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Mendel at the sesquicentennial of 'Versuche über Pflanzen-Hybriden' (1865): The root of the biggest legend in the history of science

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In 1965, Mendel was still celebrated as the undisputed founder of genetics. In the ensuing 50 years, scholars questioned and undermined this traditional interpretation of his experiments with hybrid plants, without, however, managing to replace it: at the sesquicentennial of the presentation of his 'Versuche' (1865), the Moravian friar remains, to a vast majority, the heroic Father of genetics or at least some kind of geneticist. This exceptionally inert myth is nourished by ontological intuitions but can only continue to flourish, thanks to a long-standing conceptual void in the historiography of biology. It is merely a symptom of this more fundamental problem.

'Historians of science are trained and paid to replace simple stories (. . .).'[1]

M.J.S. Hodge

Introduction

The hybridization work of Gregor Johann Mendel has, since its 'rediscovery' in 1900, been the subject of a large number of widely varying and often conflicting interpretations.[2] There are, as one scholar put it, 'almost as many different interpretations as there are commentators.'[3] One reason for this kaleidoscopic plethora of perceptions is that not only did Mendel not publish much about hybridization, he also did not leave notebooks.[4] This scarcity of background documents – a small number of letters and some notes and pencil marks, scribbled in some of the books he read–, together with the brevity of his hybridization articles, renders it very difficult to find out what he thought he had discovered and allowed later biologists to basically read into his published hybridization experiments what they wanted to read in them.[5]

Two hotly debated topics in the early Mendel literature were the question whether Mendel's data were too good to be true (i.e., falsified or even fictitious) and whether or not he supported the concept of (Darwinian) evolution. It did not take long for Mendel scholars to situate him in the tradition of the hybridists.[6] However, for a long time, his status as the first geneticist remained practically unchallenged.[7] As late as 1965, the historian Robert C. Olby presented Mendel in basically the same way that biologists celebrated him during the centennial of the presentation of his 'Versuche': as the scientist who formulated the first genetic laws.[8] Apart from a certain ambiguity of expression

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[1] Hodge, M.J.S. 2013. 'Darwin's book: *On the Origin of Species*.' *Science & Education*, 22 (9): 2267–2294, p. 2268.

[2] There is a voluminous literature about Mendel. For non-exhaustive overviews, see, e.g., Orel, V. 1996. *Gregor Mendel: The First Geneticist*, translated from Czech by Stephen Finn. New York: Oxford University Press (see pp. 92–94 and pp. 157–160); Fairbanks, D.J. and Rytting, B. 2001. 'Mendelian controversies: a botanical and historical review.' *American Journal of Botany*, 88 (5): 737–752 and Kampourakis, K. 2010. 'Mendel and the path to genetics: portraying science as a social process.' *Science & Education*, 19 (2): 1-32 (see section 2).

[3] Sapp, J. 1990. 'The nine lives of Gregor Mendel,' in H.E. Le Grand (ed.), *Experimental Inquiries: Historical, Philosophical and Social Studies of Experimentation in Science*. Dordrecht: Kluwer Academic Publishers, pp. 137–160, p. 138. The article can be found online at http://www.mendelweb.org/MWsapp.html.

[4] Most of his publications dealt with meteorology. He only published two articles about hybridization: 1866. 'Versuche über Pflanzen-Hybriden.' *Verhandlungen des naturforschenden Vereines in Brünn*, 4: 3–47 and 1870. 'Über einige aus künstlicher Befruchtung gewonnenen Hieracium-Bastarde.' *Verhandlungen des naturforschenden Vereines in Brünn, Abhandlungen*, 8: 26–31. Both were first translated in English by William Bateson under the title 'Experiments in plant hybridization' and 'On Hieracium hybrids obtained by artificial fertilisation.' See http://www.esp.org/foundations/genetics/classical/gm-65.pdf and http://www.esp.org/foundations/genetics/classical/holdings/m/gm-69.pdf.

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[5] His first and most important hybridization article was merely the text of his two lectures, delivered at two meetings of the local *naturforschenden Verein*, on February 8th and March 8th, 1865. Mendel was well aware of the fact that this short paper might not be sufficiently clear. In his second letter to Carl Nägeli, the only scholar with whom he corresponded about his hybridization experiments, dated 18 April 1867, he wrote: 'The paper which was submitted to you is an unaltered reprint of the draft of the lecture mentioned; hence the brevity of the exposition, as is essential for a public lecture.' Quoted in Orel, *Gregor Mendel: The First Geneticist*, p. 96.

[6] See, e.g., Roberts, H.F. 1929. *Plant Hybridization before Mendel*. Princeton, NJ: Princeton University Press and Zirkle, C. 1935. *The Beginnings of Plant Hybridization*. Philadelphia, PA: University of Pennsylvania Press.

[7] It is probably no coincidence that the first scholars who explicitly questioned or modified Mendel's status as Father of genetics were Dutch: the Dutch botanist Hugo de Vries, the first 'rediscoverer' of Mendel's work, in 1900 qualified it as 'trop beau pour son temps.' See Heimans, J. 1947. *De Elementen der Genetica. Rede uitgesproken bij de aanvaarding van het ambt van hoogleraar aan de Universiteit van Amsterdam op 10 maart 1947*. Amsterdam: W. Versluys and Stomps, Th. J. 1954. 'On the rediscovery of Mendel's work by Hugo de Vries.' *Journal of Heredity*, 14 (6): 293–294.

[8] See Olby, R.C. 1965. 'The Mendel centenary.' *The British Journal for the History of Science*, 2 (4): 343–349.

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and confusion of terminology, which Olby deemed inevitable when formulating fresh principles, the only point on which Mendel might possibly be criticized was for making no reservations about the law of independent assortment of characters (many characters are not inherited independently). However, even that was not necessary as all seven characters which he investigated were inherited independently.

This traditional Mendel story meshed beautifully with the traditional, positivist and present-centered or Whiggish model of the history of science. Mendel's status as the first geneticist had been questioned before but it was the new, conceptual model of scientific change, as epitomized by Thomas S. Kuhn's epoch-making *The Structure of Scientific Revolutions* (1962), that, in the years and decades after the Mendel centennial, inspired professional historians like Olby to deconstruct the 'biggest legend in the history of science,' i.e., to question whether Mendel had been a Mendelian.[9] Innovators, of course, often turn out to have been less revolutionary than previously thought but Mendel is, legend-wise, indeed in a league of his own: he is, so to say, a revolutionary Lavoisier who turned out to have been a conservative Priestley. This may help explain why the deconstruction of the Mendel legend has not been a resounding success, to say the least. There seems, as Waller points out, 'to be an almost universal willingness to skate over the way in which Mendel actually interpreted his results and to ignore the gulf between his worldview and many of the ideas now central to modern genetics.'[10]

Some of the first Mendelians had, as we shall see, their own reasons to proclaim Mendel as the first geneticist but it seemed, at the time of the rediscovery in 1900, also very logical to assume that Mendel had been the first geneticist. His mathematically inspired and thoroughly experimental work with *Pisum* plants not only epitomized modern science (as popularly perceived) but at the same time also uncovered transmission patterns that could easily be interpreted as (at that time highly sought after) genetic laws. I will introduce an, at first sight, odd-looking analogy to underline and clarify how self-evident but at the same time also thoroughly fallacious this traditional Mendel story is (Section 'Self-evident but fallacious: an analogy'). Not only is it still very much alive among biologists and the public at large, the old view that Mendel was an isolated figure, tragically ahead of his time, remains, to some extent, even popular among Mendel scholars: most scholarly Mendel accounts must be brought under the broad 'Mendel the hybridist and some kind of geneticist' denominator (Section 'Mendel the hybridist and some kind of geneticist'). Accounts that unequivocally and explicitly deny that Mendel was the first serious student of the biological phenomenon that we call heredity remain, in any case, an exception.[11,12] The Mendel myth is (or seems) not only firmly grounded in logic and tradition, it is also nourished by universal cognitive biases (Section 'A cultural attractor'). However, the ultimate cause of its remarkable inertia is that the gulf between Mendel's worldview and ours has not yet been aptly conceptualized (Section 'A conceptual void'). It seems evident to me that, as long as we do not have accurate and fitting concepts to capture and characterize Mendel's perception of intergenerational transmission and life in general and ours, this gulf will remain ignored or underestimated and that as long as this is the case, *the birth of genetics will continue to be implicitly assumed to have been simply a question of studying the facts of transmission with the help of the right, Mendelian or 'genetic' methodology*. That these two perceptions or paradigms are still under-conceptualized is all the more puzzling as the shift to the modern, 'genetic' paradigm has already been called a 'conceptual revolution of major proportions,' comparable even with 'the Darwinian debate.'[13,14] This is, in any case, the real problem of which, as we shall see, the curious persistence of the Mendel myth is but one symptom. As long as it is not remediated, the modern, Kuhnian reinterpretation of the birth of genetics will remain unfinished.

Self-evident but fallacious: an analogy

The Pantheon is a strange place to start an analysis of Mendel's work, but that is where the first half of my analogy leads us. Copernicus's heliocentric model of the cosmos has been speculated to have been inspired by it.[15] He certainly spent the jubilee year 1500 in Rome. It is also not difficult to imagine how he might have been inspired by the Pantheon. The circular opening in the center of its dome ('oculus') is akin to the sun whereas the solid disk and the five circular structures surrounding it can be interpreted as representing the mobile spheres of its satellites and the immobile sphere of the fixed stars (Figure 1). They even line up almost exactly with the circles in Copernicus's heliocentric model. The resemblance is very striking and, of course, also not completely coincidental (oculi were meant to illuminate the interior of buildings like the Pantheon, i.e., function as a 'sun'). However, even if Copernicus had indeed been inspired by the Pantheon, this would, of course, not mean that its dome was designed to represent a model of the heliocentric cosmos.

Likewise, after 1900, Mendel's work with *Pisum* hybrids (the equivalent of the oculus and the surrounding circular structures) was interpreted as an exercise in genetics (the

[9] See Sapp, 'The nine lives of Gregor Mendel,' p. 137. He begins his essay with the sentence: 'There is no greater legend in the history of science than that of the experiments of Gregor Mendel.'

[10] Waller, J. 2002. *Fabulous Science: Fact and Fiction in the History of Scientific Discovery*. Oxford: Oxford University Press, p. 157.

[11] See, in this respect, for example, Corcos, A.F. and Monaghan, F.V. 1993. *Gregor Mendel's Experiments on Plant Hybrids: A Guided Study*. New Brunswick, NJ: Rutgers University Press. They state that 'the laws of heredity which are supposed to be there, are not present. Instead one finds a series of laws relating to the formation of hybrids, which are entirely different from the traditional 'Mendelian' laws of heredity' (p. xvi).

[12] The use of the term 'heredity' in reference to Mendel's work is potentially misleading as it implies, or certainly can be interpreted as implying, that he interpreted what is called here 'the intergenerational transmission of traits' in the same way that we interpret it, *quod non*.

[13] Bowler, P.J. 1989. *The Mendelian Revolution: The Emergence of Hereditarian Concepts in Modern Science and Society*. London: The Athlone Press, p. 7.

[14] Length restrictions prevent me from discussing the crucial question as to why this shift has, as yet, not been properly conceptualized (not even by Bowler), but I have answered it elsewhere (2013. *The Non-Mendelian Revolution: A Conceptual Reinterpretation of the Genetic Revolution*. Unpublished Ph.D. thesis: UGent).

[15] See http://bldgblog.blogspot.be/2007/04/heliocentric-pantheon-interview-with.html. Copernicus's interest in astronomy in 1500 was also kindled by the observance of a lunar eclipse on November 6.