mechanism to internalize the cost of its operations to the environment nor any interest in responding to human need, purpose or hope. To address the inextricable intersection of science and technology with the social condition of humanity, he believes that we need to call on institutions other than the market.

Along the way, Piel discusses the impact of the Cold War arms race on the trajectory of scientific knowledge, the scientific actors behind the Manhattan Project to build the first nuclear weapons, the passions unleashed over the cancellation of the Superconducting SuperCollider in 1994, the general unease over the entrenched commercial interests in the development of genomics, and debates about global warming and the carrying capacity of the planet.

The fact that Piel consistently connects the growth of scientific knowledge to the social and political milieu of its genesis, while simultaneously alluding to the changes in the social context induced by these discoveries, makes *The Age of Science* one of the best introductions I've seen to the world of science and its practitioners. I think it is easily the most intelligent, lucid and sociologically sensitive discussion of the broad trajectory of scientific knowledge yet available. For anyone wishing to look beyond the 'science wars' to get the big picture of science, this book is the place to begin. ■

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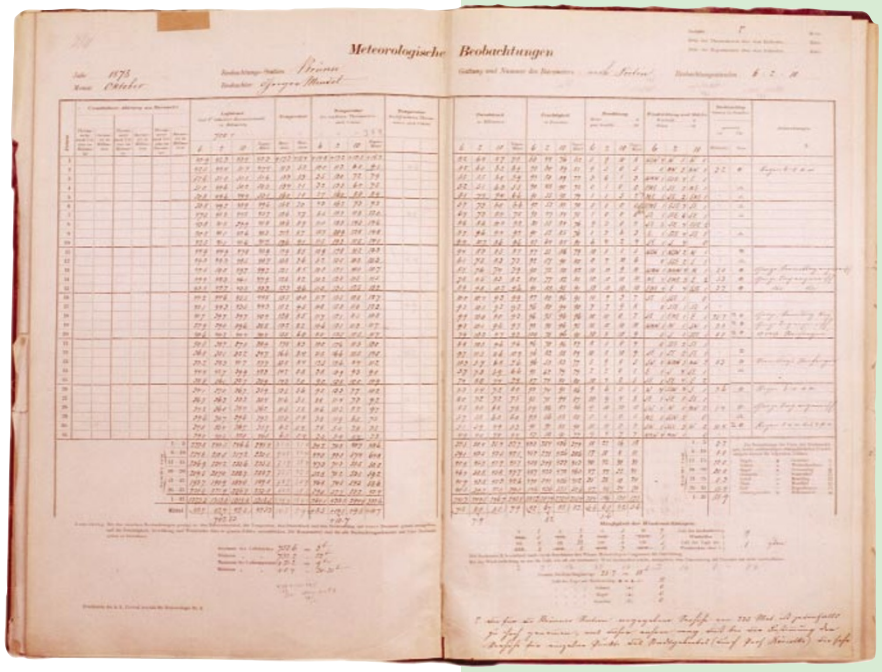
Pretty as a table: Gregor Mendel's meteorological data were presented largely without pictures.



Science in culture

Peas without pictures

Gregor Mendel and the mathematical birth of modern genetics

Martin Kemp

Natural history before Gregor Mendel and Charles Darwin was full of visual delights. The publishing of books on the sciences of nature had been sustained in large measure by attractive prints of familiar and exotic specimens of flora and fauna, accompanied by texts which fluently combined observation, learned citation, philology, hearsay and legend. The Book of Nature, which stood alongside the Books of Scripture as providing us with access to the divine scheme of things, was lavishly illustrated. What, then, are we to make of the chastely non-visual publications of the two figures who were to rewrite the natural sciences, Darwin and Mendel? Darwin almost seems to have tested how far he could go before resorting to a picture, and Mendel's key discovery was expressible in ratios, algebraic letters and tables, rather than through images of plants.

There is a paradox at work here. Darwin and Mendel were supreme observers, relying on systematic handling of information obtained through rigorous scrutiny of things they had seen. Mendel's experiments with peas depended on the visual identification and methodical counting of traits that were significant in tracking the as yet unknown units of inheritance that passed through successive generations. Unrelenting visual and manual discipline was required for his meticulous pollination and data-gathering in the garden and greenhouse of the Abbey of St Thomas in Brno. Yet his crucial paper of 1865, published obscurely the following year in the proceedings of his local society for natural science, is devoid of illustrative interest. His results are laid out in rows of figures, with sets of paired characteristics designated by capital and lower-case letters – Aa, Bb – in which the capitals signal the 'dominant characters'.

There is no single explanation for this shift away from the visual image in cutting-edge biology. There was clearly a general sense that if natural history was to be regarded as a 'hard' science, it needed to cast off its image as an attractive pursuit for amateurs and collectors of nature's wonders. In this, Darwin's impersonal theory — the disinterested mechanism of natural selection — combined conceptual abstraction and physical process in a way that seemed to promise the abandoning of subjectivity. Mendel was, in a way, even more radical. He resorted to mathematics, the province in the sciences of nature that had been the prerogative of physics and, to a lesser degree, chemistry.

What has become apparent in the work that I have done with Marina Wallace and our company Artakt for our exhibition about Mendel, "The Genius of Genetics", which opened earlier this month at the abbey in Brno, is the extent to which Mendel's studies in Vienna and the greater part of his activity as an investigator of natural phenomena were concerned with quantification in sciences other than natural history. His training in Vienna included studying with Christian Doppler, the first professor of experimental physics in Austria, noted astronomer and formulator of the Doppler effect. Mendel came to biology with a mastery of combinatory mathematics, and his own publications centred on meteorology, which had become the most statistical of all the sciences of natural phenomena.

The library in the abbey still contains Mendel's annotated copy of August Kunzek von Lichton's *Lehrbuch der Metereologie, Leichtfasslich Dargestellt* of 1850, an important textbook by the physicist on the taxonomy of clouds and the mathematical science of the atmosphere. The abbot's assiduous contribution to local meteorological records is evident in the sheets of patient and systematic data-gathering in the exhibition. Seen in this light, his genetic researches can be seen to belong with the nineteenth-century obsession with categorizing and quantifying as much as with traditional natural history and the practice of selective breeding in agriculture and horticulture.

The old cliché tells us that an illustration is worth a thousand words. For Mendel and those who gainsaid the seduction of pictures, thousands of acts of counting were worth more than either.

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http://www.mendel-museum.org

The Genius of Genetics, A Celebration of Gregor Mendel Through Science and Art runs at the Abbey of St Thomas in Brno, Czech Republic until May 2003.