BOOK REVIEWS

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Gregor Mendel—The First Geneticist. Vítězslav Orel. Translated by Stephen Finn. (Pp 363; £29.50.) Oxford: Oxford University Press. 1996. ISBN 0-19-854774-9.

This is an excellent biography, very well written by the Emeritus Head of the Mendelianum (Mendel Museum) in Brno in the Czech Republic, and very well translated, of a man whose achievement can without any hint of hyperbole be described as unique in the annals of science. The uniqueness of this achievement resides in the fact that a series of experiments with peas, which seem but an interlude in the life of Abbot Gregor Johann Mendel, sandwiched during a few brief years between a multitude of other activities, both scientific and administrative, now inspires and informs every aspect of the large areas of biology which are associated with genetics. In the words of Dobzhansky (page 92 of Orel's book), "Genetics, an important branch of biological science, has grown out of the humble peas planted by Mendel in a monastery garden".

It has become a truism to state that if a scientific discovery had not been made by a certain scientist in a certain place, then it would have been made within a very short span of time by another scientist in another place. Indeed, this pattern of more or less simultaneous scientific advance in institutes which are widely separated geographically is now so well established that it is unusual for a clear cut winner to emerge even a few months ahead of the field with respect to an important discovery, and bitter and rancorous controversies about priority are all too common. This pattern even applies to the rediscovery of Mendel's work in 1900 by Correns, de Vries, and Tschermak. In sharp contrast, Mendel had no rivals for several decades both before the original discovery and for several decades afterwards, until this rediscovery took place.

There are, of course, other examples of "prematurity" in scientific discovery, prematurity being defined by Stent as follows. "A discovery is premature if its implications cannot be connected by a series of simple logical steps to canonical, or generally accepted, knowledge." There is a good case, nevertheless, for arguing that Mendel's discovery outstrips these other instances, both in the quality of its "prematurity" and in its importance, which has led to the passing of his name into everyday language in the form of words such as Mendelian and Mendelism.

Although very few of Mendel's experimental notes have survived, we know that between 1857 and 1863, he investigated the laws of the origin and development in *Pisum* of variable hybrids in connection with seven pairs of traits. It is difficult to conceive how Mendel could have had the good fortune (or the prescience or even perhaps the divine inspiration) to have chosen just these traits in just this species, whose study enabled him to show the basic laws of heredity and to create clarity and order out of the chaos which had long characterised this area of biology. The extent of the good fortune involved in this choice may be gauged by the fact that Mendel himself was not able to repeat the results which he obtained with *Pisum* in experiments with several other plant species.

Mendel's insight was so profound that his concepts of dominance and recessivity remain entirely valid today. Thus, he denoted the round shape of the ripe pea seeds as dominating over the angular wrinkled shape which, temporarily receding from view in the F_1 hybrid generation and reappearing in a ratio of 1:3 in the F_2 generation, he denoted as recessive. Among the plants with round seeds of the F_2 generation, he showed a ratio of 2:1 if he differentiated in the F_3 generation bred by self-fertilisation between the "meaning of the dominating trait as a hybrid (that is, producing F_3 plants with round and wrinkled seeds in the ratio of 3:1) and as a parental (that is, producing only F_3 plants with round seeds) trait". Thus, in his analysis of this monofactorial experiment, as it came to be called later, he clearly appreciated the difference between the appearance of the dominating trait, or phenotype, and its hereditary basis, or genotype. As a trained physicist, he commanded combinatorial mathematics to an extent which enabled him to interpret the ratios obtained in his bi- and trifactorial experiments, and to extrapolate these results in mathematical terms to general predictions involving *n* pairs of factors.

These arithmetical ratios through which Mendel showed the particulate inheritance of traits in the pea seem, in retrospect at least, to be so simple. However, this simplicity is only apparent with the benefit of hindsight, and no one had had an inkling of these truths before Mendel. Nor did any one grasp these truths for several decades after he reported his results in two lectures given on 8 February 1865 and 8 March 1865 to the Natural Science Society of Brünn (Brno), a prosperous city of moderate size in Moravia, then a part of the Austro-Hungarian Empire, where he was a monk in the Augustinian monastery.

Thus, in so far as his cardinal discovery of particulate inheritance was concerned, Mendel had no predecessors and, for several decades, no successors. With respect to predecessors, Fisher, in an extensive analysis of Mendel's work with peas, came to the conclusion that this was not just experimentation, but rather an exposition of particulate inheritance which Mendel had already thought out and which he had then demonstrated in his capacity as a teacher. In this exposition, he had had no predecessors or precursors to help him in his discovery of principles on which the whole science of genetics is founded. It is of interest to note that Mendel himself showed insight into the importance and the uniqueness of his discovery, in that in the preamble to his paper, based on his lectures and published in 1866 in the Proceedings of the Natural Science Society of Brünn (*Verhandlungen des Naturforschenden Vereines (Brünn)*), having surveyed previous work in the field of "plant hybridisation", he stated: "among all the numerous experiments made, not one has been carried out to such an extent and in such a way as to make it possible to determine the number of different forms under which the offspring of hybrids appear, or to arrange these forms with certainty according to their separate generations, or definitely to ascertain their statistical relations."

As far as the lack of immediate successors is concerned, it would be an error to suppose this to have been because of the inaccessibility of Mendel's 1865 lectures. Mendel corresponded with the leading scientists in the field, and sent a reprint of his paper to the most prominent among them, Nägeli, as well as describing his work to him in detail in the course of an extensive correspondence over a number of years. In fact, Mendel ordered 40 reprints of his publication, and these reached colleagues all over Europe; some have been found relatively recently, often uncut. In addition, the journal itself, *Verhandlungen des Naturforschenden Vereines (Brünn)*, was not an obscure one, and it is known to have reached the libraries of the Royal Society and the Linnean Society in London, among many other academies and universities throughout the world of learning. Despite this, Galton, who, during the years 1872-5, made the closest approach to Mendelian theory that was achieved in the 19th century, as Orel points out on page 165 of his book, did not know of Mendel's work.

In passing, it is of interest to note that Mendel visited the Great Exhibition in London in 1862, at a time when he was coming to the end of several years of experimentation with *Pisum*. Although there is no evidence that Mendel's visit to London represented anything more than an excursion as a tourist, in the company of a large group of fellow Moravians, Orel mentions totally unfounded speculation that Mendel might have paid a visit to Darwin. It is astonishing, in general, how little the details, both personal and scientific, of the life of this modest and retiring priest are documented.

Had such a meeting occurred during Mendel's visit to England, it might also have included Darwin's cousin, Galton. Discussions between these three men might well have led to the immediate recognition of the importance of Mendel's work, with momentous consequences for the development of the science of genetics. The meeting did not take place, however, and, despite the fact that his paper was published in a widely distributed journal in 1866, it was not until a third of a century later, at the beginning of our own century and long after his death in 1884, that Mendel's work was rediscovered. There is no evidence that Mendel felt resentful or bitter with respect to the failure of his contemporaries to appreciate the importance of his work. As already indicated, he himself appreciated its importance and, in talking with a colleague, Niessl, he uttered the prophetic words "My time will come".

And his time has indeed come. Throughout our century, his work on *Pisum* has been subjected to endless analyses, questioning the reasons why it was undertaken, the way in which it was done, and the accuracy of the reporting of the results. Perhaps the most appropriate comment on these analyses, which are extensively discussed in Orel's book, is that of Sturtevant (page 200) who

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