''From leaves we live''. Patrick Geddes in Naples

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Abstract. The paper focuses on the years of Patrick Geddes' (1854-1832) training as a biologist and the research he carried out in Naples between 1879 and 1881 at the Zoological Station founded by Anton Dohrn in 1872. In those years, Geddes made a series of discoveries on the symbiosis between marine organisms that led him to formulate the theory of "reciprocal accommodation" in evolutionary terms. His exploration of the topic of symbiosis, central to the debate on the "struggle for survival", placed him in the context of a specific strand of studies on cooperation and mutual support which made him one of the forerunners of ecological thinking. At the height of the Victorian era, his thinking joined that of other exponents and groups who, like him, opposed contemporary industrialisation and advocated different models of development and cities, not only in Britain.

Keywords: Symbiosis; Mutual aid; Participation; Regeneration; Naples Zoological Station.

Introduction

One of the undisputed fathers of ecological thinking is Patrick Geddes (1854-1832). A biologist, botanist and one of the founders of urban studies, he was among the first to apply transdisciplinary cognitive surveys for urban regeneration based on the participation of inhabitants. As noted: «His widespread interests were not the result of a pursuit of pure knowledge, but of an attempt to clarify and emphasize – in an increasingly specialized world – the inter-relations between all branches of knowledge for the benefit of human life» (McGrath, 1996). To him we owe the famous motto: «Think Global, Act Local», as well as: «By leaves we live». Lewis Mumford, who was his most famous pupil and divulgator in America, described him not «as a bold innovator of urban planning, but as an ecologist, the patient investigator of historical filiations and dynamic biological and social interrelationships» (Mumford, 1955).

In his early years as a biologist, Geddes was introduced to those ecological principles that would guide him throughout his life and form the basis of his urban and social studies. As young scientist, he devoted himself to a series of experiments to verify the presence of chlorophyll in certain marine animals. This led him to formulate a theory of "reciprocal accommodation" in the context of contemporary research on symbiosis formulated by Anton de Barry in 1879 (Sapp, 1994).

Within a few years of the publication of *The Origin of Species* (1859), the subject also became central to testing whether there was a principle that governed life and its origin based on natural selection for the gradual transformation of species, different from the one indicated by Charles Darwin (1809-1882), i.e. the "survival of the fittest", which ended up establishing that interspecies competitiveness dominated the "struggle of the living". Although Geddes was prompted by Thomas Henry Huxley (1825-1925) to carry out his studies on symbiosis, he reached very different positions from his master, for whom nature was a bloody spectacle, hence his famous motto: "Nature, red in tooth and claw".

The Naples Zoological Station

After a short period at Cambridge, where he studied embryology, Geddes was employed in 1876 as a demonstrator at the Royal School of Mines, where his mentor, the biologist Thomas Henry Huxley, was a lecturer. It was Huxley who, in 1877, awarded Geddes a scholarship to London's University College, where he met Charles Darwin, and who a year later encouraged him to carry out research on a particular species of "chlorophyll-containing" marine worm at the Zoological Station in Roscoff (1872).

In the late 19th century, the so-called "chlorophyll-containing animals" were a much-discussed case among scientists and the subject of a long taxonomic dispute. Were they plants or animals or yet another species? The most common belief was that the chlorophyll observed in many different invertebrate species was an endogenous product. This belief was challenged in the early 1880s, thanks in part to the contribution of Geddes, who showed that chlorophyll was not produced by these organisms because it could be removed without harming its hosts (Sapp, 1994).

Soon after the stay in Brittany, Geddes decided to move to Naples for a few months, to continue his research related to this topic at the Zoological Station directed by Anton Dohrn.

The first letter found in the historical archives of the Naples Zoological Station dates back to 28 January 1879, in which Geddes wrote to Dohrn from Paris informing him that he would not be able to arrive for about ten days due to his busy schedule. He inquired whether the species he had named *Convoluta schultzii*, *Echinus sphaerae* (*sea urchins*) and other species were present in the waters of Naples and said that he was considering arriving by steamship from Marseilles (Geddes, 1879).

Dohrn, who was born in Szczecin, had come to Naples in 1870 with the specific intention of building a zoological station there, which he had built between 1872 and 1873 at his own expense on a piece of land in the Villa Reale still lapped by the sea and ceded at no cost by the City Council (1840-1909) (Heuss, 2011). Assisting him in the project, in addition to the architect Oscar Capocci and engineer Giacomo Profumo, was his close friend Adolf von Hildebrand (1847-1921) (Florio, 2015). The Station immediately specialised in morphology, a branch of biology, whose main field at the time was embryology. Dohrn had been introduced to these studies by his professor in Jena, the biologist Ernst Haeckel (1834-1919), the greatest populariser of evolution in Germany, known for his "recapitulation theory" according to which the main stages of evolution, i.e., phylogeny, are repeated in the development of an embryo. Haeckel is also credited with the introduction of the term ecology in 1866, but also with the later reading of Darwin's theories for ratial purposes.

In 1875, at the Station's late inauguration party, Dohrn expounded Darwinian theories to the large audience of Neapoli-

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tans invited to the music room embellished with sculptures by Adolf von Hildebrand and frescoes by Hans von Marées (1837-1887). Darwin was one of the greatest inspirers of the Station's program as well as Dohrn's correspondent and donor of precious volumes for the library (Florio, 2015; Groeben 1982).
Starting with the Ostend laboratory established by Pierre Joseph Van Beneden in 1843, numerous research institutions were established in Europe on the coast, including the French institute in Roscoff and the Triste Station, a branch of the University of Vienna (1975). The one in Naples was, instead, configured as an autonomous institution, disassociated from universities or local administrations, and was strongly characterised by the presence of an aquarium open to the public. Based on a design by the English engineer William Alford Lloyd, author of the 1868 Hamburg aquarium and the 1871 Crystal Palace aquarium in London, it was inaugurated in August 1874. It immediately became an important destination for the 30.000 tourists per year (out of a population of more than 500.000) who on average visited Naples in the mid-19th century and thus an important source of funding for the institute (Groeben, 2010).
The Station became a compulsory stop for young biologists, including Geddes. Under the agreement with the British Association signed between 1875 and 1914, he had the opportunity to occupy a so-called "study table" from 26 February to 4 April 1879 and from 8 October to 14 November 1881. This meant that he did not only have a desk, but also access to various bibliographic sources and, above all, the possibility of taking marine samples in situ to study them (Dohrn, 1881, 1882).
The laboratories with saltwater tanks for live and preserved animals, all caught in the nearby waters of the Bay of Naples, were equipped with state-of-the-art equipment, including the indispensable microscopes with Zeiss lenses, produced in Jena at that time and perfected by Ernest Abbe (1840-1905), a mathematician and physicist, Dohrn's friend and university colleague. Geddes described the Neapolitan Station in an article in *The Scottman* of 14 July 1879: «The entire upper storey is reserved for purposes of scientific research, and consist chiefly of laboratories, containing in all twenty-four tables, each of which is a condensed laboratory in itself, being supplied with several small working aquaria, each having a constant stream of salt-water passing through it. […] Most of the tables open for non-resident workers have thus been let, and over one hundred naturalists, many of them of European reputation, have already taken advantage of the exceptional facilities offered there for carrying on their special lines of investigation. The marine fauna of the Bay of Naples is exceedingly rich and varied, and by means of dredging carried on by the aid of a steam yacht, a constant supply of the necessary specimens is maintained. These are utilized partly in stocking the public aquarium, and partly in supplying the working tables» (Geddes, 1879 a).
Once the descent of man from other animals had been revealed once and for all, the sea with its elementary life forms became a rich world for scientists to study in search of the origin of life and its evolution. Geddes himself described the enormous potential of studying embryos from the sea, lamenting the absence in his homeland of an institution like the Neapolitan one, and planning one inspired by it: «Highly desirable as it is to have a complete list of all the denizens of our seas, it is for the purpose of elucidating life problems, still more important to know their life history, especially in its earliest or embryonic stage, for it is to the embryo that the believer in the doctrine of descent must look for confirmation of his views, as well as for guidance in building up a scientific genealogy of the animal kingdom. The study of embryology, however, necessitates not only the collection of specimens but also the preservation alive during a lengthened period of observation, and in the case of marine animals, this can only be affected by means of salt-water aquaria.[…] A movement is, however, at present on foot for the establishment of zoological station on the Aberdeenshire coast in connection with the University of the Granite City, and the moderate sum has already been subscribed, in aid of the scheme, which, if carried out, we probably lead to the foundation of many similarities institution on our coasts» (Geddes, 1879a).
Back in Scotland, Geddes wrote twice from Aberdeen to the Station (on 12 May and 10 June), this time to Hugo Eisig (1847-1920), one of Dohrn's principal assistants who was to become Deputy Director in 1909 (Geddes, 1979c). These were mostly requests for certificates and orders for boxes with a range of marine species, including *molluscs*, *balanoglossus*, *algae* and jellyfish. One of the facility's additional services of the Station was to send "big boxes" – sort of small portable aquaria containing live marine species – on order to Europe, ensuring that they arrived at their destination "in excellent preservation", as Geddes himself confirms in his letters and according to the procedure he describes in his article (which led to supplying even the Crystal Palace Aquarium!): «collections of the marine animals of the bay, preserved so as to be afterwards fit for dissecting purposes, are forwarded, as required, to various Continental Universities to teaching purposes. Live specimens are also occasionally sent long distances, sometimes by post, as when the curious little fish, *Amphioxus*, was thus forwarded alive and safely to the Crystal Palace Aquarium» (Geddes, 1879c).

The museum of Stonehaven

In addition to his studies on the symbiosis between algae and micro-organisms, Geddes was sent by Huxley to Naples to draw inspiration from this re-

nowned institution throughout Europe and to replicate it in Scotland. It was not long (August 7, 1879) before the young biologist became the director of his marine museum: the Marine Scottish Station in the Stonehaven countryside, 15 miles south of Aberdeen. He gave a detailed account of it in two articles in The Scotsman on 14th July and on 22nd September 1879 (Geddes, 1879a, 1879b).

We learn the news from the letter with a photo (missing) dated 4th September 1879 written by Geddes from Perth to Eisig: «This is a portable wooden house like that of the Dutch naturalist: in fact Dr. Hubrecht kind has gave me the idea when I had the pleasure of meeting him in Naples» (Geddes, 1879d). As we learn from the same letter, Ambrosius Hubrecht, curator of the Rijksmuseum van Natuurlijke Historié in Leiden, had shared with Geddes his stay at the Station, before becoming the renownedbiologist specialising in embryonic studies of tarsids.

The Stonehaven Station was set up together with the biologist James Cossar Ewart, who specialised in the study of horse-zebra hybrids, Conservator of the Museum at University College London (where he had attended laboratories with Geddes) and Professor of Natural History at Aberdeen University where Huxley had become rector in 1872. It was equipped with two boats, fishing gear for collecting specimens, a laboratory, a shop, a zoological library and tanks for public display of marine animals. It had a mostly didactic purpose and it was Geddes himself who was responsible for welcoming visitors and explaining the various species on display. Once the summer was over, it was dismantled and reassembled at various locations in Scotland. In his letter of 4 September 1879, Geddes also mentions his forthcoming trip to Mexico, in the aftermath of his failure in the competition at the University of Manchester, where he came second after Cambridge embryologist Milnes Marshall, giving his address where he received mail until April 1880: "pl. Banco de Londres, Mexico". The British Association for the Advancement of Science had awarded him a grant for research in palaeontologyand zoology in Mexico, with the task of sending rare species to Europe from the remote country. Patrick's brother Bob, a director at the National Bank, also worked there. This stay marked a turning point in Geddes' career, as an illness caused him to temporarily lose his eyesight, permanently preventing him from using a microscope. His return began a period in which his university career and scientific research were increasingly complemented by social and urban studies.

The theory of "reciprocal accommodation"

Geddes' stay at the Dohrn Station was important above all from a scientific point of view, as can be seen from his publications from those years (Geddes, 1879e). He studied the nature and function of the yellow cells he observed in Naples in the marine protozoa known as *Radiolarians*, which Huxley called *Thallassicolla*, showing that the filozoon (the term Geddes coined for the yellow cells) and the cells of the Radiolarians were mutually beneficial.

Moving to Edinburgh in 1880 to obtain the professorship in Botany (which he won in 1888 at the University College of Dundee), he got back in touch with the Neapolitan Station, this time writing a letter dated 5 April (Geddes, 1880) to Paul Mayer (1848-1923), another important collaborator of Dohrn's since 1874. The letterhead of his letter read School of Medicine, Zoological Laboratory, Edinburgh, and Geddes specified that as he had moved to Edinburg to start lectures on Zoology (as a private lecturer), he had to prove to the University that he was in possession of the specimens, diagrams and all the teaching apparatus necessary for his confirmation. To this end, he asked Meyer to send him from Naples 'the sooner the better' a list of preparations, perhaps taking advantage of some English scholars returning to his country (this is confirmed in the following letter to Meyer dated 7 June). As mentioned above, he returned to his study desk at the Neapolitan Institute from 8 October to 14 November 1881. The correspondence kept at the Zoological Station ends here[1].

In October 1881 he set out his theory of "reciprocal accommodation" in a paper entitled *Symbiosis of Algae and Animals*, which was first read at Edinburgh University Medical School and then published in *Nature* a year later. The conclusion summarises its scope: «For a vegetable cell no more ideal existence can be imagined than that within the body of an animal cell of sufficient active vitality to manure it with carbonic and nitrogen waste, yet of sufficient transparency to allow the free entrance of the necessary light. And conversely, for an animal cell there can be no more ideal existence than to contain a vegetable cell, constantly removing its waste products supplying it with oxygen and starch and being digestible after death. […] In short, we have here the relation of the animal and the vegetable world reduced to the simplest and closest conceivable form. It must be by this time sufficiently obvious that this remarkable association of plant and animal is by no means to be termed a case of parasitism. If so, the animals so infested would be weakened, whereas their exceptional success in the struggle for existence is evident» (Geddes, 1882).

Conclusion: the urban implications

Geddes' studies on the symbiotic relationships observed in marine organisms characterised by an ecology based on "reciprocal accommodation" were the basis for interpreting other types of relationships as well, including those between humans in the city, even the poorest one considered in Victorian age, in the middle of the race of capitalism, a parasite (Samyn, 2020).

From these years onwards, Geddes began to openly take sides within the circle of thinkers who opposed progress because of the form it was taking in Britain at the height of the industrial revolution. In his book *Ruskin Economist*, published in 1884, he formulated a political economy that was a synthesis of culture, science and the environment. The same year he was among the founder of the "Edinburgh Social Union" thus contrasting the measures of the Improvement Act for Edinburgh (1867) under which unhealthy housing was simply torn down. This was followed by membership in Arts and Craft in 1889, in conjunction with the association's convention in Edinburgh, which Geddes attended with William Morris.

In 1886 Geddes married Anna Morton with her he went to live to James's Court a slum in the city, which was rather run-down and infamous, and to which they devoted to repopulate and create what we today call urban mixite: an urban society composed from different populations.

Colin Ward highlights how Geddes' position is at the antipodes to that carried out in those years through large-scale gutting that eliminated the genius loci, since, in his vision, an old building properly renovated can be reused for modern uses (Ward, 1976). But the issue pertains not only to the physical sphere of buildings, but rather to the social dimension of neighborhoods that must be considered as urban communities, governed by the coexistence of different classes. Thus, applying evolutionary principles to human society as it relates to the space in which it has settled, even considering the housing condition of the "parasite people", contribute to the improvement of society, to which these generally marginalised people also contribute.

Morton had been working in London with Octavia Hill (1838-1912), as well as with Henrietta Barnett (1851-1936), both of whom focused onimproving the housing conditions of the poor people (Whelan, 1998). Many of the activities carried out by the Geddeses were inspired by their legacy, namely micro-interventions carried out together with the inhabitants, in which the creation of public spaces and gardens played a fundamental role. Within the "Edinburgh Social Union", Geddes dedicated himself to decoration, starting from window embellishments with plants and flowers (Ciacci, 2021).

In this light, the reuse of historic buildings for students and professors' residences that he initiated in those years should also be read. The University Hall and the Ramsay Garden were projects based precisely in repurposing pre-existing housing into places of study for new residents who would bring, with their culture, added value to the old neighborhood (extending the university to the city, outside the classrooms).

It is not surprising that Pëtr Alekseevič Kropotkin (1842-1921), who between 1890 and 1896 formulated the theory of "mutual aid", at the heart of the principle of solidarity, along with the geographer Élisée Reclus (1830-1905) and the zoologist Éli Metchnikoff (1845-1916), visited the Geddes family in 1886 (Ferretti, 2016). Openly opposed to what was crystallising as "social Darwinism", and thus to competition as an evolutionary factor, Kropotkin found himself perfectly aligned with Geddes' ideas. In his text *Mutual aid: a factor in Evolution* published shortly afterwards (Kropotkin, 1902), the Russian prince had identified each point on an "evolutionary ladder" as the dominant motif of mutual aid, a factor of natural balance and progress between peoples. It was Kropotkin who introduced Reclus to the urban renewal projects the Geddeses were carrying out. The French geographer is known to have attended the Edinburgh Summer School in 1893 and 1895 organised by Geddes. The Outlook Tower (1905) was its continuation (Meller, 1990).

From his scientific discoveries and through these meetings, Geddes would increasingly outline his position based on "reciprocal accommodation" in an evolutionary sense, which would orient his approach as a scholar of urban phenomena. Indeed, rom this ecological perspective he will write his most famous text *Cities in Evolution* (1915), and he will base his chair on Sociology in Bombay from 1920.

NOTES

[1] The 30 January 1888 letter to Dohrn from Edinburgh, the 28 January 1888 'letter of application', and the 8 March letter to Dohrn from Edinburgh are archive gaps.

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