NSS News 44(11):379-381. 1986.

He Wanted To Know Them All

Eigenman and His Blind Vertebrates

By Aldemaro Romero, Ph.D

When *Cave Vertebrates of North America, a Study in Degenerative Evolution* was published in 1909, it instantly became a sort of bible for all who had any interest in cave animals and to those interested in the loss of vision. That book reflects the qualities its author aimed for in his lifelong research efforts: it is comprehensive, detailed, and authoritative. This is the story of the man, Carl H. Eigenmann, and the work that led him to produce one of the "classics" of speleological literature.

Early Years

Little is known about Carl Eigenmann's childhood. He was born March 9 1863 in Flehengen, a small village near Karsruhe, Baden, in what is today West Germany. His mother died when he was a child and his father remarried soon afterward. When he was in his early teens Carl came to the U.S. with his uncle and settled in Rockport, southern Indiana.

Working and studying energetically, Carl Eigenmann finished high school in only two years and was admitted to the University of Indiana, intending to study law. However, during his sophomore year the famous American naturalist David Star Jordan, a professor of natural history, overturned the traditional system of courses in the classics, and instead offered his students a choice of studying either Latin or biology. The new system was a tremendous success.

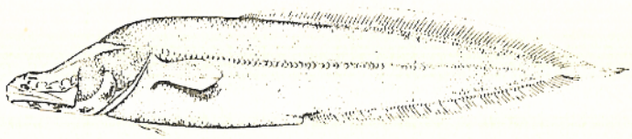
With his characteristic enthusiasm, Eigenmann took biology. His accomplishments must have been quite impressive since Jordan, writing about the first group of students taking the biological alternative, said: "...the leader of these, Carl H. Eigenmann, found Zoology the passion of his life" and that his work was "of the highest order" (Jordan 1922). A year later Eigenmann was posted as Instructor of Zoology.

During 1885, his junior year, Eigenmann published his first scientific paper (co-authored with Jordan) and submitted many more.

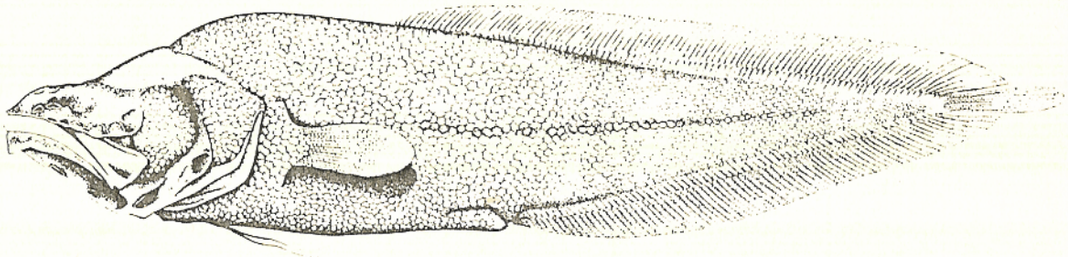
First Cave Fish

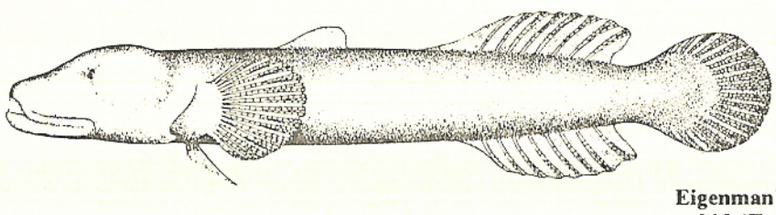
In his *Cave Vertebrates* Eigenmann stated that "my first experience with blind vertebrates was in 1886, when Superintendent Funk sent to Indiana University a living blind fish which had been taken from a well at Corydon, Indiana, and which proved to be a new species, *Typhlichthys wyandotte*, the only representative of the genus so far taken north of the Ohio River."

Eigenmann didn't describe this "new" species until 1905. Later it became evident that this fish as well as his *"Typhlichthys osborni"* were actually mis-identifications of the southern cavefish, *Typhlichthys subterraneus*, a species previously described by Girard in 1859.



Drawings of Cuban blind cave fish, *Lucifuga subterraneus* and *Lucifuga* (former *Stygicola*) *dentatus* collected by Eigenman in 1902.





Eigenman's drawing of the California blind gobid (*Typhlogobius Californiansis*).

Miss Smith

In 1886, with his bachelor's degree under his arm, Eigenmann took a long trip to California. He arrived too late to apply for a job as a school principal, as he had intended, so he moved on to San Diego to visit Miss Rosa Smith, an ichthyologist with whom he had maintained professional correspondence.

Miss Smith must have been a remarkable woman. Born in Illinois October 7 1858, she was one of the first American women to become a scientist, studying fish and spiders, and was the first woman president of Sigma-Xi, the national scientific research society.

From 1880 to 1882 she attended Indiana University, where she may have met Eigenmann. Whatever the circumstances, Eigenmann, five years her junior, fell in love with her and they were married in San Diego on August 20, 1887.

New Horizons

The newlyweds were offered a chance to study the immense Brazilian fish collections made by Louis Agassiz in 1865-1866 and by Agassiz and Franz Steindackner during the Hassler Expedition which encircled South America in 1871-1872; they moved to Cambridge in 1888 to undertake this tremendous task at the Museum of Comparative Zoology of Harvard University.

With his brand-new master's degree from Indiana, Eigenmann and his wife spent long hours working on the taxonomy and development of those South American fish. In 1888 they began publication of a series of papers on the subject and during the summer they went to the Marine Biological Laboratory at Woods Hole, Massachusetts, where they spent the rest of the year doing research.

The next year Eigenmann received his doctoral degree from Indiana and returned to California as Curator of the San Diego Natural History Society, while establishing the San Diego Biological Station.

The California Blind Fish

The fish of the California coast became a new focus of interest for the Eigenmanns. Mrs. Eigenmann took her husband to a place named Point Loma, where a blind fish (*Typhlogobius californiensis*) could be found among the rocks. As Eigenmann put it: "when a stay in southern California came in prospect, a study of the blind fish, *Typhlogobius*, living under rocks along the base of Point Loma, was one of the first definite plans (for the study of blind animals) formed."

This new subject impressed him so much that the question of how some vertebrates became blind was one of the centerpieces of his research for the next few years. He had started working on that fish when a new event gave him the opportunity to broaden his area of research.

In 1891 Jordan became Stanford University's first president. Before leaving Indiana University, he appointed Eigenmann as professor of zoology at Bloomington, Indiana. Now the German-American professor was within the geographical range of the North American fish family Amblyopsidae and many other cave vertebrates. By then, a large amount of the world's blind vertebrate fauna already had been reported from the Mississippi plateau area.

From 1897 to 1909 much of Eigenmann's effort was devoted to comprehending the process of the loss of visual structures in cave vertebrates. In May, 1896, he visited Dalton's Spring (actually a cave-stream) where he secured 20 specimens of the northern cavefish *Amblyopsis spelae*. This became his favorite collecting locality. By 1903 the state legislature of Indiana placed the land, where the entrances and exits to this and other caves were located, under the care of the trustees of Indiana University.

In 1898, Eigenmann published the description of a new species of cave fish he named after his wife, *Typhlichthys rosae*, the Ozark cavefish. Today it is recognized as *Amblyopsis rosae*. This species from southwestern Missouri is characterized by its rudimentary eyes.

Eigenmann extensively visited the caves of Indiana, Kentucky, Texas, and Missouri in search of specimens for his work. At Mammoth Cave he became "impressed with the value of the scientific problem the cave presented" and (after walking for one hour or two from the entrance) he noted "...it begins to impress one very forcibly."

Cuba

There are two species of cave fish (of marine origin) from Cuba which are quite distinct from those in North America. These Cuban blind cave fish were described by Felipe Poey in 1856. The two species are known today as *Lucifuga subterraneus* and *Stygicola dentatus*. Eigenmann wanted to know how much convergence was occurring among cave animals and the Cuban species offered an excellent opportunity. He wanted to know all cave species.

In March, 1902, Eigenmann visited Cuba for the first time to secure specimens for his comparative studies. He had been working on fish reproduction in the past and quickly recognized that these two fish species were viviparous (have live births instead of laying eggs). He therefore planned a second visit during October-November when, as he

calculated, pregnant blind fish could be collected with the young embryos still in their early development stages. This time he planned to collect individual fish alive, so they could be placed in cages located in a well-lighted cave entrance. His idea was to find out what happens when light penetrates through the adult body walls and reaches the embryos. Eigenmann and his assistants were not very lucky securing specimens with embryos, so he embarked again for Cuba, arriving on December 18, 1903, but no fish with young embryos were then found.

With his typical persistance Eigenmann went back to Cuba on August 15, 1904, and obtained two females with young, but by this time the cages that had been built and placed two years earlier were in very bad shape. So in September he took the fish to Indiana where low temperatures caused high mortality. In 1905 three of his co-workers went to Cuba again trying to secure more live females with young; again success was not complete.

Contrary to Mammoth Cave, Eigenmann found the localities for the Cuban blind fish "monotonous in the extreme." From 1906 to 1907 he did many laboratory studies in Europe, mostly in Germany at the laboratory of Prof. R. Wiederstreim, with the Cuban specimens he collected.

During this period he made plans to visit the Yucatan Peninsula. There had been persistent rumors of a varied cave fauna in that part of the world. He never made that trip. However, in the '30s a series of scientific expeditions unearthed an impressive number of cave organisms from the Yucatan Peninsula, many of them fish studied by Carl Hubbs.

From 1898 to 1905 Eigenmann published 39 papers on cave vertebrates, dealing mostly with developmental and anatomical aspects of loss of vision in blind fish, salamanders, lizards, and the blind rat in an attempt to understand the underlying process of blindness among these animals. All this research was summed up in his "Cave Vertebrates of North America" (1909), containing 341 pages and 30 plates.

The Meaning

Despite the fact that he was a taxonomist by training, Eigenmann never stressed classification problems of cave vertebrates (after all, there were not that many). Instead he was really concerned with the problem of the origin and evolution of the cave faunas.

To understand Eigenmann's contributions to biospeleology, we have to take a historical perspective. Although Darwin had put forward his ideas about organic evolution by means of natural selection several decades prior to Eigenmann's interest in cave fauna, evolution by natural selection was far from being widely accepted because, among other things, Mendel's crucial papers explaining the basis of genetics were not rediscovered until the turn of this Century. To make things even more complicated, Darwin himself had argued for Lamarckian mechanism (disuse combined with the inheritance of acquired characteristics) to explain blindness in cave animals.

There is little question that Eigenmann's evolutionary explanations for the reduction and/or disappearance of organs were a mixture of neo-Lamarckism and Darwinism. On the one hand he stated that "the bleached condition of animals living in the dark, an individual environmental adaptation, is transmissible and finally becomes heriditarily fixed." On the other hand, he was quick to affirm that "...ornamental secondary sexual characters not being found in blind fish are, when present, probably due to visual selection," apparently implying natural selection based on sexual selection.

Such apparent contradiction was not unusual at his time (certainly Darwin himself held similar concepts) and the dismissal of the idea of inheritance of acquired characteristics would not take place until the late 1920s when the new ideas of population genetics were put forward.

Eigenmann was an early supporter of Herbert Spencer's ideas that cave faunas were not the result of "accidents" but rather the product of an active process of colonization.

He also argued that the reduction or disappearance of organs among cave animals was a case for convergent evolution; i.e., the well-defined conditions of the subterranean environment facilitate evolutionary changes leading to blindness and depigmentation in a variety of different vertebrate and invertebrate organisms which come to inhabit them—a view which although seemingly self-evident is still overlooked or discounted by many researchers.

Eigenmann was quick to point out that the lack of pigmentation had to be understood as the combination of genetically fixed and epigenetical (environmental) characteristics. In other words, although lack of pigmentation is a characteristic genetically determined, its degree may vary under certain light conditions.

Finally, for his time he was closer than anyone else in singling out development compared to developmental abbreviation as the descriptive mechanism for understanding the evolution of blindness among cave animals.

South America and More Cave Fish

Although Eigenmann maintained a profound interest in cave faunas, he kept working on other fish. During his most active speleological period (1898-1905), he published 26 papers on other subjects. Later he spent almost all his efforts on discovering and describing South American fresh-water fish. His contributions here were as important as those on cave faunas. Again, he wanted to know and study them all.

Even so, he found more time and opportunities to contribute to our current knowledge of cave animals. He kept publishing articles on the subject until 1919 when he described a new species of blind fish, *Trogloglanis pattersoni*, from the artesian waters of San Antonio, Texas. This is a remarkable herbivorous toothless catfish, which shares its habitat with another blind catfish, *Satan eurystomus*, a carnivore.

Epilogue

Back in the 1910s South America was not an ideal place, even for a mature man of apparently endless energies. During his 1912 trip to Colombia, he was affected by fevers of unknown origin, and while climbing the Chilean Andes in 1919, he had to quit. His exploration days were over, at the relatively young age of 59. In 1926 he went to sunny California hoping to recover his health. However, on April 24 1927 he died at a private hospital at Chula Vista, San Diego County. His wife died on January 12 1947 at the age of 89. They were survived by four daughters and a son.

During his lifetime Eigenmann received many honors. He was most proud to be a member of the National Academy of Sciences. He published 229 papers (some of them extensive monographs) and described nearly 400 species of fish. But few of those monographs rival "Cave Vertebrates of North America" because in few of them did he try so hard to show that he had intended to know them all.

Acknowledgements

Thanks to Dr. Stanley H. Weitzman of the National Museum of Natural History who helped me to locate some of the illustrations that accompany this article and who read the MS, making valuable suggestions.

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