The Gregor Mendel Bicentennial Tribute—Enduring Mementos of the Founder of Genetics

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July 20, 2022, was the bicentennial of the birth of Johann Mendel, the founder of the modern science of genetics, who died at 62 years as Abbot Gregor Mendel. In that midsummer anniversary week, about 600 people assembled for musical festivals, cultural festivals, and a gala reception at his abbey and museum in the city of Brno, Czech Republic, where Mendel lived and worked, and 400 people from 24 countries attended a celebratory biomedical conference (where we lectured) in tribute to his revolutionary discoveries.

The musical centerpiece was the Brno Philharmonic's performance of the *Glagolitic Mass* by the prominent Czech composer Leoš Janáček, who provided the music for the 1884 funeral of his good friend Fr Gregor Mendel. A 7-m-high inflatable green pea was parked at the site of the event for the week after traveling throughout Brno over the year to celebrate its famous citizen.

A 7-m plastic "pea" sat outside Mendel's basilica and museum during the bicentennial conference, having traveled to public spaces in Brno, Czech Republic, and other cities throughout 2022 (J. J. Mulvihill).

But these festivities were only one component of a yearlong reassessment of the scientist-priest over the year. The common impression of Mendel is that of a lonely monk, working without help and unappreciated, who meticulously crossed pea plants and counted offspring with several traits to develop his laws of inheritance that are now familiar to every undergraduate biology student but little noticed in his lifetime; who published a paper in an obscure German journal (which he then mailed to the other 19th-century naturalist giant, Charles Darwin, who utterly ignored it [arguably to the detriment of his own work on natural selection]); who died unrecognized and was rediscovered only in 1900; and whose published counts of phenotypic heritability (25% for recessive inheritance, 50% for dominant) looked too good to be true, suggesting some "fudging" of the data.

There are grains of historic truth in these perceptions, but most are wrong, and the bicentennial events, including a slew of new biographies and publications (**Box**), paint a far grander portrait. He had the support of his institutions, family, and academic and religious colleagues, experimented with other organisms, reported his observations faithfully, traveled to England and Italy, gave several other public lectures, and published 14 papers that were cited at least a dozen times before 1900, including by the *Encyclopedia Britannica*.

Other correctives to common misperceptions include a new appreciation of Mendel's "big data" science (his famous pea experiments used 28 000 plants with 300 000 individual peas, putting to rest any suspicions about the statistical power of his

Box. Publications for Mendel's Birth Bicentennial

Books

Drozdová E, Doubek M, Pospíšilová Š. *Gregor Johann Mendel: Ways to the Genome of the Founder of Genetics*. Masaryk University Press; 2022

Fairbanks DJ. *Gregor Mendel: His Life and Legacy*. Prometheus; 2022

Sekerák J, Pončíková P, *Iconographia Mendeliana*. Moravian Museum; 2022

Müller-Willa S, Hall K, Dostál O, eds. *Gregor Mendel, Versuche Über Pflanzen-Hybriden [Experiments on Plant Hybrids] (New Translation with Commentary)*. Rutgers University Press, 1993

Matalova and E. Matalova. *Gregor Mendel–the Scientist: Based on Primary Sources 1822-1884.* Springer; 2022

Klein J, Klein N. *Solitude of a Humble Genius–Gregor Johann Mendel: Volume 1: Formative Years*. Springer; 2013

Seifertová L, *Gregor Johann Mendel and the Trouble-Ridden Story of Genes.* Mendel University; 2021

Biomedical journals and popular magazines[a]

January 2022 issue of *The American Biology Teacher*

July 2022 Czech-language issue of *National Geographic*

July 2022, special sections of

Plant Cell (5 articles)

Proceedings of the National Academies of Science (9 articles)

PLOS-Biology (5 articles)

Heredity (4 articles)

[a] A search for "Mendel" on PubMed shows 69 papers in 2022 with the term in the title or abstract, up from a yearly average of 28 over the last quinquennium.

A room inside the Mendel Museum, Brno, Czech Republic (W. W. Grody).

studies)[1]; his achievements in meteorology (weather recording and prediction, tornado descriptions); his leadership of the social aspects of science (regional science societies and mentoring); his roles in his biological family (his salary as a bank official paid for his nephews' medical education and, although as a friar he naturally had no direct descendants, he jokingly referred to his pea plants as his "children"); and his facile and productive synthesis of scientific and religious world views (as a metaphor, notes for an upcoming sermon were found on the back of a sheet of laboratory results).

Perhaps the most surprising news, which was available preliminarily in a monograph[2] with updates at the conference, were the fascinating archeologic, anthropometric, clinical, radiographic, and genomic sequencing results following the exhumation of Mendel's remains, performed in anticipation of his bicentennial and dually permitted by the Catholic Order of Saint Augustine and authorities of the Brno city cemetery where he was buried. Near death, Abbot Mendel requested his autopsy, allegedly for fear of being buried alive. The original report from 1884 cannot be found, although the contemporary clinical description and prescriptions for some 20 medications point to a somewhat rapid demise from chronic hypertension and glomerulonephritis with edema, uremia, and nephrotic syndrome. Details from the 2021 exhumation added evidence of chronic periodontitis, obesity, a biological age of 65 years (vs a calendar age of 62 years), spina bifida of 3 sacral vertebrae, calculated height of 168 cm (about average male height for the region and era), and slightly high intracranial volume (1580 cm^3 [compared with 1350 cm^3 for contemporary men]). The authors offer a deadpan caution: "It is not possible to establish causality between Mendel's large neurocranium and his ingenious ideas and thinking." The skull was brachycephalic with a delicate jaw and wide forehead, consistent with photographs throughout his life.

Sequence of mitochondrial DNA from a dental root from the exhumation perfectly matched that from a stray hair found in a favorite book of his. Nuclear DNA variants were interpreted as possibly associated with some of his health problems, including a variant in the gene *KCNJ2,* known to underlie the rare Anderson-Tamil cardiodysrhythmic periodic paralysis syndrome with dysmorphic facial and skeletal features (OMIM 170390), as well as 2 genes associated with long-QT syndrome, 1 with hypertrophic cardiomyopathy, 3 with kidney failure, and 1 with hyperaldosteronism (possible hypertension and depression). Of course, one should be careful not to overinterpret these variants as indicative of causality in the absence of known symptoms of these genetic disorders during life.

As lasting tributes to the bicentennial, the cities of Brno (where he performed his experiments) and Vienna (where he took university courses) now have permanent signs near key buildings where his activities in teaching, bank director and president, and lecturer took place. This year, the city square outside the abbey and its museum has been reconfigured to highlight a new sculpture, commissioned after an international competition; at 4.6 m tall, it portrays a bed of stylized peas with appearance and numbers reflecting Mendel's laws of inheritance in the famous 9:3:3:1 ratio pointing to independent assortment. The momentum of the bicentennial has continued into 2023 with another July festival, the grand opening of the reconstructed greenhouse at the abbey, the dedication of the sculpture in Mendel Square, and further peregrinations of the giant green pea, even to Vienna.

One aspect of the Mendel mythology that is not an exaggeration was his humility. He was indeed the gentle friar as depicted in his garden, having entered the clergy in part to ensure access to higher education. Twice he failed the credentialing examinations for his chosen career as a secondary school teacher and was relegated to serving as a "substitute." He had performance anxiety and would take to his bed for weeks at a time with attacks of depression and psychosomatic illness; he was a tireless experimentalist driven by innate curiosity rather than any desire for self-aggrandizement; and he was an Augustinian abbot subject to a vow of celibacy who unveiled the most fundamental aspects of sexual reproduction. We can glean valuable lessons as much from his person as from his science.

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Additional Information: For information about continuing events to honor Mendel, see www.mendelje.cz. Some references are embedded as hyperlinks in the online version of this article.

1. Radick G. Mendel the fraud? a social history of truth in genetics. *Stud Hist Philos Sci*. 2022;93:39-46. doi:10.1016/j.shpsa.2021.12.012

2. Drozdová E, Doubek M, Pospíšilová Š. *Gregor Johann Mendel: Ways to the Genome of the Founder of Genetics*. Masaryk University Press; 2022. doi:10.5817/CZ.MUNI.M280-0081-2022