the subject, particularly to Laurence Snyder who brought the genetics of blood groups to America, and to James Neel at the Michigan Department of Human Genetics. Neel was to play a major part in the expansion of human genetics research in America with his work for the Atomic Bomb Commission on the Hiroshima/Nagasaki survivors. On these grounds Comfort sees considerable continuity between medical genetics prior to World War II and human genetics in the post-war years.

The last chapter brings us to molecular genetics, recombinant DNA technology and the Human Genome Project.Titled "Genetics without Sex" the message is that these technologies are making achievable the aims of "positive" eugenics without the taboos and difficulties associated with traditional eugenic policies. The obvious first target would be to track the DNA sequences associated with our predispositions to particular illnesses, a great potential for the drug industry, Comfort notes! With a touch of sarcasm, he also quotes David Nichols' quip: "We are all patients now", having our "lifelong prescriptions of pharmaceuticals." (p. 243), and adds that, "Heredity trumps environment by collective decision. Not natural

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http://dx.doi.org/10.1016/j.shpsc.2014.11.001

necessity … As the greatest risk of hereditary determinism may be not the results it produces but the alternatives to which it blinds us." (p. 246.) Is this comment a reference to diet, exercise, and environment ?

The author uses vivid language deftly to describe personalities and situations. For example, of young Bateson's academic record at Rugby School, he writes: "his marks strained toward but rarely attained mediocrity" (p. 15) and of Bateson's first text on Mendelian heredity, *Mendel's Principles of Heredity: A Defence* (1901) he comments: "a strange sprawling book, by turns brilliantly incisive and maddeningly petty … It is at once dirty-laundry personal and test-tube elegant" (p. 17). Even Francis Galton does not get away without hard words: for his "emphasis on the population drained him of compassion for individuals" (p. 11). The author's lively style combined with astute appreciation of context is evident in his description of situations. For example he writes of Garrod's first paper on alkaptonuria: "Read carefully it is indeed a medical masterpiece. But squeezed among the other articles of the *Lancet,* it must have seemed yet another obscure article by yet another erudite physician" (p. 19).

2. A cultural history of heredity

This impressive book has drawn upon the many fascinating papers delivered at the international workshops given to "A Cultural History of Heredity", held at the Max Planck Institute for History of Science in Berlin and the ESRC Research Centre for Genomics in Society at the University of Exeter. Directed by Hans-Jörg Rheinberger with assistance from Staffan Müller-Wille, these events brought scholars from many countries together to present a wealth of research on heredity. Here the authors have produced a "synthesis of the results" and have drawn upon their own considerable researches to give an overview of current scholarship. Clearly written and accessible even to readers unfamiliar with the science of genetics, it presents an historical overview of "Heredity" from the eighteenth century to the end of the twentieth century—a vast agenda. The contributions of numerous researchers in the fields and centuries included here find generous mention in the extensive and invaluable bibliography. A selection of papers from two of the workshops has been published earlier (Müller-Wille & Rheinberger, 2007).

The authors of the early chapters in the newest book chose to explore the meanings given to terms such as "heredity" within the "knowledge regimes" in which they were generated, e.g. in the context of the laws regarding marriage and the transfer of property in the eighteenth and nineteenth centuries. The authors' thesis is that "the knowledge regime of heredity started to unfold as people, goods and the relationships they mediated began to move and change on a global scale" (Müller-Wille & Rheinberger, 2012, p. 3). With exploration came knowledge and encounters with different peoples, unknown languages, and strange customs. From such contacts the idea of race was born. Colonialism added administrative and political responsibilities. Thus, legislating the racial status of the offspring from misogynous unions gave rise to the fractional law of inheritance, the law widely assumed among nineteenth century hybridists. Their example was then followed by biologists, among them Charles Darwin and Carl Naegeli. This part of the book concludes with discussion of nineteenth and early twentieth century eugenics, racial anthropology, and the genealogy of kinship.

With the third and final section we arrive at—or rather are taken back to the nineteenth century—and encounter Mendel and the hybridists, Mendel's research, the belated discovery in 1900 of his now famous paper and the rediscovery of his laws. Finally we move to the molecular genetic discourse which was "configured by developments at the fringes of the discourse of genetics" (page 161). The book closes with a concise and very accessible account of the remarkable transformation of the classical molecular biology of the fifties and sixties by the discoveries of the seventies, and the elucidation of the base sequences of the human genome. A masterly achievement in 32 pages!

This text is an invaluable resource both for individual and class study. Together with its admirable bibliography it offers the researcher a rich resource. The lesser familiarity of the topics of the earlier chapters give them a freshness which is particularly welcome. For explanatory purposes the authors do at times play with the calendar. Thus the book starts out with Galton in 1876, then steps back to Buffon in 1784—then to Harvey and Linnaeus, before traversing the nineteenth century and beyond. But Galton, in using political analogies for hereditary phenomena, serves the authors' wish to emphasize from the start of the book, the social and political contexts in which the science has and continues to live.

3. Genetic explanations

This multi-author work is arranged in three sections sandwiched between an introduction by Sheldon Krimsky and a conclusion by Jeremy Gruber. The book's foreword, provided by Harvard University's Richard Lewontin, co-author with Steven Rose and Leon Kamin of the powerful critique of biological determinism, *Not in our Genes* (Lewontin et al., 1984) sets the tone of the contributions by warning us against the 19th century view that "everything about us as individuals is specified in our biological ancestry." And now, "it is said that 'its all in our DNA'. This book", he adds, "is meant as a challenge to that convention and the current dominant metaphor of DNA or genetic reductionism that drives it" (p. xi). Drawing an analogy between an ill person and a defectively acting machine, Lewontin explains that the cause of a machine's malfunction may be due not to a structural fault, but to inadequate servicing or inappropriate treatment. Structural explanations—damage/alteration to the genes—are not the whole story, so "we are faced with the epistemological question of how to find out and of what the reigning conventions of investigation and explanation are at any time" (p. x). The message is clear: "Servicing" your body and not maltreating it may prove more important than worrying about the harmful genes you may be told you have, or running to the pharmacist for solutions.

The authors of the sixteen essays belong to a variety of disciplines—cytology, neurology, genetics, public health, urban planning, history, philosophy, and the law. This diversity is welcome, as is the inclusion of those who in the past have critiqued the concept of the gene: Ruth Hubbard in 1997 (*Exploding the Gene*), Evelyn Fox Keller in 2002 (*The Century of the Gene*) and Eva Jablonka in 2005 (*Evolution in Four Dimensions).* These earlier critiques have since been strengthened by the revelations coming from the completion of the Human Genome Project, achieved in preliminary form in 2003. Realizing that only some 3% of the human genome or less constitutes DNA sequences that specify proteins was a shock to many. Hence this collection of critical essays is opportune. The dust has begun to settle and there is now an opportunity to reevaluate the science of genetics, both its theoretical status and its medical and social influence.

Of course, the gene critics can have a "field day" with claims of the nature of James Watson's comment that: "We used to think our fate was written in the stars. Now we know it is written in our genes" (Gruber, p. 271). But the main thrust of the critiques in this book is to the exaggerated expectations expressed for the application of molecular genetics, especially the human genome project, to medicine. Thus, Susan Lindee challenges the commercial development of sequence testing available on line, called