Strawberry Fields Forever

Inspired by Gregor Mendel's cross-breeding experiments with peas, researchers around the world endeavored to track down the mechanisms of inheritance. **Elisabeth Schiemann**, plant geneticist and Director of the **Max Planck Research Unit for the History of Cultivated Plants** in Berlin, chose to study an especially tricky subject.

TEXT **ELKE MAIER**

Mara des Bois has an enticing fruity flavor with hints of wild berries and a good sugar-acid balance. Salsa can't hold a candle to it in terms of taste, but trumps it with larger fruits whose uniform conical shape makes them suitable for cakes. There are now thousands of strawberry varieties available – and that despite the fact that plant breeders have long been bewildered by the infuriatingly complex inheritance patterns of the strawberry plant. Elisabeth Schiemann dedicated several decades of her scientific career to the beloved garden plant of the *Fragaria* genus. But she wasn't concerned with perfecting new varieties. She was mainly interested in answering fundamental biological questions about the inheritance of characteristics and the origin of species. In 1908, Elisabeth Schiemann, born on August 15, 1881 in Viljandi, Estonia, was one of the first women to be admitted to a university to study science. One of her tutors in Berlin was Erwin Baur, who inspired her to explore the still fledgling subject of genetics. She was driven above all by the question of how new species arise and what processes occur in cells.

Schiemann initially investigated the role of mutations. As one of Baur's doctoral students, she studied the widespread black mold fungus *Aspergillus niger*, which often colonizes food, such as fruit and old bread crusts, and also grows on room walls.

For the young scientist, the generally unloved microscopic fungus proved to be a useful study object: in the lab, she exposed mold cultures to high temperatures and toxins, such as potassium dichromate. In this way, she was able to induce genomic mutations that were expressed as different colorations or shapes of the mold colonies.

However, this undemanding mold wasn't suitable for cross-breeding experiments due to its predominantly asexual mode of reproduction. After receiving her doctorate, Elisabeth Schiemann therefore switched to higher plants. In addition to barley, wheat and snapdragons, she also studied the strawberry plant at the Institute for Genetic Research at the Berlin Agricultural University, which was headed by Baur.

Baur had already encouraged Schiemann to cross-breed strawberry plants in 1919. His aim was to marry the flavor of the native strawberry (*Fragaria vesca*) with the size and perennial life cycle of the American cultivated strawberry. However, it soon turned out that the project was more difficult than originally thought: the hybrid plants were either not viable or infertile.

The reason for this string of failures was identified by American and Japanese botanists in the mid-1920s: The different lineages couldn't be cross-bred, as they differ in the number of chromosomes their cells contain. Whereas the native wild strawberry is diploid, meaning it has a double set of chromosomes, the cultivated varieties and their American parent plants are octoploid, so there are eight sets of chromosomes in each cell.

Such differences not only prevent successful fertilization, but also affect the formation of the sexes. Thus, diploid strawberries have hermaphroditic flowers, while those with multiple chromosome sets bear unisexual flowers.

Botanist Flora A. Lilienfeld achieved a surprising breakthrough in 1933 when she succeeded in cross-breeding two species with different chromosome numbers. Her paper entitled "The genesis of fertile plant hybrids [...] from crosses of species with

Birds banished: Elisabeth Schiemann covered her experimental grain fields with wire mesh to protect them from hungry beaks.

Photo: Archives of the Max Planck Society, Berlin-Dahlem

Daughter from a good house: Elisabeth Schiemann came from a German Baltic family. Her father was the well-known historian Theodor Schiemann.

different chromosome numbers" caused a sensation among *Fragaria* researchers.

From that point on, Elisabeth Schiemann made progress with her study of strawberries. She began experimenting with the hexaploid musk strawberry (*F. moschata*) used by Lilienfeld. Crosses of this species with the diploid green strawberry (*F. viridis*, syn. *F. collina*) also resulted in fertile offspring with four chromosome sets. Schiemann even classified it as a new species.

With the help of cross-breeding experiments and chromosome analyses, Elisabeth Schiemann delved deeper and deeper into the world of *Fragaria* plants. She concluded, for example, that the diploid species were derived from a common ancestor. The various species branched off as a result of autopolyploidy – multiplication of the same chromosome set.

Despite her enthusiasm for this subject, Elisabeth Schiemann's research interests went well beyond pure genetics. In the early 1930s, she turned her attention to the origin and history of cultivated plants. To do so, she accepted an unpaid and uncertain position at the Botanical Museum in Berlin-Dahlem.

In the following years, she developed methods for analyzing archeological findings of cultivated plants, analyzed grain finds from Troy and plant residues from the tomb of Tutankhamen, and evaluated the imprints of grape seeds in Neolithic clay vessels.

Tagesspiegel of August 15, 1971

» Professor Elisabeth Schiemann, director of the Research Unit for the History of Cultivated Plants of the Max Planck Society from 1949 to 1956, turned 90 today in Berlin. Many of the disciplines that have contributed to our understanding of the origin and history of cultivated plants were strongly influenced by her research.«

Her book on the origin of cultivated plants, which was published in 1932, became a standard reference work. Today, Schiemann is regarded as one of the founders of the field of paleoethnobotany.

Among other things, she concluded that central European cultivated plants like barley and wheat didn't come from the north, but from Mesopotamia and Ethiopia. She was therefore at odds with the claim of the National Socialists, according to whom "Nordic races" had produced European agriculture.

From the point of view of a geneticist, she also dismissed the Nazi's race ideology, arguing that keeping human "races" pure was scientific "nonsense." She embellished her lectures with quotes from Jewish and Russian authors, boycotted the meetings of the National Socialist Association of Lecturers, and publicly condemned the illegitimate National Socialist state at every opportunity.

And there were consequences: in 1940, her teaching license was revoked during a purge of the universities. Had it been known at the time that she helped Jews escape abroad and even hid them in her own apartment, she would have been threatened with far worse.

In 1943, Elisabeth Schiemann was offered a job as department head at the Kaiser Wilhelm Institute for Cultivated Plant Research in Vienna-Tuttenhof. "I'll be there immediately, if I don't have to say '*Heil Hitler*,'" she responded. She accepted the offer, but continued to work out of Berlin.

Throughout the war years, she tended her strawberry assortment, which had grown enormously over the decades, with dedication and patience. "I've since planted a second assortment of *Fragaria* species – and I'm finally out of the botanical garden, where the weeds have taken over my plot among the rubble," she wrote to a friend, nuclear physicist Lise Meitner.

It wasn't until after the war, at the age of 65, that Elisabeth Schiemann, who never married, was granted a full professorship at what would later become Humboldt University in Berlin. For many years she had made do with teaching contracts, grants and even unpaid jobs. In 1953, her department was taken over as the Research Unit for the History of Cultivated Plants of the Max Planck Society, and Schiemann was nominated as a Scientific Member.

After she retired in 1956, the Research Unit was disbanded, closing an era of experimental strawberry genetics, for which there were, until 1950, only three world centers: two in the US and one in the person of Schiemann in Berlin-Dahlem. After Schiemann left the world of science, her valuable strawberry assortment went mainly to the Max Planck Institute for Plant Breeding Research in Cologne-Vogelsang, where it was cared for by Günter Staudt. Staudt was a student of Schiemann and rose in the 1960s to become the "Dean of Strawberries." In addition to researching the *Fragaria* genetic tree, he also dedicated himself to plant breeding.

Elisabeth Schiemann died on January 3, 1972 at the age of 90. She was buried in the cemetery of St. Anne Church. On her grave, the pastor planted a strawberry from the old breeding garden. The name of Schiemann then faded into oblivion for many years. In 2012, the Max Planck Society set up the Elisabeth Schiemann Kolleg. Its aim is to help young female scientists along their path to becoming tenured professors or Directors.

A primarily German-language research volume on Elisabeth Schiemann has been published:
Reiner Nürnberg, Ekkehard Höxtermann, Martina Voigt (ed.): Elisabeth Schiemann 1881–1972. *Vom Aufbruch der Genetik und der Frauen in den Umbrüchen des 20. Jahrhunderts*, 575 pages, Basilisken-Presse im Verlag Natur + Text, Rangsdorf 2014, 39.00 euros

Photo: Archives of the Max Planck Society, Berlin-Dahlem