Stazione Zoologica Anton Dohrn, Naples, Italy

The Stazione Zoologica Anton Dohrn (Anton Dohrn Zoological Station) is a public research institute focusing on biology and biodiversity. Hereafter called the Station, it was founded in Naples, Italy, in 1872 by Anton Dohrn. The type of research conducted at the Station has varied since it was created, though initial research focused on embryology. At the turn of the twentieth century, researchers at the Station established the sea urchin (Echinoidea) as a model organism for embryological research. A number of scientists conducted experiments on embryos and embryonic development at the Station from the 1890s to the 1930s, including Hans Driesch, Jacques Loeb, Theodor Boveri, Otto Warburg, Hans Spemann and Thomas Morgan. Research completed during this time at the Station contributed to the study of experimental embryology and developmental biology and helped shape the history of embryology.

The institute was founded by Anton Dohrn, a zoologist working to establish stations for zoological research. While doing post-doctoral research at the University of Jena in Jena, Germany, Ernst Haeckel introduced Charles Darwin's 1859 theory of evolution to Dohrn. In pursuit of research material, particularly marine organisms, Dohrn traveled and worked alongside Haeckel and others in facilities located by the sea. During this period, Dohrn and colleague Nicolai Miclaoucho-Maclay proposed to create a network of zoological stations. Dohrn proposed that those stations should be equipped with laboratory rooms and experimental instruments and supplies for scientists to collect research materials, make observations, and perform experiments before potentially moving to the next station. Dohrn identified Naples as an ideal location to establish a research station, due to the abundance of fauna in the nearby Mediterranean Sea and to the cosmopolitan character of the city.

After convincing the city authorities to allocate a piece of land by the sea, Dohrn founded the Station in 1872. He created the building plans for the institute, and in 1873, a year after laying the foundations, the first building was opened. Marine laboratories already existed elsewhere, but they were often affiliated with other institutes or universities and mainly served educational purposes. The Station was the first independent organization created to serve as a research institute for marine biology.

The majority of the funding for the Station came from Dohrn himself, who also donated his personal library. Other funds came from Charles Darwin, Thomas Huxley, and Rudolf Virchow, among others. The Berlin Academy of Sciences in Berlin, Germany, also provided funds for the Institute in 1877. To raise additional income, Dohrn constructed a large portion of the Station as a public aquarium. Ernst Abbe, a friend of Dohrn's who improved the quality of the Zeiss lenses used in microscopes, allowed the Station to purchase sets of microscopes from the Zeiss factory at a discount. Dohrn also established agreements with many universities worldwide. The agreements allowed the universities to rent pre-established amounts of research tables at the laboratory, and the universities sent a corresponding number of scientists to the Station. With an annual rental, scientists were provided with lab space, chemicals and equipment, access to the library and other amenities of the Station, as well a supply of marine animals for research purposes.

To disseminate information about the work conducted at the Station, Dohrn founded the journal Mittheilungen aus der Zoologischen station zu Neapel (News from the Naples Zoological Station), which published from 1879 to 1915. This publication became Pubblicazioni della Stazione Zoologica di Napoli (Publications from the Naples Zoological Station) (1924–1978). The journal later turned into the two journals Marine Ecology (1980—), and History and Philosophy of the Life Sciences (19797–). Additionally, Dohrn founded the journal Zoologischer Jahresbericht (Zoological Annual Report) (1880–1915) and the series of monographs Fauna e Flora del Golfo di Napoli (Fauna and

Flora of the Gulf of Naples, 1880–1982).

The Station did not have an independent research program, but instead it supported the interests of the scholars working there. During the 1870s to the 1890s, scientists focused on embryological processes and tried to describe the mechanics of development. While working at the Station in 1875, Oscar Hertwig observed the entry of the sperm cell or spermatozoon into the egg of a sea urchin and the fusion of the two nuclei. Hertwig recognized the role of the cell nucleus in supplying material for embryonic development, and he observed that chromosomes are numerically reduced during fertilization. August Weismann performed experiments at the Station from 1881 to 1882, and he found that the tissues producing sexual cells (the germ plasm) are separate from the other tissues of the body (the somatic plasm) during development.

In 1889, Theodor Boveri conducted experiments at the Station. Boveri hybridized, or cross bred, different species of sea urchins to determine which part of the cell determines inheritance and development; the nucleus, the protoplasm (cell material outside of the nucleus), or both. He did so by fertilizing an egg deprived of its nucleus (enucleated) of one species with the sperm of another species. The resulting offspring displayed only paternal characteristics and lacked characteristics from the enucleated egg cell. If he crossed egg cells containing nuclei from one species with sperm from another species, the resulting offspring displayed characteristics from both species. From these experiments, Boveri inferred that the nucleus and its components are responsible for biological inheritance in sea urchins.

In 1891, while working at the Station, the zoologist Kurt Herbst discovered that calcium-free water spontaneously separated the cells of a sea urchin zygote, or fertilized egg cell, during the first stages of cleavage. Taking advantage of Herbst's discovery, the embryologist Hans Driesch separated the first two cells of a zygote and showed that each cell developed into a complete embryo. Additionally, Driesch fused two sea urchin eggs together, the result being a single whole embryo, that became larger than regular sea urchin embryos. Driesch's experiments led him inquire into the philosophical nature of development. He stated that the embryo is a system in which all parts have the same potential to develop. Driesch called such a theory harmonious-equipotential system. According to Driesch, a cell undergoes a goal-oriented process and eventually reaches its developmental goal due to a non-material entity driving development, an entity he called an entelechy.

The physiologist Jacques Loeb also conducted experiments at the Station in 1889–1890. While at the Station, Loeb studied growth and regeneration in invertebrate marine animals. Loeb continued experiments in the US to demonstrate that a sea urchin egg could undergo development even when unfertilized by sperm. He initiated the development process in unfertilized sea urchin eggs by exposing them to salt solutions and increasing osmotic pressure. This process of inducing development in an unfertilized egg became called artificial parthenogenesis. These experiments led Loeb to refuse Driesch's theory of a special force underlying developmental processes and to claim that development is mechanic and relies on chemical interactions.

Around the turn of the century, Thomas H. Morgan worked at the Station to conduct experiments on the embryology of several organisms belonging to the phylum ctenophora. Additionally, Otto Warburg worked at the Station and traveled to Naples between 1908 and 1914. Warburg studied the chemical processes involved in development. He performed experiments to demonstrate that after fertilization, the sea urchin egg increases its consumption of oxygen. In 1909, Warburg found that iron plays an essential role in early development. That research led him to focus on cellular respiration. Warburg was awarded the Nobel Prize in Physiology or Medicine in 1931 for his description of enzymes that aide in respiration.

During World War I, Dohrn and other Germans working at the Station had to return to Germany. Though the Station was owned by a private German citizen, the Station was deemed an Italian institution from 1916 to 1920 when it fell under the directorship of an Italian National Committee. In 1920, the Italian Minister of Education, Benedetto Croce, gave the station to the nation of Germany. The German ownership lasted three years, until 1923. The Station then transfered to the control of the Italian Minister of Education, with the mayor of Naples as the director and Rinaldo Dohrn, Anton's son, as the administrator. Through the transitions in ownership and World War I, the Station continued to host many international scientists.

In the 1920s, the Station expanded to include new research programs, such as physiology and neural transmission, or the process by which neurons transmit signals, and the Station continued to support individual scientists' research efforts. The embryologists Hans Spemann and Hilde Mangold traveled to the Station various times to study eye development in amphibian embryos. The biochemist Otto Meyerhof visited the Station to study the chemical processes involved in the stimulation of muscular fibers. He received the Nobel Prize for Physiology or Medicine in 1922 for his work on muscle metabolism. In 1935, the physiologist Zènon-Marcel Bacq and the chemist Francesco Paolo Mazza studied the chemical aspects of nervous transmission, and they demonstrated the occurrence of acetylcholine in the optic ganglion of the octopus at the station. One year later, in 1936, the neurophysiologists John Z. Young and Enrico Sereni visited the Station to research the nervous system of the octopus (Octopus vulgaris).

The Station closed from 1943 until 1945 due to World War II. After the war, funding for the Station came from the US National Science Foundation, the Lilly Endowment, and the Rockefeller Foundation, all headquartered in the US. Research at the Station in the 1950s and 1960s continued to focus largely on embryology, as well as genetics. In 1951, Maurice Wilkins presented an X-ray image of the crystalized structure of DNA during a conference hosted at the Station. Wilkins's talk inspired James Watson, who was present at the conference. Watson, Francis Crick, and Rosalind Franklin would later utilize similar methods to discover the structure of DNA in 1953.

The Station struggled with finances in the 1960s, largely due to an increase in equipment costs and the difficulty in maintaining individual research laboratories. The number of scientists visiting from countries outside of Italy dropped significantly by the 1970s. In 1976 Alberto Monroy became the new director of the Station and he aimed to restore the international prestige to the institution. New programs were created to respond to a various new areas of research. Research programs launched after the 1980s focused on ecology and biodiversity.

In 1982, the Station was renamed Stazione Zoologica Anton Dohrn (Anton Dohrn Zoological Station) to include its founder's name. Gaetano Salvatore served as president from 1987 until 1997, when Giorgio Bernardi replaced him. Bernardi helped to establish research on molecular evolution at the Station. In 2010, the President of the Italian Republic, Giorgio Napolitano, planned to close the Station due to public financial difficulties. A petition was launched to support the Station, which succeeded. As of 2014, the marine biologist Roberto Danovaro serves as president of the Station. The Stazione Zoologica Anton Dohrn exists as a public research institution with research focus in marine biology and biodiversity of marine organisms.

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