

# COLONIZATION AND SCIENCE NETWORKS BETWEEN PERIPHERIES AND THE CENTER: THE CASE OF THE NATURALIST FRITZ MÜLLER

YARA GUASQUE

The correspondence and the exchange of specimens between Fritz Müller, 1822-1897, and Charles Darwin, 1809-1882, characterize what Bruno Latour called transformation networks. The naturalist's procedure in his observation of the phenomena in loco in the forest could only be legitimized as science after the screening of the "transformation networks".

The construction of scientific knowledge takes place far away from the periphery where data are collected. The scientist, with a focused view that differs from that of the naturalist immersed in the forest, reduces the phenomenon to an abstract inscription. The peripheries with their ecosystems are the ones that feed the centers, with data collected among a diversity of phenomena, through the "transformation networks". The correspondence and the exchange of specimens between Fritz Müller, 1822-1897, and Charles Darwin, 1809-1882, characterize what Bruno Latour called transformation networks. Fritz Müller, a voluntary emigrant in the Brazilian South region, belonged to the first settlement group of Dr. Blumenau's colony in Vale do Itajaí – Alto do Itajaí. He found in Brazil an almost untouched nature which he visited in his lonely pilgrimages along the coast and also in the plateau, accompanied by the highway engineer Dr. Oderbrecht, in the service of Dr. Blumenau. Without having visited the capital city of Rio de Janeiro and without ever returning to Europe, Fritz Müller lived 45 years between the village of Blumenau and Desterro, in Santa Catarina – from 1852 to 1897, when he died – and there he conducted studies and research on aquatic flora and fauna - according to Zillig, 'on commission,' [1] sent by letter to his foreign correspondents. The botanical material expatriated through letters has not been dimensioned. *Oxalis*, *Cassia*, *Abutilon*, *Gesneria* — *Corytholoma*, *Maxillaria*, *Plumbago*, *Coccocypselum*, *Eschscholtzia*, *Heteranthera reniformis*, *Epidendrum* are the names contained in the letters he exchanged with Darwin. Many specimens collected by Fritz Müller in the Atlantic Forest biome, which portray the diversity in the South of Brazil in the 19th century, are in the English herbarium of Kew Gardens. In Brazilian institutions, only 158 samples have been preserved, 152 at the National Museum and 6 at the Botanical Garden. Without quantifying the ones sent to Charles Darwin in the form of seeds or dried specimens, Teixeira, Santos, Hagen and Fontes [2] cite the 483 specimens that Fritz Müller sent between 1867 and 1869 to Joseph Dalton Hooker, who was, at the time, the director of Kew Gardens, near London.

Fritz Müller graduated in Medicine in Germany and, attracted by a libertarian dream that had spread in Europe about life in the recently founded German colony, he abandons his country to run away from social and religious pressures. During the period between 1852 and 1897, in which he lived in Santa Catarina, he established a link with Charles Darwin and with other foreign researchers: Hermann Müller and Wilhelm Müller, his brothers, Hans Spemann, Max Johann Sigismund Schültze, Ernst Haeckel, Ernst Krause, Oscar Schmidt, Carl Friedrich Wilhelm Claus, Wilhelm Moritz Keferstein, Friedrich Hildebrand, Friedrich Ludwig and Friedrich Leopold August Weismann in Germany; in France, Henri Milne-Edwards; in Italy, Paul Meyer; in the United Kingdom, Raphael Meldola and Joseph Dalton Hooker; in the United States, Alexander Agassiz, Robert McLachlan and Herman August Hagen. But he continued exchanging information with researchers in Brazil: Ernst Ule, Hermann von Ihering and Nicolau Joaquim Moreira.

Peer recognition contributed to Fritz Müller's projection as a scientist. In the period in which he lived in Brazil, Fritz Müller received several titles, among which two Ph.Ds, sixteen years after the University of Berlin, where he had studied Medicine, denied him this title because he had not taken the oath: Ph.D. *honoris causa* in Medicine, conferred in 1868 by the dean of the School of Medicine of Bonn, Max Schultze, during the festivities in celebration of the 50 years of the School; Ph.D. *honoris causa* in Natural Sciences by the University of Tübingen, in its 400th anniversary celebration in 1874 – the year in which he was also invited to be Correspondent Member of the then recently founded Argentinean zoological society, National Sciences Society, of Buenos Ayres; and the title of Honorary Member of the Entomological Society of London, in 1884.

Although Fritz Müller's garden is large, the space reserved in the house for scientific work is little and modest. A critic has said that the size and opulence of the laboratories were many times in inverse proportion to the importance of the works that were conducted in them. I remembered these words whenever I saw the small office of Blumenau, from where so many fertile ideas were launched to the world. The small room has only three square meters. Beside the window there is a simple table covered with the most necessary devices for work, among which there is an old Hartnack microscope. In addition, there are a very simple bookcase, a bed and a lavatory, and next to the only worn out chair there is room only for a second one. There are no collections. I don't believe that in the entire Earth there is a wise man who is more worthy of this name that is satisfied with such a modest device. But all the zoologists and botanists know how many scientific results were achieved with that small device. [3]

In his voluntary exile in the Southern Hemisphere – which made him venture as a settler in the recently founded colony of Dr. Blumenau – he starts a pioneer research. The Brazilian ports, open at that time to European scientific expeditions, would not reserve to Fritz Müller, a European among us, the post of sole observer of the flora. The fact of having lived in the colony restricted the interchange of ideas with scientists from more advanced cities of the Brazilian Empire, like Rio de Janeiro and São Paulo, but he conducted an investigation in the open air about the coastal vegetable cover and the crustacean larvae of Santa Catarina. His notes survived the timid environment of Desterro, as Florianópolis was then called, and Blumenau, and were also launched beyond the national network of researchers that was being formed around the National Museum of Rio de Janeiro or São Paulo's Museum. His friendship with European scientists, Ernst Krause, Charles Darwin and Ernst Haeckel, among others, enabled him to publish short papers in *Kosmos*, in *Notícias Entomológicas*, and in other zoology journals, such as *Relações da Sociedade Botânica Alemã*. During his exile in Brazil he produced 237 of the 248 papers he wrote in his life. Many of them, extracted from the manuscripts contextualized with detailed illustrations he had shared with his European correspondents, were published abroad as if they had been written by the addressees of his letters. The publications of the National Museum in the Brazilian territory that had been promised by its director, Ladislau de Souza Mello e Netto, if carried out in time, would not be important to the European scientific circle – despite the effort of institutional consolidation.

Although he worked in Brazil with modest equipment, his enormous advantage was the scientific background he obtained through the education and formal schooling he received in his native country, Germany. Afterwards, in Brazil, his education was consolidated by the network of international collaborators and the activities of teacher and Traveling Naturalist. Immersion in the forest did not prevent him from extracting singular discoveries from the live material he observed. We highlight just a few of them, like the insect-plant interaction in the bromelias and orchids; his ontogenetic recapitulation of phylogeny – recognized as an Ernst Haeckel's proposition; his representation, in branch diagrams, of shared characters to show phylogenetic relationships between species – known today as cladistics; and Müller-

ian Mimicry, about which he wrote in 1875. Developing the Batesian Mimesis, in which palatable butterflies imitate unpalatable butterflies, Fritz Müller demonstrated mathematically that, between two species of unpalatable butterflies that imitate each other, the rarest would have a smaller number of losses, being benefited regarding the non-predation of its individuals in an inverse proportion to the square of the number of its individuals. [4]

His investigation for the National Museum, and his job as an elementary school teacher in the cities of Florianópolis and Blumenau, mix with his difficulties to adapt to the Southern hemisphere and live as a colonist in Blumenau. Beside the hard work in the colony and the distance from Rio de Janeiro, another obstacle that the naturalist had to overcome to act professionally as a teacher, and afterwards as a Traveling Naturalist, writing reports, was the Portuguese language.

The legitimation and the scientific nature of his job depended on the international collaboration network, but also, on the enculturation and formation of the Brazilian research institutions, responsible for the scientific circles that were created around them: the National Museum, the Botanical Garden of Rio de Janeiro and São Paulo's Museum, directed by his colleague Ihering from Rio Grande do Sul, also a researcher in the service of the National Museum, like Fritz Müller. The efforts of Imperial Brazil in relation to equipping the scientific and cultural institutions are determinant, although they were still below the expectation of a European with university education. D. Pedro II was recognized in Europe as a friend of the arts and sciences. It is worthy of note the influence of D. Pedro II on the nomination of Fritz Müller for the post of Traveling Naturalist on October 2, 1876, and on his readmission in 1888 – after having been exonerated due to intrigue in 1884. This influence was highlighted in the necrological text written by Ernst Haeckel, when Fritz Müller died. After the proclamation of the Republic in 1889, the National Museum received information from the Minister of Instruction, Post Offices and Telegraphs of the new Government, determining that the Traveling Naturalists had obligatorily to live in the Federal Capital City, Rio de Janeiro. As he did not want to abandon his family and his home in Santa Catarina, Fritz Müller quits the job definitively in 1891. His residence in Blumenau, where he stayed after being dismissed from the job of teacher of the Lycée in Desterro, was his live laboratory, “where he collected a considerable volume of scientific data that have already been incorporated into the collection of zoologists and botanists all over the world”. [5]

The Europeans believed that Fritz Müller's dismissal in 1884 from the post of Traveling Naturalist had a political connotation. A sympathizer with the monarchy regime and with the influence of the imperial family on the political directions of the country, Fritz Müller - a follower of *Deushtum* among many others in the colony – had become inconvenient concerning the purposes of the new State, and of the creation of the nation in the passage from Imperial Brazil, which had brought the division between republicans and federalists.

To take on the post of teacher in a public institution at Desterro, he became naturalized as a Brazilian. As a teacher of the Provincial Lycée of Santa Catarina, he taught Mathematics between 1857 and 1864 and thought about teaching chemistry and physics, among other disciplines, to the more advanced students. This activity kept him “in uninterrupted contact with all branches of the natural sciences and literature, and this contact was much closer than the one he would be able to keep in the subsequent years of his life.” [5] In parallel with teaching, he researched, in his free time in the shore of Desterro, which is now Florianópolis, the medusas, the Bryozoa, the polyps, and the crustaceans, which resulted in the only book he published, *Für Darwin*. The book, concluded in 1863, was published in 1864 by Engelman in Leipzig, Germany, just five years after the publication of *The Origin of Species*, by Charles Darwin. Since

1861, the year in which he received a copy of this book, his investigative effort derived from his argumentation in favor of the theory of evolution.

Still as a teacher in Desterro, he projects, in one part of the farm where the *Lycée* was built, the creation of a small Botanical Garden. He collaborates with seeds and specimens for this small Botanical Garden and for the National Museum, with replicas that ended up being transplanted to the Botanical Garden of Rio de Janeiro. After the school's renewal, Fritz Müller was prevented from exercising his role of teacher without, however, losing the employment bond. Thus, he could propose to the government the creation of an experimental field on the margins of Itajaí river for planting and cultivating exotic species of the flora that were useful to the country, an activity to which he was designated in 1867. [6] Later on, his collections, scientifically argued and illustrated in detail, enriched the National Museum of Rio de Janeiro. The invitation to the post of Traveling Naturalist of the National Museum of Rio de Janeiro, which Fritz Müller held from 1876 to 1891, was made by Ladislau de Souza Mello e Netto, who was then the director of this Museum.

To contextualize the stage of the equipping process of the cultural and scientific institutions in Brazil, in the passage from colony to Empire, between 1807 – when D. João VI, at the time prince regent of Portugal, abandoned Portugal upon Napoleon's troops' invasion of the Iberian Peninsula, and came to live in Brazil – and 1815, the National Museum was instituted, as well as the National Library, the Fine Arts Academy, the Royal Press, the Bank of Brazil. Three generations of monarchs were necessary so that the Botanical Garden of Rio de Janeiro, also constituted by D. João VI in 1808, could form in 1890 its herbarium, with the donation of a rich collection of dehydrated plants that belonged to D. Pedro II. [7] The herbarium of the National Museum had preceded it – founded in 1831 by the botanist Ludwig Riedel, who participated in the scientific expedition of von Langsdorff from 1825 to 1829 in the country. The job that Fritz Müller had in the Museum between 1876 and 1891 coincides with the advancements of the institutions created in the consolidating Empire and the passage to a new administration of the already republican Brazil.

The conflicting view of nature in the colonization of the South of Brazil can be exemplified by Hoehne's testimony. In the volume dedicated to the coast of Southern Brazil, Frederico Carlos Hoehne [8] highlights the opposition between two words, fields and woods. As the director of the Botanical Institute of São Paulo, which he had founded, a post he held between 1942 and 1952, Hoehne planned to pay homage to Fritz Müller in a singular way, not with a statue to be erected in the urban space, but attributing his name to one of the rough-hewn trails in the lands of the Botanical Institute that still need to be demarcated at the time. He believed this would be a fairer homage than dedicating to him the name of a street or urban square, "in which the completely banished nature cannot establish anymore the relation between the person who has been honored and the reason for the homage." [8] The trails should be "a practical school of botany," [8] immersing the observer and exempting the help of the master.

To Hoehne, the two illustrious figures of the history of colonization of Alto do Vale do Itajaí in Santa Catarina, Dr. Blumenau and Fritz Müller, were opposites. In Dr. Blumenau, Hoehne saw the disciplined obstinacy of a persevering explorer and administrator, an educator, a "man of material initiative." In Fritz Müller, he saw the consolidated scientist who had "the forest as his favorite book", although *The Origin of Species*, by Charles Darwin, was one of the volumes of his extremely reduced library. What determined that his observation became a scientific investigation? What were the implications of having the forest as experimental practice of the observation of phenomena in their complexity? Between the fields and woods, he was thus described: "in the fields, barefoot, wearing a large straw hat, sleeves

rolled up, hoeing weeds from the cornfield, pruning the orange grove, [...] by the Itajaí river or in the woods, collecting insects, observing birds, plucking plants.” [8]

The interdependence between flora and fauna observed in the forest is different from the one observed in the fields and in the garden. Between the forest, the fields and the garden there are different degrees of nature domination, which reduce the complexity of the relations and show the advance of colonization. Knowledge extracted from these collection places, which were Fritz Müller’s laboratory, would have to differ from knowledge produced in the academies’ laboratories.

The garden was the live inventory of his correspondence exchange with European scientists. The proximity to Fritz Müller’s house enabled the monitoring, at different times and seasons of the year, of the rotation of the stems of climbing plants or of the movement of leaves in the rain, and a more comfortable and speedy transposition of these data to his worktable – where he registered them with indexes and formats that were more reliable to science, and in long-lasting media. The fields, even with the utilization of cultivation methodologies, were, at first, the colonists’ subsistence area, with no greater economic ambitions.

The fields, with the felling of the forest and a clearing open in the woods, served the increasing needs of safety and communication of the inhabitants of the colony, which was becoming a city. It was part of the administrative project of domination and rationalization, which saw the native vegetation as a productive force.

In 2010, the REFLORA notice was opened for cataloguing and repatriating the Brazilian native species of the 18th, 19th and 20th centuries that are in two international herbariums. This initiative has strengthened and stimulated the creation of networks of researchers working with the inventory of the remaining flora specimens in the state of Santa Catarina. One of the aims of *Inventário Florístico Florestal de Remanescentes Florestais do Estado de Santa Catarina*, IFFSC – Forest Floristic Inventory of Remaining Forest Species of the State of Santa Catarina, is the update of the list of endangered species. The project expects to conclude, in three years, the mapping of the species that are in the herbarium of Kew Gardens, in England, besides others. Among the species catalogued in this institution, some were collected by Fritz Müller in the 19th century. Of the species planted in Fritz Müller’s garden, fruit of his investigation and correspondence with other foreign scientists, nothing is known. With the discussion about the changes in the Forest Code in Brazil, the trajectory of Fritz Müller’s life and work becomes of paramount importance for reflection. Transformation networks is the movement of the observation carried out in the periphery that is legitimized, as an abstract datum, in the calculation centers that promote an accumulation of knowledge, the surplus value of information. It is in the transformation network that intellectual control is exercised, and through it the centers are capable of representing phenomena that were previously out of their reach. The paper focused on the science network between the German colony in the south of Brazil and the center, with the European scientists and naturalists with whom Fritz Müller exchanged letters, and tried to map the plant specimens that Fritz Müller sent to Europe. The concept is employed in the paper to refer to the naturalist’s procedure in his observation of the phenomena in loco in the forest, and also to highlight that his observations could only be legitimized as science after the screening of the “transformation networks.”

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