THE AQUARIUM AS A HYBRID SPACE BETWEEN ANIMAL HOBBIES AND EXPERIMENTAL ZOOLOGY

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This essay is part of Christian Reiß's PhD project (Friedrich-Schiller-Universität Jena) on the history of the Mexican axolotl (*Ambystoma mexicanum*) as an experimental animal in the life sciences. First I'll provide explanations of some of the terminology he used. Reiß frequently refers to the term "life sciences" in his article. Life sciences comprise the branches of science that involve the scientific study of life and organisms – such as microorganisms, plants and animals including human beings. This science is one of the two major branches of natural science, the other being physical science, which is concerned with nonliving matter. Biology is the overall natural science that studies life and living organisms, with the other life sciences its subdisciplines. However, in the context of this article is concerned only with the aquarium and its effect on zoological; research. Reiß uses the term "fancy" alone and also terms such as "animal fancying," "aquarium fancying" and similar terms. In all these instances I have used "hobby" instead.

Reiß also uses the term "hybrid spaces," which is best explained by the following example.

In 1872, August Weismann (he studied how the traits of organisms developed and evolved in a variety of organisms, mostly insects and aquatic animals, and proposed the theory of the continuity of germ-plasm, a theory of heredity) started his research project on the Mexican axolotl. He wanted to find out in the context of his experimental studies on evolution whether the irregular and rare transformation from axolotl to amblystoma August Duméril (Duméril, 1866) had observed ten years earlier in Paris (Fig. 1) was caused by environmental influences or the internal phyletic force suggested by other zoologists.

What he at first considered to be a straightforward *experimentum crucis* (crucial or critical experiment), which would ultimately show that evolution happened gradually and was driven by natural selection, turned out to be much more complicated. His first experimental attempt failed and all axolotls died. Only after he handed the project over to the naturalist Marie von Chauvin did the experiments turn out to be successful (Chauvin 1876). Her initial interest was in the natural history of insects, but she soon acquired a reputation as a talented and experienced animal breeder (Siebold, 1876).

Chauvin used the aquarium as an experimental tool, altering the environmental conditions according to the axolotls' reaction. For her experiments, she kept five axolotls in an aquarium that was set up like a lakeshore, that is, only a part was filled with water. To induce the transformation, she slowly lowered the water level so that the animals could only submerge at one spot. During the experiments, Chauvin showed great skill in observing the reaction of the axolotls to the experimental treatment, adjusting the further steps accordingly.

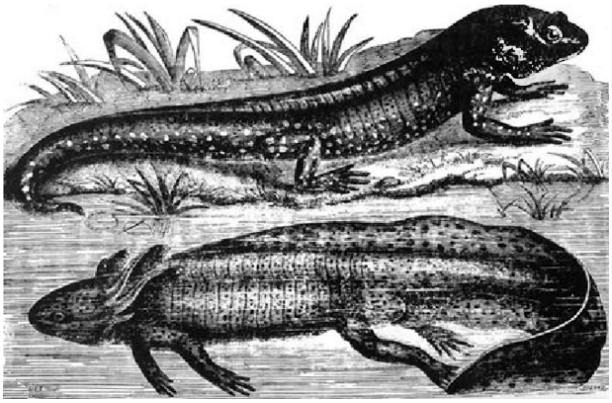

Figure 1: Bottom: Axolotl, Top: Amblystoma. As depicted in one of Auguste Duméril's publications (Duméril, 1866).

The result was the transformation of all five animals. In the course of a subsequent series of experiments she conducted over ten years, she managed to control the axolotls' transformation with the help of the aquarium to the extent that she could start it, stop it, and even reverse it up to a certain point (Chauvin 1883a, 1885). These axolotl experiments were part of a larger experimental system on amphibian metamorphosis, adaptation, and reproduction, on which she also published in the fancier journal Isis.18 While the aquarium was often just used as a gateway, which brought new species into research spaces, Chauvin took full advantage of the aquarium as an artificial environment and turned it into an instrument allowing her to manipulate ontogenetic processes (i.e., processes that are based on visible morphological characters) in several amphibian species.

The following is my translation of his own summary of Reiß's work.

Despite its widespread use in the life sciences, the aquarium has so far received little scientific and technological historical attention. This is not least due to the fact that the aquarium and its history have so far largely been viewed as non-scientific.

Contexts as diverse as acclimatization, amateur natural history and middle-class popular culture played an important role. At the same time, the development of the aquarium is also closely linked to the history of the life sciences. With a view to the second half of the 19th century, I understand the aquarium as a techno-natural assemblage in which technology, culture and nature are connected to an artificial natural space. Its history begins in British amateur natural science and the French acclimatization movement. In Germany in the late 19th century, the aquarium developed into a mass phenomenon.

At the same time it found its way into the life sciences, where it was used as a gateway, instrument and environment. As it turns out, the aquarium is a highly engineered technology that emerged from a combination of different traditions and brought life to the life sciences.

The following is the portion of his dissertation that it of most relevance to the aquarium hobby. I have edited it slightly to make it more readable for American aquarists. *Albert J. Klee, Ph.D., Editor.*

THE AQUARIUM AND THE HISTORY OF SCIENCE

Even though it was and still is an integral part of laboratory research in the biomedical sciences, the aquarium leads a shadowy existence in the history of science and technology. The rare opinions given by historians of science are short and unambiguous. For David Allen, the aquarium was a "plaything of fashion" (Allen, 1996, pg. 394) and the aquarium hobby an "extra-intellectual interest" (Allen, 1994, pg. 122) in the context of British amateur natural history. Andreas Daum describes the aquarium hobby as yet another variety of popular science in nineteenth century Germany, in which "non-professional nature lovers [aimed] for fulfilment and organization" (Daum 2002: 108). This article contributes to these and further works that focus on the aquarium's role in

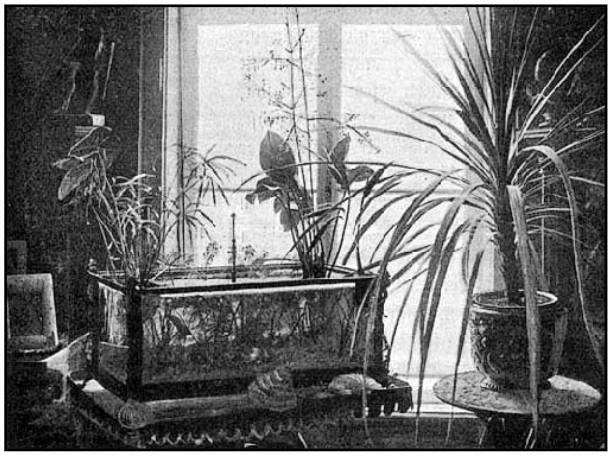

Figure 2: The aquarium as a techno-natural assemblage, integrated into the urban home (Bade 1899, pg. 72).

nineteenth and twentieth century popular culture (Schlebrügge, 2005/ Lorenzi, 2009/ Kranz, 2010/ Brunner 2011/ Hamera, 2012). At the same time it challenges the bias towards an extra-scientific history of the aquarium by emphasizing the aquarium's hybrid nature as an object in popular and laboratory culture.

The aquarium is such a functional space and a technology-in-use in twentieth and twenty-first century laboratory culture. Hence there must be a history of its emergence and stabilization and a historical link to its history in the nineteenth century. And this connection must either provide a feedback from Daum's popular science into the professional realm, or the aquarium must have been more than Allen's profane "plaything of fashion."

Closer inspection reveals that both scenarios apply and that the aquarium indeed has a history of science. It is not just exclusively a history of science, but also a history of fanciers, of animals, of industrial and urban technology and of nature constructed. It is the history of a technology that developed from a broad desire to bring nature into cities, into domestic spaces and – last but not least – into scientific spaces.

THE BRITISH AQUARIUM CRAZE AND THE SALTWATER AQUARIUM

In The Naturalist in Britain, David Allen reconstructs the history of the aquarium and the aquarium craze in Britain in the 1840s and 1850s, linking it to a number of other subfields of British amateur natural history (Allen, 1994). By way of explaining the spreading of the aquarium and the nature of the aquarium craze, he points to two central factors. First, it was the removal of the excise duties on glass (*ibid.* pg. 122) that made products of plate glass, including the aquarium, accessible to a broader audience. Second, there was a social change in the public for natural history, i.e., an emerging educated and prosperous middle class that turned enthusiasm into a craze.

The Aquarium hobby in Britain was materially and practically linked to a set of activities, which all consisted of collecting organisms or parts of them and arranging and displaying them in different kinds of boxes. While in academic natural history, these activities had a long tradition and were based on a taxonomic and classificatory epistemology, amateur crazes followed a different logic.

Driven by the writings of Philip Henry (Gosse, 1856) and following on the heels of seaweed and fern hobbyists, the aquarium offered a new opportunity for members of the emerging middle class to enjoy nature, advance their (scientific) education, and develop and display their aesthetic sensibility. The aquarium hobby originally meant to go to the coast during ebb tide – British aquarium hobby concentrated mainly on saltwater aquaria – to collect plants and animals from the tidal pools and then arrange them in aquaria. With its rising popularity and almost becoming a must-have for the salon, the aquarium became a commodity with a growing industry offering everything from fresh saltwater to fully equipped and even regularly maintained aquaria (Brunner, 2011). The most prominent aquarium trader was W. Alford Lloyd, whose Aquarium Warehouse in London had 15,000 animals in stock (Lloyd, 1858 and Alexander, 2005). To secure a steady supply of fresh water, plants and animals, traders like Lloyd took advantage of the rapidly developing railroad system in Britain, which connected the coast with inland cities like London and allowed a fast and stable transport of the sensitive freight (Schivelbusch, 1978). The rising popularity together with the new infrastructural possibilities owing to industrialization meant that soon "… great stretches of the coast were largely stripped of their attractive inhabitants" (Allen, 1994, pg. 124).

Even though the enthusiasm evaporated as fast as it had emerged, seeing most aquaria abandoned (Brunner, 2011), it left a lasting legacy by laying

the foundations of aquarium technology and practices, and thus of techno-natural assemblages. Furthermore, public aquaria made their way to the European continent as a new attraction for the masses. Following the bankruptcy of his aquarium warehouse with the end of the craze, W. Alford Lloyd became the most eminent expert for public aquaria in Europe, constructing aquaria for the *Jardin zoologique d'acclimatation* in Paris (1860), the *Zoologische Garten Hamburg* (1864), and the *Stazione Zoologica* of Naples (1874).

In addition, it sparked the proliferation of the aquarium as a research technology in the life sciences. While during the first half of the nineteenth century, scientific research with and on aquaria largely remained an isolated endeavor conducted by people like Robert Warington (Hamlin, 1986), Anna Thynne (Stott, 2003) or Jeanette Villepreux-Power (Brunner, 2011) the use of aquaria became widespread among British anatomists and zoologists (Elwick, 2007) from the 1850s onwards. Thus, not even the British aquarium tradition should be considered a purely amateur movement or as popular science. The amateur-professional dichotomy that already received substantial criticism (Daum, 2002/ Nyhart, 2009 and Phillips, 2010) does not hold for the situation in France and Germany either.

The history of the British aquarium craze and of the public aquarium reflects a specific tradition in the aquarium hobby which is intimately tied to a broad cultural (re-)discovery of the ocean at the beginning of the nineteenth century (Corbin, 1994, Rozwadowski, 2005 and Schwarz, 2005). Saltwater aquaria became the focus of this tradition, serving as imaginative spaces of the mysterious and undiscovered wonders of the ocean. In addition, the geographic specificities of Great Britain as an island with a big ratio of coastline to area and the resulting short distances between coast and inland cities simplified their set-up and maintenance.

THE CONTINENTAL COUNTERPART: ACCLIMATIZATION, AQUACULTURE AND THE FRESHWATER AQUARIUM

The situation in continental Europe differed from Great Britain in several ways. Due to the geographic differences – less coastline per area and hence long distances between coast and most inland cities – saltwater aquaria never became as popular and common as in Great Britain. Even though adept enthusiasts managed to set up and maintain saltwater aquaria for several years without changing water, the organisms populating the aquarium nevertheless eventually died and had to be replaced by new ones. As breeding turned out to be almost impossible for most marine organisms, fresh supply had to come directly from the sea.

This corresponds to the fact that, especially in France and Germany, the aquarium hobby was much more rooted in the acclimatization movement with its specific agendas among science, enthusiasm and commerce. The acclimatization movement emerged in France and Great Britain at the end of the eighteenth century (Osborne, 2000). Due to the rapidly increasing circulation of organisms along colonial networks animals, plants and humans were frequently exposed to new environments, and the influence of different environments on organisms came into focus. Acclimatization was the attempt to deal with and even to take advantage of this influence. In Great Britain this meant the transfer of organisms between similar environments, while the French approach assumed that organisms could, to a certain degree, be bred to adapt to different environments (*ibid.*).

The *Société Imperiale d'Acclimatation*, the first acclimatization society founded in Paris in 1854, set its agenda accordingly (Osborne, 1994). It announced prizes (consisting of medals and considerable sums of money) for the successful introduction and breeding of a wide range of organisms that were considered agriculturally and eco-

nomically promising in various ways. Its activities were directed both at France as well as at the colonies and included attempts to acclimatize alpacas, zebras, bustards, new silkworm species, new wax-producing insect species and quinine bark in France, edible fish in Algeria and "an animal to Martinique that could exterminate the fer-de-lance (*Bothrops lanceolatus*) living there."

These examples illustrate the Société's policy ranging from projects in France to ones in the colonies, and from agriculture to pharmacy. In parallel to stimulating acclimatization efforts by its members, the *Société* founded a zoological garden. The *Jardin Zoologique d'Acclimatation* was opened in 1860 and designed as a mix between an acclimatization laboratory and public animal display. In the *Bois de Boulogne* outside Paris, which had been landscaped under the direction of Baron Haussmann into a park in 1852, the *Société* built what was soon regarded as the ideal of a modern zoological garden. Financed by stock shares and a large network of powerful members, the *Jardin* was the manifestation of the acclimatization ideology.

The French acclimatization movement must be understood as part of a much broader regenerative movement, which Napoleon III turned into a state policy during the Second Empire. Projects ranged from Baron Haussmann's urban renewal of Paris to reforestation projects all over France, following the idea of "making facts of nature into instruments of human progress'' (Kinsey, 2006: 536). Acclimatization was a complex set of practices that linked "science to animal display, urban renewal, agricultural improvement and France's colonial mission" (Osborne, 1994, pg. 13).

One of these projects was scientific aquaculture, the attempt to "elevate the last unconquered region of the planet – its aquatic wilderness – to a level of domestication" (Kinsey, 2006: 527). The aqua-cultural revolution, like any other regenerative project at this time in France, was carried by heterogeneous interest groups "including scientists, bureaucrats, sportsmen and entrepreneurs" (*ibid*. pp. 552). State and private actors aimed for the rational and scientific reorganization of the use of aquatic species and tried to acclimatize foreign species in French waters, including salt- and freshwater "fish, mollusks, and even leeches for medical purposes" (*ibid*. pp. 528). For their Jardin, the Société commissioned W. Alford Lloyd to build an aquarium, which included both saltwater and freshwater tanks as well as facilities for fish, oyster and frog culture.

While committed to the improvement of nature in general, and human food sources in particular, the spectacle of the exotic and ornamental held a prominent place on the acclimatization agenda as well. As a result, aquaria did not only become an integral part of the *Jardin* but also objects for private homes (Lorenza, 2009). Compared to Great Britain that created a different blend of aquarium culture, the specific mixture of economic and ornamental motives, the inclusion of freshwater aquaria, and especially the close association with imperial networks and acclimatization shifted the attention away from the one-way relation between the ocean and the aquarium toward the breeding and circulation of aquarium organisms within techno-natural assemblages.

THE AQUARIUM IN GERMANY

The French acclimatization movement - and especially its *Jardin Zoologique d'Acclimatation* - soon acquired European fame, and similar societies and zoological gardens were founded across Europe. Germany was one of the countries where [French] acclimatization found a large following. Zoological gardens were opened or reorganized (Wessely, 2008), societies founded, journals published and a broad affinity to animal keeping and breeding emerged.

While acclimatization and its encompassing improvement agenda turned out to be rather short-

lived in Germany, the educational and leisure aspect of animal keeping and breeding acquired increasing prominence. This development was amplified by the particular German tradition of non-academic natural history (Nyhart, 2009). In this context, Emil Roßmäßler, the German counterpart to Philip Henry Gosse, promoted the aquarium and set the agenda for German aquarium culture (Roßmäßler, 1856, 1857 and Daum, 2002). As in Great Britain and France, aquarium enthusiasts were members of the middle class with the necessary resources in money, time and education (Daum, 2002).

After the initial boom between the 1870s and 1890s, the hobby saw another upswing in the interwar period. During these years, the aquarium found a new audience among members of the working class, and large numbers of proletarian clubs were founded (Hohl, 2001).

The rapid expansion of the field in the late nineteenth century is apparent in the growing number of increasingly specialized journals and the formation of clubs or *Vereine*. Until the 1870s, *Der Zoologische Garten, Zeitschrift für die gesamte Tiergärtnerei* (The Zoological Garden, Journal for the Entire Field of Zoo Keeping), founded in 1859, was the most important journal in the field of animal hobbyists. Originally the journal of the Frankfurt zoological society and its zoo, it soon became the central publication for zoological gardens, acclimatization and animal breeding in Germany. In 1876, *Isis, Zeitschrift für alle naturwissenschaftlichenLiebhabereien, Verkehrsblatt für naturgeschichtlichen Kauf und Tausch* (Isis, Journal for all Scientific Hobbies and Natural Historical Trade and Exchange) was launched. It specialized in the needs of the ever-growing private animal hobbyists, serving as a platform for the exchange of practical information and to connect animal buyers and sellers (Paepke, 2007a). The journal *Natur und Haus, Illustrirte Zeitschrift für alle Naturfreunde* (Nature and House, Illustrated Journal for all Friends of Nature) founded in 1892 and its follow-up *Nerthus: Illustrierte Wochenschrift für Tier- und Pflanzenfreunde, Organ für Sammler und Freunde aller naturwissenschaftlichen Zweige* (Nerthus: Illustrated Weekly for Friends of Animals and Plants, Institution for Collectors and Friends of all Scientific Branches), launched in 1899, were directed at similar audiences (Daum, 2002).

Isis was only published until 1889, but one year later, in 1890, *Blätter für Aquarien- und Terrarien-Freunde, Illustrirte Halbmonatsschrift für die Interessen der Aquarien- und Terrarienliebhabei* (Journal for Aquarium and Terrarium Enthusiasts, Illustrated Half-Monthly for the Interests of Aquarium and Terrarium Enthusiasts), was launched as the first journal exclusively for aquarium and terrarium hobbyists. This project was initiated by Bruno Dürigen, the co-founder of Isis and one of the most prolific figures in the field of German animal keeping and breeding (Paepke, 2007b), and Ernst Bade, former editor of *Nerthus* and a leading figure in the German aquarium and terrarium scene who ran his own commercial aquarium breeding business in Berlin. The journal's title points to a characteristic of German aquarium culture – the close connection between the aquarium and the terrarium, often subsumed under the umbrella term vivarium. This meant a generally more inclusive approach with a broader array of animals, ranging from fish, amphibians, and reptiles to insects and plants, as well as a more complex set of habitats, which often combined aquatic and terrestrial spaces.

In 1902 the *Blätter* was renamed *Blätter für Aquarien- und Terrarienkunde, Illustrirte Wochenschrift für die Interessen der Aquarien und Terrarienkunde* (Journal for Aquarium and Terrarium Studies, Ilustrated Weekly for the Interests of Aquarium and Terrarium Studies) and switched from bimonthly to weekly publication. While the latter indicates the growing number of authors and readership, the change in the title from Freunde (enthusiasts) to Kunde (studies) points to the effort of enthusiasts to be taken seriously in their activities, which they understood as a form of production of knowledge complementary to the

sciences (Nyhart, 2009). In 1909, *Natur und Haus* merged with *Blätter* and in 1939 *Blätter* merged with its competitor *Wochenschrift für Aquarien und Terrarienkunde* (Weekly for Aquarium and Terrarium Studies), founded in 1904.

Aquarium clubs started to appear in the late 1870s. By 1911, 284 clubs existed and could be found in every large German city (Hohl, 2001a). In the same year German aquarium and terrarium hobbyists saw a further institutionalization with the foundation of the *Verband der Aquarien und Terrarienvereine* (Association of Aquarium and Terrarium Clubs) (*ibid*., 2001b).

This continuing specialization and institutionalization of the aquarium and terrarium hobby found no complement in France and Great Britain. Aside from monographs that were regularly published in all three countries, only Germany saw the development of highly specialized, practice-oriented journals and a national network of clubs (Daum, 2002). Clubs mostly worked as local communication platforms where a common interest cultivated sociability in the exchange of practices, technologies, knowledge and organisms. Hobbyist journals fulfilled the same function at national and sometimes international level, connecting likeminded enthusiasts and the growing number of professional aquarium suppliers and acting as platforms on which knowledge and practices were further negotiated, stabilized, exchanged and archived. Especially in the second half of the nineteenth century, when the keeping and breeding of organisms in aquaria and terraria was still developing, clubs and journals were crucial in developing, stabilizing, and making accessible the necessary knowledge and technologies. The following examples demonstrate this process of tinkering and stabilizing techno-natural assemblages as well as their integration into middle-class life worlds in nineteenth-century Germany.

Water ventilation was the most crucial aspect of running an aquarium. Although hydraulic/ pneumatic devices (often in combination with a fountain (Fig.3) or spring mechanisms driving a paddle wheel) had been available from early on, enthusiasts were constantly experimenting with alternative mechanisms, like small steam engines (Buck, 1875) or the growing infrastructures of urban supply. Adolf Sasse, who ran the biggest aquarium shop in Berlin, even made a trip from Berlin to Lübeck to study the apparatus constructed by Heinrich Lenz, director of the local natural history collection, who used the water pressure from the recently installed urban water supply system for ventilation (Sasse, 1878).

In Sasse's description of his own efforts to install this apparatus in his apartment, several conflicts of integrating techno-natural assemblages become visible. The new apparatus had the advantage of replacing the old pump system, which was rather bulky and used to spray water. As Sasse emphasized, "nobody was happier than my wife" (*ibid.* pg. 143) about its disappearance. Still, the new apparatus consisted of a rubber pipe, which ran through three rooms and connected the water tap in the kitchen to the aquaria. In the end it was the landlord who ended "this municipal *perpetuum*

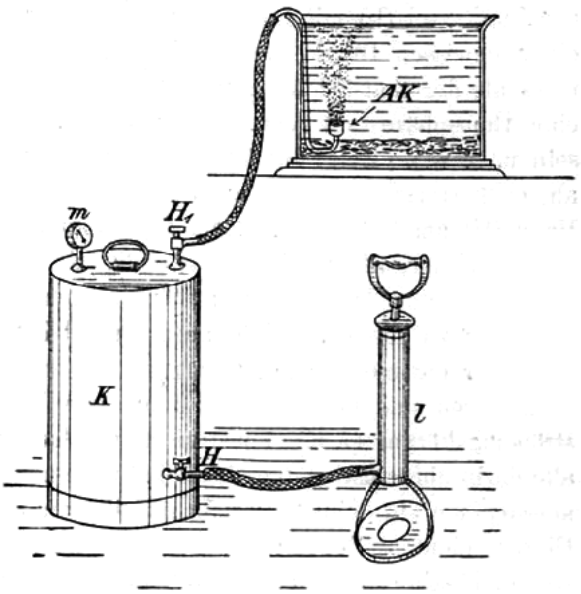

Figure 3: Construction plan for an aeration device using an air pump (Zernecke 1897, pg. 41).

mobile" (*ibid.*), complaining about the water running day and night. Sasse had to return to his old pump system. The kind of ventilation device developed by Lenz did not become commercially available until 1908 (Hohl, 2001a).

As these examples show, the process of creating a shared space for human and non-human animals went beyond mere technical feasibility and had to meet different interests. The decorative aspects of the aquarium often conflicted with the necessities of maintenance and functionality. The boundary between human and non-human subspaces turned out to be problematic in various ways. *Blätter* editor Ernst Bade (Bade 1897) brought these boundary issues to the fore when he discussed the following dilemma. If the aquarium is not filled up to the top lip, the water surface leaves a strip of dirt, which over time is more and more difficult to remove and blemishes the aquarium. Yet filling up the aquarium to the seam, one runs the danger that the fish jump out.

Last but not least, the aquarium hobby had to be integrated into family life. In a text on aquaria for children from 1899, the author discussed the question why children rarely shared their father's enthusiasm. He identified one reason in the way the aquarium was integrated (or rather, not integrated) into family life. While it often formed the center of the household, dominating the needs of wives and children, "no wife, no child is allowed in the vicinity of the aquarium, let alone to touch it" (Dankler 1899: 94).

In the course of this mediation between the diverse interests of aquarium animals, family members and landlords, the aquarium became socially and domestically integrated and the techno-natural assemblage developed into a stable and increasingly ready-made infrastructure (Fig. 2). As the aquarium hobby found a growing audience, a market developed that was served by a growing number of suppliers. To give just one example of its dimensions: between 1905 and 1912, the company A. Glaschker in Leipzig sold 100,000 aquaria (Hohl, 2001b: p. 117).

THE AQUARIUM IN THE SCIENCES

The process of integrating the aquarium did not only take place in domestic spaces. For a number of partly overlapping reasons, life scientists started to keep animals as well. While many life scientists were fanciers themselves, there were also practical and methodological reasons that created a growing demand for living animals. Even though the aquarium was likewise used in scientific institutions in France (for instance at the *Musëum d'Histoire Naturelle* in Paris) and Great Britain (Elwick, 2007), the highly diversified German aquarium culture and the development of the life sciences in Germany in the second half of the Nineteenth century (Coleman, 1971) constituted an especially fertile ground for proliferating the aquarium in the life sciences.

Physiology achieved growing institutional independence and especially experimental physiology developed a research agenda that intensified its consumption of research animals (Nyhart, 1995/ Dierig, 2006). When in 1877 Emil DuBois-Reymond had his new physiological institute built in the center of Berlin, he included a ranarium, that is, a facility to breed frogs, so as to have a steady supply of frog muscles for his electrophysiological experiments (Dierig, 2006). In turn physiologist Elie de Cyon considered the aquarium as the best way to secure this steady supply and he noted that every "experimental scientist should personally make sure that the animals are held under living conditions that fit their nature the most" (de Cyon, 1876, Pg. 29). As de Cyon emphasized, the growing urban infrastructures could be easily used for this purpose (Dierig, 2006).

In parallel, anatomy and zoology shifted from a systematic to a morphological framework (Nyhart, 1996). Instead of studying particular anatomical structures in particular species (often

using particular specimens from a collection) to comparatively understand the taxonomic relation of these species, morphology used a number of species from one group as exemplars to understand the history and thus the development of a structure in the whole group. Gradually, the scope expanded to increasingly fundamental principles and ever-larger taxonomic groups.

Since this research was based on the investigation of the successive steps of morphological development, it needed the successive developmental stages of often several animal species. Accordingly, the large collections of dead and preserved specimens gradually lost their significance in this context. Like experimental physiologists, zoologists started to rely on species that were either of great abundance locally or could be kept and bred rather easily (Hopwood, 2011). Hence availability slowly outpaced taxonomy.

In this context, experimental embryology emerged as a new field of research. It was a science of, or better, at the sea, with roots in the morphological questions of *Entwicklungsgeschichte* (developmental history). After primarily developing at marine stations that were founded on all European coasts in the 1870s and 1880s, it heavily relied on easy access to eggs and larvae of mostly marine invertebrates (Groeben, 2008). As a consequence, decades into the twentieth century, several generations of zoologists and anatomists traveled at least once a year to one of the stations, the most famous being the Stazione Zoologica of Naples (Fantini, 2000).

And finally, life history studies, though often less visible, always played an important role in zoology (Nyhart, 1996). Following the publication of Darwin's Origin of Species, the interrelations between organisms and their environment became an important area of research that was increasingly carried out in the emerging hybrid spaces of techno-natural assemblages.

Especially in the context of experimental embryology and the research style developed at the marine stations, the aquarium gained significance. But this observation should neither suggest that the aquarium was imported into science as ready-made technology, nor that there was a clear distinction between amateur and scientific uses of the aquarium. Lynn Nyhart has already brought to attention the importance of "practical naturalists" (Nyhart, 2009, pg.108) for the life sciences and the role played by the "everyday business of keeping the animals alive." Not only people generally considered as amateurs contributed to scientific knowledge; also scientists participated in activities generally considered as amateurish.

Aquarium enthusiast and scientist were often identities of the same person, sometimes being almost unconnected but sometimes being closely interwoven on the practical level. Probably one of the most (in)famous examples in this context is Paul Kammerer. He started out as an aquarium/ terrarium enthusiast in his youth, became a corresponding member of the Berlin club *Triton* (Rieck/Mau, 2008, pp. 60) and published in the *Blätter* (Kammerer, 1901). In 1902, he started to work at the *Biologische Versuchsanstalt* in Vienna, also known as the Vivarium. It is no coincidence that Kammerer, known for his special aptness for breeding and keeping amphibians (Rieck/Bischoff, 2001/ Gliboff , 2006/ Berz, 2009), worked at this institution which was in all aspects designed for keeping, breeding and experimenting with animals (Reiter, 1994/ Gliboff, 2006/ Berz, 2009). But he kept close contact to the aquarium movement, acting as editor for the *Blätter* from 1908 until 1909.

Other examples include Valentin Haecker, Professor of Zoology at the University of Halle, who had a close relationship to the *Vivarium-Halle*, one of several local clubs. Some of his doctoral students were members of this club and did their experimental research on aquarium animals (Roßmäßler-Vivarium 2006). Werner

Schnakenbeck, for example, published his breeding experiments with the Mexican axolotl in the Blätter (Schnakenbeck, 1922a), and his experimental research on the same animal in scientific journals (1922b, 1923). In Jena, Friedrich Maurer, Professor of Anatomy, Ludwig Plate (Levit/Hoßfeld, 2006), Ernst Haeckel's successor as Professor of Zoology, Karl Hobstetter, Professor of Veterinary Medicine and Julius Schaxel (Reiß 2007), Associate Professor of Zoology, were all members of the local club *Wasserrose e.V.* [e.V. under German law is a Körperschaft (corporation), which is defined as being a legal entity which is separate from its members, i.e. not a partnership], 1913, Jena. The fact that many university libraries in Germany hold a wide variety of aquarium journals further demonstrates the close ties between the academic life sciences and the intermediary realm of enthusiasm.

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Figure 4: Christian Reiß.