

Field Guide to the Major Organisms and Processes Building Reefs and Islands of the Dry Tortugas: The Carnegie Dry Tortugas Laboratory Centennial Celebration (1905 – 2005)

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Tributes to the Accomplishments at the Tortugas Laboratory

Tortugas Marine Laboratory: Threshold to Modern Sponge Biology

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Animal or plant species can only be fully understood after they have been observed live in their environment, perhaps even manipulated in some experimental way. Sponges are no exception, but until the dawn of the 20th Century, poriferologists were museum people who processed the dry or alcohol-preserved material sent by beach combers and visitors to foreign shores, or brought home by sea-faring expeditions, for instance the *Blake*, *Challenger*, *Albatross*, *Hirundelle*, *Valdivia*, *Endavour*, *German South Polar*, *Percy Sladen Trust*, and many more. The early marine stations were all located in Europe, in harbors of cities or towns such as Naples, Rovinj, Monaco, Roscoff, and Plymouth.

Establishing the Tortugas Marine Laboratory on Loggerhead Key, Florida, was revolutionary in many ways. The laboratory was the first marine field station in the tropical Americas and was located on a small island that itself was part of the coral reef ecosystem to be studied. The facilities were simple but invited ingenious improvisation for experimental study of organisms that were readily available from nearby habitats. And, in addition to the conventional dredges and sponge hooks used to obtain sessile benthic organisms, a “diving apparatus” was available. This apparatus, a diving helmet made popular in the writings of William Beebe, was first used by the only sponge scientist to work at the laboratory, Max Walker de Laubenfels, who wrote after a walk on the bottom of the reef that “comparisons to a ‘fairyland’ are appropriate.”

During the summers of 1927 and 1928, de Laubenfels conducted a cell-physiology study involving the common Caribbean sponge *Iotrochota birotulata*, and a second species that he described as new, *Haliclona longleyi*, named after W.H. Longley, the Executive Officer of the Tortugas Marine Laboratory. To demonstrate the effect of different temperatures on cell aggregation and growth (and improvisational skills in a place where electricity was not an around-the-clock convenience), he used a “double wooden tunnel... with wood wool or excelsior between inner and outer layers for insulation. Ice was placed at one end, the other left open to the tropical air.”

Sponges were also the subject of interest of another worker in the Tortugas at the time, Arthur S. Pearse, who spent the summer of 1931 examining the rich fauna of endobionts occupying the vast canal system of five species of common reef sponges (identified by de Laubenfels), including the common and huge *Sphaciospongia vesparium* (appropriately, its common name is loggerhead sponge). Pearse found and identified between about 6,000 and 17,000 specimens of polychaete worms, crustaceans, brittle stars, and fishes in sponges ranging in volume from 50 to 185 liters.

De Laubenfels returned to the Tortugas Marine Laboratory “at the edge of the Gulf Stream [which] offers most favorable conditions for biological work, especially in regard to sponges” during June–August, 1932. He and laboratory staff collected at many sites, shallow and deep, primarily E and SE of Loggerhead Key (4–20 m, 70–80 m), Bird Key and Bush Key reefs (0–15 m), Garden Key (2–25 m), including the Fort Jefferson moat (0–1 m), White Shoals (15–20 m), and partway to Cuba (105 m, 1047 m). In the resulting monograph (published in 1936), de Laubenfels not only described the 77 species he found but he went much farther by providing revised diagnoses of all known genera and families of sponges, a truly pioneering work. The *Sponge Fauna of the Dry Tortugas* also stands out for live observations of color, structure, consistency, and smell and comments on habitats and environmental conditions, such as substratum, light exposure, temperature, water movement, sedimentation, and biological associates. The voucher

material of this study is deposited in the sponge collection of the Department of Invertebrate Zoology, National Museum of Natural History, Smithsonian Institution, Washington, D.C. (formerly U.S. National Museum, USNM).

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Researchers at the Carnegie Laboratory for Marine Biology in the Tortugas Laid the Firm Foundations (1905-1937) for 20th-Century Reef Science

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Besides being the first permanently based tropical marine laboratory in the Western Hemisphere, the Tortugas Marine Laboratory hosted the research activities of the most distinguished national and international coral reef scientists of the first half of the 20th Century. Alfred G. Mayor, the founding Director of the laboratory, was the first worker to demonstrate that reef-building corals live precariously close to their upper temperature-tolerance limits. He also found that the fastest growing corals were the most susceptible to elevated temperature stress. Coral growth-rate studies, the early life history of corals, their tolerance to various physical stressors, and nutritional needs were also investigated at the Tortugas

Laboratory by T. Wayland Vaughan and his student J.W. Wells. Vaughan later became the Director of the Scripps Institution of Oceanography and J.W. Wells the doyen of American coral reef science. The saturation state of CO₂ in Tortugas reef waters, a critical control of the precipitation of coral limestone skeletons, was studied by R.C. Wells. All of these early studies were prescient vis-à-vis present-day concerns with global warming, coral reef bleaching, and the degradation of coral reefs on a global scale.

Mindful of the power of the comparative approach in science, Mayor extended his studies of Tortugas reef coral ecology to the wider Caribbean region (Bahamas, Jamaica, Puerto Rico, and Trinidad-Tobago) and to the far western Pacific (Torres Strait, Fiji, and American Samoa). Several scientists from other countries also visited and conducted comparative studies at the Tortugas Laboratory. Notable among these workers were H. Boschma, the world's authority on fire corals, and Sir Maurice Yonge, the leader of the Great Barrier Reef Expedition. Inspired by his work at Tortugas, C.H. Edmondson continued with and pioneered the first ecological and physiological studies of corals in Hawaii. R.A. Daly, another celebrated geologist who challenged the ideas of C. Darwin and J. Dana on reef development and growth, also worked in the Dry Tortugas. We present-day coral reef researchers and students stand on the shoulders of these giants of the Tortugas Laboratory.

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