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The "Stazione Zoologica Anton Dohrn" and the History of Embryology

BERNARDINO FANTINI

Louis-Jeantet institute for the History of Medicine. Geneva Medical School, Geneva, Switzerland

Historians of biology, biologists and science managers have reconstructed and underlined well the particular role that the Stazione Zoologica di Napoli (SZN) has played since its foundation in 1873 in all the major advances in biological sciences and its role as a model for other institutions in the field (Heuss, 1962; Kühn, 1950); (Benson, 1988 ; Fantini, 2000; Fischer, 1980; Groeben, 1984 ; Groeben, 1997; Gross, 1985; Monroy & Groeben, 1985 ; Montalenti, 1968; Müller, 1975; Partsch, 1980; Simon, 1980). In a well-documented paper published in this Journal, Irmgard Müller analyzed the impact of the Stazione on experimental and physiological embryology (Müller, 1996). The paper devoted to Alberto Monroy in this same issue clearly shows the centrality of this institution in the history of Italian embryology. Almost the whole history of embryology in Italy, with a few exceptions, is centered in the South of the country, in Naples and Palermo. The SZN played a major role in forming several generations of embryologists and developmental biologists, creating the ideal conditions for creative research and putting Italian scholars in contact with the leaders in the field, who used to spend long research periods in Naples.[1] It is therefore useful, in a special issue devoted to Italian developmental biology, to outline the history of this institution, in order to underline the reasons for its significance.

The origins

The foundations of the Stazione Zoologica were laid in March 1872. Anton Dohrn, founder and first director, was born in Stettin, Pomerania, present day Poland, in 1840, into a well-to-do bourgeois family. Anton's grandfather, Heinrich Dohrn, a merchant in wine and spices, had made a fortune in the sugar industry; Anton's father, Carl August, could therefore devote himself to his various hobbies, such as travelling, collecting folksongs and insects. Anton, the youngest son, studied zoology and medicine at various German universities (Königsberg, Bonn, Jena and Berlin), without much enthusiasm. His ideals changed in Summer 1862 when he arrived at Jena where Ernst Haeckel introduced him to Darwin's work and theories. Dohrn became a fervent defender of Darwin's theory of 'descent with modification', the theory of evolution by natural selection. He then decided to dedicate his future life to collecting facts and ideas in support of Darwinism, the starting point for a lifelong adventure.

At that time comparative embryology was becoming the cornerstone of morphology and evolution, based on Haeckel's recapitulation theory: the idea that an organism during its embryonic development passes through the major stages of the evolutionary past of its species. Morphology and embryology thus became one of the major ways in which zoologists sought to expand and develop Darwinian theory in the last 30 years of the 19th century. Dohrn chose to become a 'Darwinian mor-

Abbreviations used in this paper: SZN, the Naples Zoological Station (Stazione Zoologica di Napoli).

***Address correspondence to:** Prof. Bernardino Fantini. Louis-Jeantet institute for the History of Medicine. Geneva Medical School, CMU, Case Postale, 1211 Geneva 4, Switzerland. TEL: 41 22 702 5790. FAX: 41 22 702 5792. e-mail: Bernardino.Fantini@medecine.unige.ch

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The Stazione Zoologica in 1873.

phologist': the evolutionist Charles Darwin and the embryologist Carl Ernst von Baer became his scientific ideals, immortalized in the two marble busts located in the Frescoe room of the Stazione Zoologica.

While pursuing his university career (PhD in 1865 at Breslau, 'Habilitation' in 1868 at Jena) Anton Dohrn worked several times at facilities located on the seashore: at Helgoland with Ernst Haeckel in 1865, at Hamburg in 1866, at Millport in Scotland with David Robertson in 1867 and 1868, and at Messina during the winter of 1868-1869 together with his Russian friend and colleague Nicolai Micloucho-Maclay. In Messina the two friends planned to cover the globe with a network of zoological research stations, analogous to railway stations, where scientists could stop, collect material, make observations and perform experiments, before moving on to the next station.

In German scientific culture of the 19th century, the sea was at the same time the place to look for the most elementary forms of life and the symbol of the endless search for knowledge.[2] Marine organisms became the center of interest for philosophers and naturalists who accepted the *Naturphilosophie* and, after the origins of the first forms of cellular theory, adhered to a 'protoplasmic theory of life', looking into the sea depths for an 'elementary living matter', the *Urschleim*, the elementary monad endowed with life. The new generation of biologists in the 1850s and 1860s, well-versed in *Naturphilosophie* and the new biological doctrine, Darwinism, looked to the sea as a source of knowledge regarding fundamental biological problems and as a life experience.

At Messina, Dohrn rented two rooms for the "Stazione Zoologica di Messina" (February 1869), but he quickly realized the technical difficulties of studying marine life without a permanent structure (difficulty in collecting specimens, lack of storage tanks with flowing seawater, lack of a library and lack of technical assistance from well-trained personnel). Faced with such difficulties, Dohrn started to dream about the usefulness for scientists to arrive near the sea and find the "table laid" for work, that is, to find upon arrival instruments, laboratory space, services, chemicals, and books available, together with records of where and when certain species could be found and useful information on local conditions.

In Messina, he left his books, equipment, diaries and the portable aquarium he had brought with him from Scotland for those who would come after him and moved in 1870 to Naples, which he decided would be a better place for his station. This choice was due to the great biological richness of the Gulf of Naples and also to the possibility of creating a research institute of outstanding international importance in a large town that itself had a strong international vocation. An aquarium open to the public might earn enough money to pay a permanent assistant for the labs. Naples, with its 500,000 inhabitants, was one of the largest and most attractive cities of Europe and also had a considerable flow of tourists (30,000 a year) that would be potential visitors to the aquarium.

With a mixture of imagination, will-power, diplomatic dexterity and good luck, and with the friendly support of scientists, artists and musicians, Anton Dohrn overcame doubts, ignorance, and misunderstandings and persuaded the city authorities to give him, free-of-charge, a plot of land at the sea edge, in the beautiful Royal Park (today, the Villa Comunale). For his part he promised to build a Stazione Zoologica at his own expense.

The Stazione Zoologica was the product of a dream, of a visionary project, but Dohrn knew exactly what he wanted and how he wanted it done — the plans for the buildings are his. The foundations of the Stazione Zoologica were laid in March 1872, and by September 1873, the building was finished. Two-thirds of the building costs came out of Anton Dohrn's and his father's pockets, the remaining third was provided by loans from friends. After the first building - today's central part - a second building, connected with the first by a bridge, was added in 1885-1888, the courtyard and western part in 1905. Fifty years later the library was inserted between the first and second building. The core building contained pumps, machines, store rooms and seawater tanks in the cellar, the public aquarium in the basement, a large laboratory for about 12 scientists and the fresco room housing the library on the first floor, and 12 smaller labs and living quarters for the custodians and assistants on the second floor.

The public aquarium, which covers 527 square meters, was opened on 26 January 1874. It is unique because it has changed very little since its creation and it is the oldest 19th century aquarium still functioning as well as the only one exclusively dedicated to Mediterranean fauna. It was built under the supervision of William Alford Lloyd, an English engineer. The first scientists arrived in September 1873 (2 from Germany, 3 from the U.K., 2 from Russia, 2 from Italy, and 1 from the Netherlands) and the official inauguration of the Stazione Zoologica took place on April 14th, 1875.

Art, science, and culture

The importance of the Stazione Zoologica goes far beyond purely scientific aspects or practical interests. It is also famous for its humanistic values and for its cultural climate: the 'creative atmosphere' of the Naples Stazione Zoologica and the cross fertilization among different research and cultural traditions, international contact among visiting scientists and a 'permanent congress' that lasted several months instead of a few days. For many scientists the 'Naples experience' was a good mix of new research, human experience, acquisition of new methods and new cultural experiences.

The Stazione Zoologica is the only scientific institution at which, from the very beginning, science, music and art were integral components of a unique project, the two complementary halves of a unique dream. Even at the level of the architecture, the music space, the 'Fresco room,' with its statues, frescos, and allegories, was symmetrical to the laboratory, with its organisms, aquariums, microtomes and microscopes. The two halves formed a coherent and organized whole, defining together the 'soul,' the essence of the Stazione.

From the beginning Dohrn wanted to include the arts as an integral part of the home he was creating for science. The large room facing the sea and Capri was intended for the arts, music in particular. During the Summer and Fall of 1873, while the building was still under construction, the German painter Hans von Marées and the sculptor and architect Adolf Hildebrand decorated the room with a cycle of wall-paintings, depicting scenes from Mediterranean life: fishermen, Dohrn and his friends relaxing after a hard day's work and orange groves with children, men and women. Space was scarce from the beginning and Dohrn had to use the room for the library.

Art and music were essential parts of the life of the cultural elite of the 19th century, aspects of intellectual and social status, and Dohrn, like a Renaissance prince, wanted to have his 'musical laboratory.' At the same time, the search for form and beauty created a common background for both science and the arts, activities that share some fundamental aspects in their endless search for truth. As Dohrn himself wrote to E.B. Wilson in 1900:

"*Phylogeny is a subtle thing, it wants not only the analytic powers of the 'Forscher', of the researcher, but also the constructive imagination of the 'Künstler', of the artist – and both must balance each other, which they rarely do – otherwise the thing does not succeed*".

Biological research at the international level

The Stazione Zoologica di Napoli fairly soon acquired a special status in the panorama of scientific institutions, because of its peculiar institutional nature, its potentiality for advanced biological and marine research, and its pervasive and involving cultural atmosphere. It was an international institution founded by a German, managed as a private and familial enterprise and organized according to the German academic tradition. But it was located in Italy and allowed any country to participate in its scientific life and provide for its financial support.

The international character of the institute (a novelty at that time) was secured with the help and support of influential scientists such as Darwin himself,[3] Michael Foster, Louis and Alexander Agassiz, Carl Ernst von Baer, Rudolf Virchow, Emil du Bois-Reymond, and, of course, several Italian zoologists, the most prominent being Paolo Panceri, the teacher of outstanding Italian zoologists of the end of the 19th century (Carlo Emery, 1848-1925, Antonio Della Valle, 1850-1935). Panceri unfortunately died in 1877 at age 44; according to Dohrn himself, he was the first to help him in Naples and the first to understand what the Stazione needed to be, as did his successor Salvatore Trinchese (1836-1897), the teacher of Francesco Saverio Monticelli (1863-1927), Federico Raffaele (1862-1937) and Giuseppe Jatta (1860-1903). Notwithstanding his nationality and cultural background, Dohrn found a great source of strength, encouragement and help for his dream of a marine laboratory in the British natural history tradition, because his project was really at the focus of biological research. In 1870, at the annual meeting of the British Association in Liverpool, a committee was formed 'for the purpose of promoting the foundation of zoological stations in different parts of the world.' Indeed, it was this committee, through its many reports as well as notes and articles regularly published in *Nature*, which gave such widespread publicity in the English-speaking world to Dohrn's Stazione Zoologica.

In order to promote the international status of the Stazione and to guarantee its economic and hence political independence and freedom of research, Dohrn introduced a series of innovative measures to finance his project, first of all the rental of work and research space ('table system'): for an annual fee the contract partner (universities, governments, scientific institutions, private foundations, even individuals) could send one scientist to the Stazione for one year where he or she would find available all that was required to conduct research (lab space, animal supply, chemicals, an exceptional library and expert help from the staff), without any constraint on his or her own projects and ideas.

This so-called 'research table system' or 'Bench system' worked extremely well. By 1890, 36 tables were rented annually by 15 different countries, and when Anton Dohrn died in 1909 more than

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1 An analysis of the impact of the Zoological station on Italian Zoology has recently been carried out by Christiane Groeben and Michael T. Ghiselin (lecture in Padua, 15/2/2000, in press).

2 The interest in marine organisms for the understanding of the fundamental problems of biology was prompted by Johannes Müller (1801-1858), the father of physiology and theoretical biology in Germany. Müller widely publicized the concept of marine biological research as a means of elucidating fundamental biological concepts. Moreover, Johannes Müller was the name of the first boat used by the Stazione Zoologica for collecting marine fauna and flora.

3 See (Groeben, 1982).

2,200 scientists from Europe and the United States had worked at Naples and more than 50 tables per year had been rented out. It was in fact at Naples that international scientific collaboration in the modern sense was invented, based on quick and free communication of ideas, methods, techniques, instruments, and on exchanges and personal contacts among scientists of different cultural traditions.

In order to diffuse the results of the scientific work at the Stazione and at the same time to secure additional income, Dohrn launched three editorial initiatives. The first was a scientific journal, *Mittheilungen aus der Zoologischen station zu Neapel* (1879-1915), continued as *Pubblicazioni della Stazione Zoologica di Napoli* (1924-1978), and later as series I *Marine Ecology* (1980-) and series II *History and Philosophy of the Life Sciences* (1979-). The second was *Zoologischer Jahresbericht*, a reference journal (1880-1915) and the third was the outstanding series of monographs *Fauna e Flora del Golfo di Napoli* (Fauna and Flora of the Gulf of Naples, 1880-1982). Dohrn hired two Neapolitan artists, Comingio Merculiano and Vincenzo Serino, for the illustrations which soon became famous for their naturalness and beauty. Through its publications the Stazione greatly contributed to the knowledge of marine fauna and flora.

Dohrn also started a specimen supply program as another source of income. Thanks to the inventiveness and skills of another Neapolitan, the preparator Salvatore Lo Bianco (1860-1910), who entered the service of the station at the age of 14, the methods for preserving marine organisms were improved to such a level that the Stazione Zoologica soon became known for the beauty and perfection of its collections of preserved marine animals. Specimens and collections of preserved animals were sold to museums, universities, schools and private individuals. Lo Bianco also became a systematicist in his own right and many guests of the Stazione acknowledged his relevant contribution to their research. According to Grassi, “one can say that the world renown of the Stazione Zoologica di Napoli is due in large part to Lo Bianco’s activity” (Grassi, 1911).

Anton Dohrn was convinced that the availability of all major published sources in addition to good working facilities was a necessity for advanced research. He donated his own large library to the Stazione Zoologica and requested donations from scientific publishers, academies and scientists such as Darwin, Huxley, and Virchow. The Stazione’s journal *Mittheilungen* served also for exchange purposes, while literature reviewed in the reference journal *Zoologischer Jahresbericht* was usually added to the library. Furthermore, visiting scholars felt morally obliged to send to the station their own publications, as a sign of gratitude to the institution. This was the source for the outstanding reprint collection catalogued and bound according to subject, discontinued only in the late 1960s because of a lack of space and personnel and due to the emergence of new technologies for information retrieval. Altogether the Naples station’s biological reference collection became an unrivalled source for bibliographic work and in fact scientists often went to Naples just to have access to such a wonderful library, still unparalleled in Europe today.

The Stazione also offered the best scientific equipment available, acquired through donations or at special low prices. The latest Zeiss instruments, that changed dramatically the microscopical and microbiological research at the end of the 19th century (Bradbury, 1967; Cahan, 1996 , #6345}, were always tested and kept available at Naples. Ernst Abbe (1840-1905) of the Zeiss factory, who introduced dramatic improvement in the quality of the lens (Abbe, 1886), was one of Dohrn’s few close friends and allowed the station to purchase sets of Zeiss microscopes and other optical instruments at a significant discount; in return, workers at the station suggested ways in which the equipment could be improved and Zeiss was brought to the attention of the international scientific community. Microtomes, staining and section cutting methods were also collected, tested and improved. Assistants and guests collaborated in improving section cutting and staining methods, thus maintaining the high level of technical services offered by the station.

E.B. Wilson, the first American biologist to work officially at the Naples station, that is at a properly subscribed table, believed that ‘the station has now become practically the headquarters from which most of the leading European laboratories derive their best methods, and where, indeed, much of their most telling work is done’ (Wilson, letter of 9 March 1883).

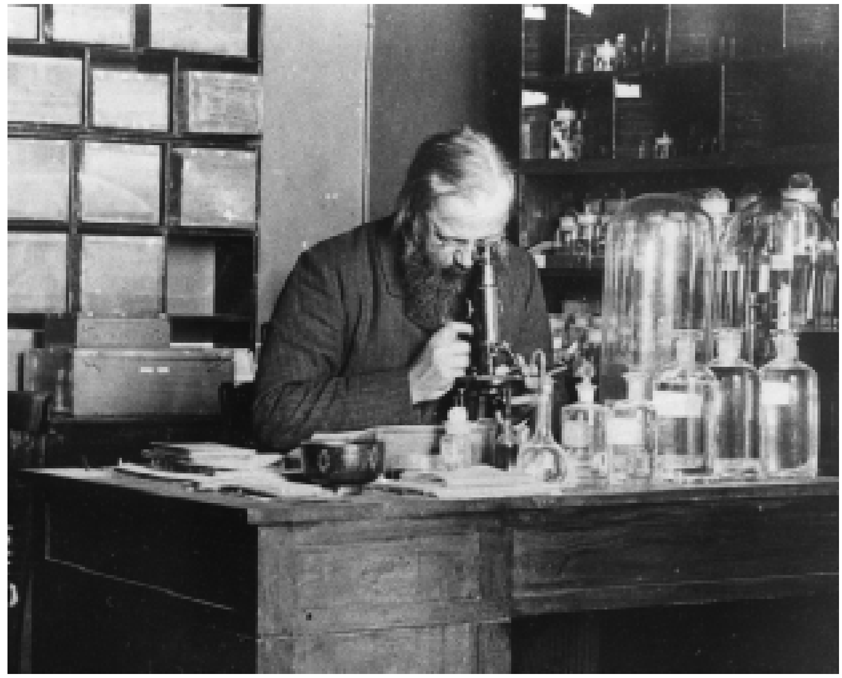
The year round animal supply, one of the advantages of the Naples station, was guaranteed by an efficient fishing-fleet and well-trained fishermen, who knew extremely well the local marine life forms. In 1877 the Berlin Academy of Sciences and the Prussian Ministry of Education provided funds for the ‘Johannes Müller,’ a 24 t, 17 m steamer which served for both collecting and excursion trips.

The Stazione Zoologica, apart from being Dohrn’s own project, did not have an in-house research project. The structure of the institute reflected the main interests of the visiting scientists. However, according to Theodor Boveri (1910), Dohrn had ‘an unusually sure eye for the significance of the different sections of our science, and for the way in which they interrelate and complement each other’ (Boveri, 1910). In such a way he was able to create a structure perfectly in tune with the main scientific problems of the time and he was able to bring to Naples the best researchers. Embryology, comparative anatomy, systematic zoology and botany - including life history, behavior and ecology - were the prevailing fields of investigation during the first decades of the Stazione’s activity.

At that time, biology was searching for general laws: evolution by natural selection, the recapitulation principle and recapitulation of the phylogenetic steps in embryonic development. The study of the morphology of the embryo during its development was the main tool for the understanding of the natural order, that is philogeny. The synthesis between comparative anatomy, morphology, embryology and philogeny characterized life sciences at the time of the creation of the Stazione Zoologica.

As a consequence, zoology, that is morphology, was the first department to be created at the newly founded Stazione Zoologica in 1873, and the most important during its first twenty years. In this department worked the following researchers: Nikolaus Kleinenberg (1873-1876); Hugo Eisig (1873-1920); Paul Mayer (1878-1913); Wilhelm Giesbrecht (1881-1913); Giuseppe Jatta (1886-1893); Pio Mingazzini (1888-1890); and Reinhard Gast (1899-1925). Marine botany was created in 1876 under the direction of Paul Falkenberg (1876-1878) and then Gottfried Berthold (1879-1881).

Although there was initially no room in the main building, physiology was added in 1882 by renting a small building near the station. Carl Schoenlein was the leader of this department between 1892 and 1899. The space problem was alleviated by adding two new sections to the main station, one in 1885-1888, and another in 1903-1906. A department of bacteriology was also added in 1887, while physiology could expand to include both comparative physiology and physiological chemistry. Cytophysiological studies of the embryo and the physiology of muscular and nervous functions in marine organisms cover a large part of the scientific history of the Stazione.



Anton Dohrn (1840-1909) at his Zeiss microscope, November 1889.

The 'golden era' of experimental embryology (1890-1914)

It is only an apparent paradox that the SZN never had a 'Department of Embryology'. In fact the embryological problems and way of thinking were at the core of its whole scientific life. In the years 1890-1914 the SZN became the focal point for the new research direction of experimental embryology. The most important biologists of the day spent long periods of research in Naples, and the whole history of experimental biology at the dawn of the 20th century cannot be understood without reference to the individual scientific contributions made by scientists working in a collective, international and interdisciplinary environment at the Stazione Zoologica.

Created during a period when morphological studies predominated and on a clear, ideal impulsion from Haeckelian biology, the Stazione Zoologica was paradoxically one of the strongholds of the revolt against Haeckelian, phylogenetic embryology. In fact, it was in Naples that the advocates of the new experimental approach to the problems of development made some of their most important discoveries, thus beginning a new era in the study of development.

Richard Hertwig (1850-1937) had observed in 1875 the entry of the spermatozoon into the egg of a sea urchin and the fusion of the two nuclei, thanks to the egg's transparency. Hertwig's discovery produced the 'right tool for the job' of investigating the factors involved in embryonic development. The sea urchin egg, easy to obtain, easy to keep in the laboratory and fully transparent, became the favorite research material in experimental studies of development.

With these new tools and with the new experimental methodology, Roux conducted, in 1888, the famous 'injury experiment': using a fine needle, Roux destroyed the nucleus of one of the two cells formed after the first segmentation of the zygote. He observed that the undamaged part continued its own development and produced half an embryo. Roux concluded that cellular division is qualitative, based on the mechanical distribution of the 'determinants.' Each cell of the early embryo has a predetermined fate, independent of the presence of other cells. These results seemed to confirm the observations made by August Weismann (1834-1914) at the Stazione Zoologica in 1881-2, in following the origin of sexual cells over several generations in *Hydromedusae.* Weismann observed that in embryogenesis a single cell produces the whole germinal tissue of the adult animal. From those observations, he drew the conclusion that in ontogenesis the tissues that produce sexual cells (the germinal plasm) remain completely separated from the other tissues of the body (the somatic plasm).

Hans Driesch was certainly one of the most interesting and influential personalities at the Naples station beginning with his first visit in 1891. For a number of scientists who worked at the station his influence was a decisive factor in their scientific life. Also, it was largely due to Driesch that researchers recognized the great advantage of the sea urchin egg. Indeed, it became a widespread belief that 'what is true for the sea urchin must be true for all animals.'

In this context, another relevant technical advance which came to play an important role in future research was made by Kurt Herbst (1866-1946), who worked for many years in Naples, together with Driesch. In 1891 he observed that the blastomeres of the cleaving sea urchin egg spontaneously separate from each other after a brief exposure to calcium-free seawater. This produced an elegant method for isolating undamaged blastomeres and for following their development independently. At the same time, these experiments paved the way for one of the most fascinating areas of research in embryology, that of cell interactions.

Using Herbst's technique, Driesch succeeded in his famous experiments, separating the first two blastomeres and showing that a whole embryo could arise from each one of them. This observation, which at first appeared to contradict Roux's results on the amphibian egg, began the long controversy on the mosaic *versus* regulatory organization of the egg. The aggressive method used by Driesch to separate the blastomeres by shaking the eggs (the embryologists who used Driesch's method were derisively called 'egg-shakers') was later superseded by the highly sophisticated microsurgical technique devised by Sven Hörstadius in the early thirties.

In another classic experiment, Driesch changed the orientation

The Frescoe Room, decorated in 1873 with wall paintings by the german painter Hans von Marées (1837-1897) and the german architect and sculptor Adolf von Hildebrand (1847-1921). Until 1958 the room housed part of the Stazione's unrivalled library, today concerts are given in the room by the chamber music group I Musici dell'Aquarium.

of cellular division, squashing a sea urchin egg between two slides, showing that cells doomed to become ectoderm can also become endoderm. Later Driesch was also able to fuse two eggs together, obtaining a normal but larger embryo. Driesch's conclusion was that the fertilized egg was a 'harmonious-equipotential system,' able to react to different conditions of development. Each cell of the embryo has a 'prospective potency,' that is what it can become, and an 'actual potency,' what it really becomes in a given condition of development. The harmony of the development is the result of the interaction between nucleus and cytoplasm; the nucleus guarantees the 'transport' of the totality of the 'prospective potency,' whereas the cytoplasm produces the specific effects that realize the 'actual potency' of each single cell.

Driesch postulated a non-material causal agent that initiates, directs and controls developmental processes. This agent controls morphogenesis, that is 'the transformation of the possibilities into the wholeness of an actuality.' This integrated directing, shaping, and developmental force of the embryo was called by Driesch *Entelechie*, recognizing that in a living organism 'something is at work that is of non-physico-chemical character.' This 'something' can only be recognized by its effects, the production of a 'harmonious-equipotential system.'

The problem of the cellular determination during embryogenesis was also discussed by the American embryologist and cytologist E.B. Wilson, who first entered this research field and the debate between Roux and Driesch during a period of research in Europe in 1891-92, initially in Monaco with Theodor Boveri, where he 'discovered' the centrality of the nucleus in development, and then at the Stazione Zoologica, where he began a collaboration and established a friendship with Hans Driesch. In a classic paper published in 1892, which summarizes the results of his research on the annelid *Nereis* carried out in 1885-1890, Wilson exposed a theory of the interaction between hereditary characters and environmental conditions during development. These studies showed the plasticity of the ontogenetic processes, in contrast to the deterministic theory of Weismann and Roux, because, as shown by Driesch, the modification of the environment can change the pathways of morphogenesis, producing the same results through different pathways. However, in contrast to Driesch, Wilson did not consider the fertilized egg as 'totipotent,' as the number of possible choices is rigidly limited by heredity, which produces a 'prelocalization' of 'formative substances' in the cytoplasm even before segmentation. Each cell gets the same number and type of hereditary factors (the chromosomes), but differentiation is 'modulated' by the cytoplasm. As a consequence, development is not preformed but epigenetic. As suggested by another American embryologist, E.G. Conklin, embryogenesis is the result of two interacting factors: the heredity of an 'ancestral tendency' and an adaptive, actual tendency. The aim of the research on 'cell lineage' was to evaluate the relative role of these two factors.

Another scientist who spent long periods of research and creation in Naples was Jacques Loeb, but his philosophical tendency was opposed to that of Driesch. If the latter accepted a vitalistic, Aristotelian biological philosophy, Loeb adopted a rigorous materialism, proposing a comprehensive theory of animal reactivity based exclusively on physico-chemical forces. In Naples Loeb studied regeneration, the possibility of controlling and regulating morphogenesis by 'external means,' that is physical and chemical agents (light, salts, acids, etc.). From isolated fragments of planaria Loeb was able to produce animals with two heads. On the basis of his experiments with the hydrozoon *Tubularia* he explained growth and regeneration with the accumulation of substances in certain regions of the embryo (growth factors). According to Loeb this was clearly in contrast to the importance of evolutionary theory in morphogenetic processes, and in favor of a purely mechanical explanation: "any theory of life must be based on our knowledge of the physico-chemical constitution of living matter and neither Darwin nor Lamarck was concerned with this" (Loeb, 1916).

In Naples Loeb also carried out artificial fertilization, showing that the sea urchin egg can begin development after being exposed to an acid or to an increase in osmotic pressure. This experimental 'chemical parthenogenesis' had a strong effect on scientific communities and on public opinion. Someone even suggested that women should avoid sea baths because of the risk of 'chemical parthenogenesis'. Loeb successfully repeated this experiment with frogs, becoming the 'father of the fatherless frogs.' According to him, the proof of replacement of the mysterious 'vital agent' with a purely physico-chemical agent (sea-water concentration), 'liberated the field of fertilization from vitalistic mysticism' (Loeb, 1912).

In 1889 the German biologist Thedor Boveri began his classic experiments in Naples on the hybridization of different sea urchin species, in order to establish whether the nucleus, the protoplasm, or both determine inheritance and development. Boveri fertilized enucleated egg fragments of one species of sea urchin with sperm from a different species, obtaining larvae that exclusively showed the characteristics of the paternal species, whereas using intact fertilized eggs produced larvae with characteristics from both parents. According to Boveri (1890) this experiment proved that the nucleus had a dominant role in inheritance.

Using a method of 'double fertilization' (polyspermic eggs), Boveri obtained 'hybrid merogones,' in which a tetrapolar spindle was formed. The separation of the different blastomeres was followed by an irregular distribution of chromosomes that produced abnormal development of the embryo. When the first four blastomeres were taken apart, at variance with normal embryos in which a larva is obtained from each blastomere, in the case of polispermic eggs some of the blastomeres developed normally, whereas others did not develop at all or became arrested during cleavage. Since Boveri could not detect any correlation between the number of chromosomes and the destiny of each blastomere, he concluded that the quality of the chromosome rather than number is the determining factor. From this he concluded that chromosomes are 'individual' and possess different qualities: 'only a precise combination of chromosomes, probably only the totality of those contained within each pronucleus, represents the entire nature of the form of the organism.' Embryonic development is therefore considered as the unfolding of the 'qualities of the nuclei.' Discussing his findings in relation to the newly rediscovered laws of Mendel, Boveri stated that individual chromosomes were the bearers of Mendelian hereditary factors, the first insight into the relation between genetics and cytology, the 'chromosome theory of heredity.' He also suggested that these 'multipolar mitoses' could be the causal factors in tumor formation (Boveri, 1903).

From 1908 to 1914, Otto Warburg spent several periods at the station, where he carried out his first major independent work on the oxygen consumption which occurs when a sea urchin egg begins to develop after fertilization. In 1908 Otto Warburg, pushed by Loeb to study biological oxidation, began his study of metabolic changes during cell division by determining oxygen consumption (Warburg, 1908). He made the classic discovery that upon fertilization the rate of respiration increases as much as six-fold. In 1909 he also discovered that iron is essential for the development of the larval state, inaugurating a new research program on cellular respiration, research that later won him the 1931 Nobel prize for the discovery of the cytochrome oxydase.

Otto Warburg's work has a special prominence. His discoveries of the change in the respiration of the sea urchin egg as a result of fertilization inspired a new field of 'chemical embryology,' a line of research pursued at the Stazione Zoologica primarily by John Runnström and his school (Warburg, 1910). Furthermore, the 'Warburg apparatus' became the tool (and the nightmare) for two generations of cell physiologists and biochemists. The theory and practice of manometry was perfected by Warburg later, in 1920, and provided the key techniques for his later discoveries.

Thomas Hunt Morgan (1866-1945) worked as an embryologist at the Stazione Zoologica around the turn of the century before devoting himself to genetics, to the creation of the *Drosophila* Group and to the development of 'chromosome genetics'. At Loeb's suggestion he had started working on regeneration, but later considered that this problem was too complex to be solved rapidly and thus decided to switch to inheritance, as a more suitable experimental problem, before returning to embryology at the end of his career. At Naples, where Morgan became friends with Driesch, his attention turned directly towards Driesch's work on fragmentation and partial embryos and their impact on interpretations of development. In the heated debates on preformation and epigenesis, on Weismann and Roux's mosaic or on Driesch's regulative views of development, Morgan himself maintained a moderate position, sympathetic to Driesch but closer to the idea of an 'organic continuity' to explain development, as proposed by American embryologists. This tendency included C. Whitman and Charles Manning Child (1869-1954), who, in 1911, studied regeneration in Naples and produced the theory of the axial gradient, according to which morphogenesis is based quantitatively on a gradient of differentiation distributed along the axis of the embryo.

Through two World Wars. Crises and new beginnings (1915-1950)

When Italy entered the First World War, Reinhard Dohrn and the German assistants had to leave Naples. Dohrn charged Federico Raffaele, a professor at Naples University who had been an assistant at the Stazione, with direction and established himself in Zurich, as a guest of the Zoological Museum, to which the editorial office of the journals was also transferred. The Stazione, the private property of a German citizen, was placed under national control and its direction was assigned to Francesco Saverio Monticelli (1915-1924). In 1916 the Stazione was solemnly inaugurated as an 'Italian institute,' under the responsibility of a national committee. The covered steamboat 'Anton Dohrn' was commandeered in 1917 and converted into a warship with the name 'Salvatore Lo Bianco.'

At the end of the war, after a period of uncertainty marked also by nationalist demonstrations, Benedetto Croce, the Minister of Public Instruction, in a speech to the Senate on December 9th 1920, replied vehemently to the charges against Reinhard Dohrn and suggested placing the Stazione Zoologica again under the responsibility of the Dohrn family, the only way, according to the Neapolitan philosopher, to guarantee the institution its scientific links and its functionality. In October 1923 its legal status was redefined and the Stazione Zoologica became an 'Ente Morale' (a semi-private institution) and Rinaldo Dohrn was designated 'managing director and administrator.'

The new institutional structures maintained the 'international status' of the Stazione, fostering the contacts among scientists of different countries and encouraging their presence in Naples, thanks to total freedom of research and the assistance of a highly effective technical structure, which created the best working conditions in terms of material and laboratory supply and in terms of cultural atmosphere. In this context the contradictory but meaningful concept of 'Italian internationality' was also introduced. The main aim of the Stazione Zoologica however, as articulated by G. Colosi in 1930, remained 'to give hospitality to the scientists and assist them in their own research, largely by offering tools and materials' (Colosi, 1930). The only specific and autonomous objective of the institute was the completion of the large systematic series on the Flora and Fauna of the Gulf of Naples.

These politics soon bore new fruit. Ignoring political and economic differences, many governments as well as public and private institutions started to rent research tables again. One can underline two important financial contributions from the Rockefeller Foundation in 1924-1929 and the renting of research tables by the newly born Soviet Union. The demographics of scientists at the Stazione was similar to that of the years before the war: roughly one third Italians, one third Germans, and one third from other countries, in particular the United Kingdom, Austria, Sweden, Switzerland, and the USA. Additionally the departmental structure remained practically the same. At the head of the zoological department one finds Umberto Pierantoni (1915-1924), later director of the Zoological institute of Naples University, Marco Fedele (1924-1930) and Giuseppe Montalenti (1939-1944). The department of physiology was directed, successively, by Filippo Bottazzi (1915-1925), Enrico Sereni (1926-1931), and Luigi Califano (1931-1935).

The scientific activities at the Stazione in the interwar period indicate a great continuity with the previous period. The aggregation points of research in these decades were physiology of the embryo, developmental mechanics, regeneration, the analysis of the biochemical components of marine organisms and their variation during embryogenesis, in particular biochemical gradients, bioluminescence and photogenesis in marine organisms, and hereditary symbiosis. At the same time, the richness of the flora and fauna of the Mediterranean, and the great diversity of superficial and abyssal forms favored the development of a new ecological approach, centered on alimentary chains, and on organism complexes in relation to the biological and physicochemical environment. Among the Italian scientists working at Naples during the interwar years, one should recall Silvio Ranzi, who spent fourteen years in Naples, often returning later to study developmental mechanics of cephalopods, axial gradients and the biochemical aspects of development in several species, a field of research also practiced by Raffaele, together with the morphology of the circulatory system of fishes.

As in previous periods, the Stazione was the ideal place for the experimentation of new technologies applied to research, such as the use of cinema for the observation of experimental embryology by Kopsch (Berlin), the first experience of scientific cinematography by the Istituto Luce and the research supported by Kodak on gels of animal origin for film.

Once again, the main scientific thrust at the station came from experimental embryology. The turning point was the publication of the classic paper by Hans Spemann and Hilde Mangold in 1924, that would come to represent for the following two decades the equivalent of the classic experiments by Roux and Driesch. In a series of experiments initiated in the first years of the 20th century, Spemann had shown that the formation of the lens of the eye in the ectoderm of amphibians was induced by the optical cup, a part of the cerebral tissue. In the following years, there was a long series of experiments, many realized in Naples, where Spemann worked quite often, always accompanied by a substantial group of assistants.

The discovery of the 'organizer' and the revelation that it was not species specific produced twenty years of intensive and largely fruitless research on its chemical nature, a biochemical version of the classical 'developmental mechanics'. This gave rise to the new research program of 'chemical embryology', aimed at the chemical characterization of the 'organizing or morphogenetic substances'. This program used the already established biochemical and physiological techniques and also new cytochemical methods to study the distribution of the different chemical species in the fertilized egg, in segmentation and differentiation. The main goal was to find the biochemical basis of the organizer and to explain its morphogenetic action in physicochemical terms.

During the WWII years, the Stazione remained virtually closed. A few scientists and technicians remained at the institute in order to assure functionality of the installations, primarily the aquarium. Giuseppe Montalenti, with the help of a few technicians, among them Alberto Pannone, Giuseppe Della Morte, Giacomo Fiorillo, and Vincenzo Serino, was able to avoid military occupation of the buildings, and the destruction and displacement of the instruments. The library also escaped destruction and heavy losses, because it was transferred to a small village inland, Pontelandolfo, in October 1943.

When the German army left, the 'Villa Comunale' was occupied by units from the American army. Personal passes were granted to the staff of the Stazione Zoologica in order to reach the institute. Due to the cooperative spirit of the American officers of the occupying units, the life of the laboratory was allowed to continue in the midst of military business, almost without interference, only a few rooms of the building being occupied.

The Allied Military Government granted substantial financial help, in anticipation of funds from the Italian Government, in order to pay salaries and to cover current expenses. Already, in the first months of 1944, the Royal Society of London granted an extraordinary contribution of £1000, important help and a symbolic gesture which marked the scientific relaunching of the institute and highly improved its credibility with Allied headquarters.

The aquarium was opened to Allied troops as early as December 10th 1943, and the income derived therefrom was added to the regular funds. The Villa was left by the occupying units on May 1st 1944, and the activity of the Stazione Zoologica returned almost to normal under the leadership of the director Rinaldo Dohrn, who returned from Sorrento, where he had found accommodation after the loss of his house, assisted by the constant cooperation of the Allied Military Authorities. And when the library was taken back to Naples and put in order in the early Summer of 1944 this was the signal for a new start for the prestigious institution.

After the liberation of Rome on June 4th 1944, contacts were established with the Italian Ministry of Public Instruction, and the Italian National Research Council. Both bodies very consistently helped the Stazione Zoologica. The latter founded there a 'Center for Biological Studies' under the directorship of the embryologist Giuseppe Reverberi, for the purpose of granting fellowships to biological students. Postgraduate students were admitted to the Stazione for the first time in 1947.

At the end of the war Switzerland, Sweden, England and the USA renewed some of the 'working tables' they had rented before the war, thus beginning again the international cooperation without concern for ideologies and nationalism, the most outstanding feature of the Stazione Zoologica. From May 1945 international scientific activities started again and at the end of that year the occupied research benches already numbered 15, increasing to 31 in the following year and stabilizing at an average of 40 between 1947 and 1953.

The scientific prestige of the Stazione and its location made it an ideal place for scientific conferences that, in the decade after the end of the war, marked the renewal and continuing development of scientific research. This was also an opportunity for Italian scientists to enter the international network and get in touch with new research projects and a new generation of biologists. The Stazione hosted important symposia on embryology and genetics, on mutagens, and on neurosecretion. In 1951 a meeting on the application of X-rays to the study of biological problems took place, focusing primarily on the submicroscopic structure of the protoplasm. During this symposium Wilkins reported on the new direction of biophysical research in John Randall's laboratory in England. Wilkins went to Naples because he wanted to study, in collaboration with Bruno Battaglia, the sperm of the Sepia in order to investigate with X-rays if the genes were arranged regularly along the head of the sperm ion crystalline array. At the conference, Wilkins showed an X-ray diffraction pattern of crystalline DNA and this stimulated J.D. Watson, who was also present, to begin his work on nucleic acids that brought him to his collaboration with Francis Crick and to the discovery of the double helix.

A small institute in the era of big science (1950-1967). The end of the 'Dohrn era'. The 'commissario'

After WWII, science, and in particular biological and medical sciences, evolved at an ever-increasing pace and on an ever-expanding institutional and economic scale. The number of scientists began to increase exponentially, and the costs of apparatus and materials increased rapidly. The era of romantic science had passed. The ideals of science changed from that of an individual enterprise linked to individual dreams and projects to that of a full-scale collective effort. When, in 1954, Peter Dohrn took over the directorship from his father Reinhard, the Stazione Zoologica was confronted with a difficult choice: either to invest heavily and try to cope with expanding costs and management difficulties of the new 'big science' or to remain a small appendix of other institutions, a marine facility for research groups established elsewhere. The Stazione chose the first option, launching ambitious projects for the renewal of its technical structure, buying new expensive laboratory equipment in order to satisfy the needs of a new kind of biological research. A new library was built, in a new five floored structure located between the two old buildings. Two new ships were also made available ('Federico Raffaele' (1955), motorboat, 10 m; 'Rinaldo Dohrn (1959), motorboat, 14 m).

The Stazione remained a reference at the international level, and the 'Naples experience' continued to be considered a necessary step in the training of a biologist hoping to specialize in embryology, cytology, or marine biology. This was particularly true for Italian science, as the Stazione was the best way to get experience with advanced biological research. The international character of the institution was maintained thanks to several collaborations, first of all with Woods Hole MBL and the British marine biology laboratories. In the mid 1950s the number of rented research tables again surpassed the figure of 50 per year, increasing to 86 and 88 in the years 1958 and 1959.

However the traditional 'bench system' produced inevitable fragmentation and a lack of continuity among the research programs and an expensive dispersal of experimental apparatus. Each guest scientist arrived at the Stazione with his or her own research project and needed the best conditions to carry it out, therefore demanding special conditions and tools. As such, it was difficult to afford the increasing costs, which often could not be shared with other projects and distributed over a longer period of time. This produced internal conflicts, a difficult financial crisis and the need for a modern status for the scientific and technical personnel of the Stazione.

The "Stazione Zoologica Anton Dohrn" as it is today.

The Stazione Zoologica needed a new administrative and institutional structure, in order to obtain a solid and permanent financial basis. For almost a century the Italian government had continued to recognize the unique character of the Stazione, a private enterprise in an international context. But in the new social context of biological sciences, this was not possible any more. In 1967 the Italian government named a 'Commissario Straordinario', charged with administration and direction, a post successively held by Mario Pantaleo (1967-1970), Guido Bacci (1970-1975) and Alessandro Barlaam (1975-1976). A scientific Advisory Board was also created, composed of Guido Bacci, Giuseppe Reverberi and Aldo Spirito. The Italian government took on more and more the burden of financially supporting the 'old lady,' a prestigious institution in need of new blood, and the Stazione became part of the Italian national science administration, but at the same time retained very large autonomy.

In the two decades following WWII the structure of the Stazione demonstrated continuity with the previous tradition. The zoological department was directed by Alberto Monroy (1944-1949), who switched in 1949 to the biochemistry department, Guido Bacci (1949-1955), Pierre Tardent (1956-1961), Andrew Packard (1961-) and Rainer Martin (1963-1973). The physiology department was directed by Francesco Ghiretti (1955-1961).

Following World War II the 'quest for the organizer' continued, turning for a time to the nucleic acids, in particular to ribonucleic acids, as effectors. However, the new generation of scientists that emerged after WWII was cut off from the research traditions of the 1930s. The problem that had fascinated embryologists of the 'classic era' did not stimulate young scientists and the problem of chemical induction became an unattractive field. The monumental accumulation of information at both the morphological and the biochemical levels on the patterns of development in animals and plants, as well as on cell and tissue interactions, seemed to be useless and embryology appeared to be in decline. Embryologists started to look at other ways of explaining differentiation, considering it as a complex chain of events rather that as a single process. The interest started to switch from chemical organizers to subcellular and cell-cell interactions, the exchange of 'information' between nucleus and cytoplasm and the genetic control of morphogenesis.

After the 'molecular revolution' of the 1950s and '60s, the creation of a new research project, molecular developmental biology, was the result of a new scientific paradigm. The main change arose in the definition of the experimental problems to be solved in the laboratory. The traditional problems of development (e.g. polarity, gradients, induction, determination, etc.) had to be reinterpreted in light of the new explanatory model based on gene expression and its temporal control during embryogenesis. New animal models had to be found for these kinds of experiments, as organisms such as the sea urchin, which for many decades had been the favorite experimental tool for embryologists, were completely unknown from a genetic point of view. Amphibians became the experimental jewel of developmental biology, replacing marine organisms. Only in the following years could new marine animal models be produced to study the genetics of development. The new generation of biologists working at the Stazione Zoologica faced new technical and scientific demands, in attempting to reinterpret the classical embryological concept within the new molecular paradigms.

Laying the foundations for a new development. The transition to a public research institute

The new organizational scheme of the Stazione Zoologica, established in 1967, took some time to be applied, but finally, in 1976, a new scientific director was appointed, Prof. Alberto Monroy, who was given the difficult task of re-establishing the former prestige through new international ties, grounded on a solid internal scientific program. Alberto Monroy, at the time the director of the Laboratory of Molecular Embryology established in 1969 by the National Science Council at Arco Felice, was a well know and respected scientist. He knew perfectly well where biological sciences were moving, was able to clearly set scientific priorities, and he was conscious of the need to secure modern laboratory facilities, to be staffed with experienced scientific and technical personnel.

His task as director became to breathe new life into the 'old lady,' as the traditional way of functioning was a product of its time and was unable to cope with the new demands in scientific research. The number of scientific guests from countries outside Italy was only 48 in 1978, reduced from 130 in 1960. This was due to the fact that administrative and financial difficulties made it difficult to work effectively in Naples. Moreover, the new technical facilities in preservation and transport of biological material made it possible for scientists to have perfectly good laboratory facilities at their home institutions. The 'scientific tourism', which was an essential and progressive character of the biological sciences in the first half of the 20th century, became less essential and sometimes useless. New ways of increasing international collaboration were needed.

The richness of the Mediterranean Sea continued to provide superior facilities for collecting and holding marine organisms and the Stazione Zoologica continued to offer some of the best conditions for scientific research: a unique animal supply system, a marvelous library, modern research facilities, and, last but not least, friendly support from the direction and the technical staff. Even in the era of molecular biology the variety of the organ systems of marine organisms continued to offer a greater diversity of form and function, necessary for the understanding of the fundamental properties of living systems. Many relevant 20th century research projects which characterized the biological revolution of the 1950s and 1960s were in fact grounded on marine organisms: vision, memory, chemical transmission, protein structure and function, hormones and chemical messengers, and genetic control of embryogenesis.

This was the major challenge at the end of the 1970s and at the beginning of the '80s. The ensemble of scientific problems that had characterized the life of the Stazione for a century (fertilization and development, induction and morphogenesis, systematic and evolution, memory and nervous transmission, botany and ecology) had to be reinterpreted in terms of molecular biology and developmental genetics, thanks to new conceptual tools (information, program, code, gene regulation and expression) and new experimental apparatus (electronic microscopy, electrophoresis and ultracentrifugation, macromolecular chemistry, and then molecular engineering). What was needed was a new framework for international cooperation, an effort to bring the frontiers of research into the scientific life of the institute, increasing the participation of local scientists in international scientific joint-programs. During the late 1960s the Stazione Zoologica underwent a substantial structural change. By that time the 'table system', which had been the structure guaranteeing 'internationality' for almost 100 years, was discontinued and the focus on guest research shifted to intramural staff research. But, only the research focus changed, not the international nature. If until 1968 the internationalism of the Stazione Zoologica had been based on the table-system, this character was guaranteed during the following years by joint programs and collaborations with foreign colleagues and institutions. The leading scientific institutions continued to support the Stazione Zoologica in the new context.

The structure of the Stazione was largely reorganized and the scientific and technical structure showed a great adaptability to the new conditions. What in the first century of its life had been a duty in order to cope with the demands of scientific guests, now became a way to build up new scientific projects and increase international cooperation.

The traditional departments remained, as the main scientific focus at the Stazione in the 1970's and early '80's remained zoology, biochemistry and developmental biology. Other departments were added in order to respond to new scientific and technical demands. Ecology became a focal point for the new development, as a scientific discipline, and the station remained a focal point for any program of Mediterranean ecology and this competence was later used in other ecological contexts, including the Antarctic.

As director, Alberto Monroy was first able to achieve fundamental results, avoiding the risk of transforming the Stazione into an ecological monitoring or administrative center, and pushing even more the need to develop basic science. The scientific life of the Stazione became increasingly lively, in a context of permanent scientific collaboration. However, it was difficult to change the objectives and the functioning of the whole institute and to bring in new blood in the different research projects. The growing financial and institutional constraints became a major difficulty for the scientific life of the Stazione. A new institutional and financial leap was needed.

"History of Virology", 7th Course of the International School of the History of Biological Sciences, held on the Island of Ischia in June 1990. From left to right: Lily E. Kaye, MIT, Cambridge, Mass., Gaetano Salvatore, President of the Stazione Zoologica (1987-1997), Mirko D. Grmek, EPHE (Sorbonne), Paris, Director of the School and Editor-in-Chief of *History and Philosophy of the Life Sciences*.

A new development. From the 'permanent congress' to an autonomous research institute. Gaetano Salvatore (1987-1997)

In 1980 Sebastiano Genovese was appointed director, seconded by a Board of Administration and a scientific Advisory Board; he remained in the post until his tragic death in 1982. In the same year the Italian Parliament approved a new special law for the Stazione Zoologica and the government assured it an increased annual budget. This law juridically recognized the Stazione Zoologica as a 'Special Scientific institution' of public interest, under the supervision and control of the Ministry of Public Instruction and Research, which meant that the Stazione had to observe the rules laid down for public organizations governing personnel and the expenditure of funds. However, the Stazione Zoologica maintained complete autonomy concerning all other decisions related to the running of the institute and scientific policy. The institute was renamed 'Stazione Zoologica Anton Dohrn' after its founder, a gesture which should be considered not so much as recognition of Dohrn's achievements, but rather, or also, as an acknowledgement of his aim of furthering the frontiers of knowledge in a research laboratory free from national, philosophical or disciplinary limitations. Ten years later the Stazione Zoologica was declared an 'Istituto di ricerca non strumentale' (basic research institute), thereby according it an even larger degree of autonomy.

The management of the Stazione Zoologica was entrusted to the President, the Director and the Administrative Council, the latter composed of the President, the Director and six other members. An International Scientific Advisory Board was created as the consulting body for the scientific and cultural policy of the Stazione. The expertise and direct involvement of the members of this Advisory Board were crucial and instrumental in helping to re-establish the Stazione on the international research scene.

In 1984 a new government commissioner was appointed (Luigi Frunzio). Finally, in 1987, Gaetano Salvatore was named as President, his responsibilities complemented and supported by those of the General Director: Antonio Miralto (1984-1990), and Lucio Cariello (1991-). A new period of concrete dreams and visionary projects began and the new-born organism reached its full maturity.

Because of his scientific status, his international links and management abilities, Gaetano Salvatore (Nino to his friends) was able to secure scientific and financial support from national and international scientific organizations. The scientific Advisory Board, composed of experts from disciplines of concern to the Stazione Zoologica, was established in order to maintain the highest possible scientific standards, to strengthen the international character of the Stazione, and to program the scientific development and broaden its research activities, and to stimulate even further active cooperation with Italian and foreign scientific communities.

The internal structural organization was remodeled, in such a way as to combine two aims that had for a long time been considered contradictory: emphasis was placed, on the one hand, on the Stazione's in-house scientific activity, conducted by the permanent scientific staff and, on the other, on national and international cooperation, formalized through conventions, research contracts, and allocation of research space to public and private research institutes.

Particular emphasis was placed on the development of new laboratories in the new fields of biology, such as molecular biology, biotechnologies, and developmental biology, and on the promotion of and participation in national and international projects aimed at solving problems related to safeguarding the marine environment and the rational exploitation of marine resources.

The training programs, that for a long time had remained a secondary aspect of the Stazione's activities, became a priority. Regular, specialized courses, meetings and workshops were organized and promoted, together with the specialized postdoctoral training of Italian and foreign scientific and technical staff.

'Back to future': Giorgio Bernardi

After the death of Gaetano Salvatore in 1997, Giorgio Bernardi, who had a long experience of contacts with the SZN and high scientific visibility, was appointed as the new President. He took over the new developments and activities initiated by Alberto Monroy and Nino Salvatore, maintaining the main objective of the Stazione: to produce scientific research of the highest standards in the fields of competence and to maintain its scientific and cultural role both in the international context and in the local community.

In the present structure of the SZN, according to its tradition, a special department for embryology or developmental biology does not exist. However, development and morphogenesis remain at the core of the scientific research programs, notably the research group headed by Roberto Di Lauro. These programs use the most advanced techniques in genetics and biotechnology to study the most classical problem of the Stazione, the origins of form during ontogenesis.

Furthermore, the creation of the new department of molecular evolution under the responsibility of Giorgio Bernardi, seems to realize, after a century and a quarter, Anton Dohrn's scientific and philosophical dream of linking experimental biology to Darwinian theory, using the best results produced by molecular and developmental biology to support Darwinian theory. The future of this prestigious institution hartens back to the vision of its founder, bringing together, in a dynamic institution, science, philosophy, culture and the constant ideal of producing something useful to mankind.

Conclusions

The unique character of the Stazione Zoologica stems from many complementary factors. First of all, there is the high level of scientific activity, aimed at fundamental biological questions and at improving living conditions and the quality of the environment. Secondly, there exists active and constant interaction and exchange with the international scientific community, the only way to ensure high-level scientific research. Thirdly a flexible organizational structure, and solid financial management make the Stazione independent from other academic and political organizations, a factor that greatly enhances its freedom to cooperate with Italian and foreign scientists and with scientific organizations. As well there are the unrivalled library facilities and the ability to use the best technical tools for biological research, from Zeiss microscopes and the Warburg apparatus, to present-day advanced computer facilities and information retrieval. And finally one must note a cultural atmosphere that has contributed greatly to the exchange of ideas and experiences, and to creative interaction among different cultures.

These aspects have made the Stazione Zoologica an example and a leading institution in the field of biology. It has shown itself to be of optimal size in terms of space, staff, budget and facilities; larger establishments are not usually flexible enough to allow extensive programs of transformation, whereas smaller laboratories rarely achieve the critical mass which is vital to produce a significant impact on the international scientific community. Tradition and innovation are fused together in an institute that always wants to remain at the edge of advanced biological research.

The 'organism' named Stazione Zoologica was able to survive in a difficult and very competitive environment, under strong selective pressure, not because it was itself strong enough to surmount all the adversities it encountered during its long history, but because it was able, at each crisis, to find new forces and new ideas brought by the community of all those who kept its project alive and found the best ways to revitalize it both culturally and materially.

Research institutes are 'political structures' in the larger sense, as they delimit the organization of scientific enterprise, guide intellectual and institutional transformations, define problems to solve, and suggest and apply a given 'image of science' and 'scientific style.' Every scientific institute has its own specific nature, the result of its history and of the living and working experiences that have taken place within its walls. It is the result of a tradition which becomes an integral part of an institution's history and its functioning, a specific 'soul' which permeates everybody who takes part in its activities, permanently or temporarily. This is particular true when the institution demonstrates unique and unrepeatable traits, when its finalities are original and specific. The "Stazione Zoologica Anton Dohrn", because of its history which spans three centuries, its peculiar structure, its scientific life always at the leading edge of research and thinking, from the Darwinian revolution to the molecular revolution, its particular mixing of international and national cultural characteristics, shows these traits of uniqueness and originality that make it an 'institute with a soul'. The permanence of a tradition, in particular the 'innovative tradition', the ability to continuously renew in order to remain at the edge of creation; these are not obstacles but guarantees for the future.

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