Ferdinand Julius Cohn (1828-1898): Pioneer of Bacteriology

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http://www.mhhe.com/biosci/cellmicro/nester/graphics/nester3ehp/common/cohn.html

Ferdinand Julius Cohn was not as famous as Louis Pasteur (1822-1895) and Robert Koch (1843-1910) because he worked on the classification of bacteria, thus he did not attract as much the attention of the general public as those who worked on the relationships of microorganisms with human diseases. His contributions include systematic classification of bacteria, discovery of bacterial spore, help in disproving the fallacy of spontaneous generation, and establishing a journal "*Beitrage zur Biologie der Pflanzen*" which served as an important vehicle for the publications of many pioneer bacteriological papers. Cohn's work also helped establish the recognition of bacteria as a separate group of living organisms different from plants or animals.

Ferdinand was born on January 24, 1828 in Breslau (now Wroclaw), Lower Silesia, now in Poland. His father, Issak Cohn, was poor and lived in Breslau's Jewish ghetto when Ferdinand was born. But Issak became a successful merchant and he cared very much about the education for his children. To his great joy, Ferdinand was a genius, he could read at the age of two and was interested in natural history at very young age. He first attended the school at the age of four. In 1835, he entered the Breslau Gymnasium (equivalent to high school) and did very well in all courses. Unfortunately, at the age of ten or eleven, he developed for a unknown reason a hearing defect, which slowed his incredible pace of learning. It was probably due to this defect that he became a shy, studious and sensitive boy who also suffered an acute physical and emotional retardation, which he did not begin to overcome until his last year of high school. In 1842, he entered the University of Breslau. During this period , he developed an interest in botany. Young Cohn finished all the requirements for graduation at the University of Breslau but, because he was a Jew, he was barred from taking the final examination, therefore, Cohn went to the more liberal University of Berlin in October of 1846, and received his doctorate degree in botany on Nov. 13, 1847 when he was only 19 years old. In Berlin, he was very much inspired by the teaching of Eilhard Mitscherlich,, Karl Kunth,, Johannes Muller and Christian Ehrenberg, who introduced him the study of microscopic organisms. But because he was sympathetic to the revolutionaries of 1848, his academic career in Berlin was not prosperous.

In 1849, he returned to Breslau and stayed there for the rest of his life. In 1850, he became a Privatdozent at the University of Breslau. In 1859, he was appointed an extraordinary professor and in 1871, an ordinary professor. Cohn was a great inspiring teacher. His academic career and research findings were all accomplished at this university.

Because he was influenced by Matthias Schleiden's cell theory and Hugo von Mohl's description of protoplasm in plant cells, he began to focus on lower plants---- microscopic organisms. His tedious observations on the unicellular algae *Protococcus pulvialis* led to his early fame. He found that the protoplasm in plant cells and "sarcode" in animal cells were very similar. He suggested that the distinction between animals and plants should not merely be based on the fact that animals possessed differentiated organ systems or a contractile substance peculiar to themselves. He drew an explicit attention to the identity between the contractile contents of plant and animal cell. Cohn's

work on *P. pluvialis* confirmed and expanded the suggestions of Karl Wilhelm von Nageli, Hugo von Mohl, Alexander Braun, Max Schultze, and others, that the essential constituents of the cell was its protoplasmic contents. All these findings eventually led to the "protoplasm theory of life", which was first published by Max Schultze in 1861. The protoplasm theory of life was a big advance step to the understanding of life.

In 1848, Cohn's former teacher Goeppert asked him to devote himself to algae and hoped that he would contribute to the flora of the cryptogamous plants of Silesia. Cohn diligently accepted this assignment and published the first two volumes of the cryptogamous plants in 1876. This work alone is a significant contribution to the plant science in general.

Cohn made detailed study of microscopic algae, fungi and bacteria. Of particular interest was the way he treated bacteria, generally called Vibrionia. At that time, bacteria were considered animals primarily because of their active, apparently voluntary movement. Cohen pointed out that the ciliated swarm cells of algae and fungi performed similar movement. He suggested that bacteria followed the same developmental course as algae, and that some large bacteria belonged to the plant kingdom and displayed an especially close relationship to the Oscillaria. But he studied mainly *Bacterium termo* Dujardin.

In 1855, he demonstrated the sexuality of the unicellular alga *Sphaeroplea annulina*. He observed in Sphaeroplea the formation of spermatozoa and followed the progress all the way to the egg. In 1856, he demonstrated the same phenomenon in *Volvox globator*, a motile alga. The same year, he was appointed chairman of the botanical sections.

Between 1856 and1866, Cohn did some work on the contractile tissues of plants, and also pioneered the phototrophic studies of microscopic organisms. At his urging an Institute of Plant Physiology of the University of Breslau was ultimately created 1866. That was the first Institute of Plant Physiology in the world. At 1872, he became the director of the that institute. In the institute, he installed a marine aquarium that yielded materials for much of his later work.

He cultured marine plants, and studied the classification of lower plants. In 1870, he founded a journal entitled *Bretrage zur Biologie der Pflanzen*, designed primarily to publish the work that came out of his institute. This journal became well known because many pioneer papers of modern bacteriology were published in this journal.

After 1870, Cohn turned his attention primarily to bacteria. He defined bacteria as "chlorophyll-free cells of spherical, oblong, or cylindrical form, sometimes twisted or bent, which multiply exclusively by transverse division and occur either isolated or in cell families."

He divided bacteria into four groups based on their morphology: i. Sphaerobacteria (spherical), ii. Microbacteria (short rods or cylinders), iii. Desmobacteria (longer rods or threads) and iv. Spirobacteria (screws or spirals). He insisted putting bacteria into the plant kingdom because of their similarity with well-known algae.

He also studied the nutritional requirement of *Bacterium termo*. He found that bacteria obtained nitrogen from ammonia compounds just the same as green plants, but bacteria

could not assimilate carbon from carbonic acid, which is different from green plants. He also made clear

distinction between putrefication and pathogenicity of bacteria. Putrefying bacteria were not necessarily pathogenic. In a long series of experiments, he pointed that a temperature of 80^{o}C would effectively destroy the life of all bacteria and prevented their development in an organic infusion. However, he admitted that *Bacillus subtilis* behaved differently. *Bacillus subtilis* was more heat resistant than did *B. termo*. With hard study, he discovered the formation of spores by *Bacillus subtilis*. In 1876, Cohen discussed extensively the implication of the discovery of thermo-resistant spores by *B. subtilis* in the controversy over spontaneous generation. He

explained that the reason why in boiled infusions or hay and cheese could resumed microbial growth was because they contained heat resistant spores.

One very interesting event in Cohn's life was his association with Robert Koch. After Koch became famous for his contribution to bacteriology, a myth developed in Breslau to the effect that Koch had been a student of Cohn, and that his ideas owned much to Cohn's influences. Cohn clarified his relationship with Koch in the newspaper *Breslauer Zeitung*, Dec. 17, 1890. He stated that Koch had come to Cohn's institute at Breslau only to demonstrate results which he had already reached on his own, and to ask Cohn and his colleagues for their judgement of his work. Cohn's role was essentially that of stimulating and encouraging Koch's work and of providing a place for its publication.

Cohn was a well known botanist, but his work was closely related to microbiology. He published nearly 200 papers and books. Cohn received many honors in his life. He held an honorary doctorate from the faculty of medicine at the University of Tubingen, and was named a corresponding,member of the Academia dei Lincei in Rome, the Institut de France in Paris, and the Royal Society of London. In 1885, he was awarded the Leeuwenhoek Gold Medal, and in 1895 the Gold Medal of the Linnean Society.

He married a former student Pauline Reichenback in 1867, apparently he had a wonderful marriage and she wrote his biography in 1901 (*Ferdinand Cohn: Blatter der Erinnerung*) . Ferdinand Cohen passed away on June 25, 1898 in Breslau.