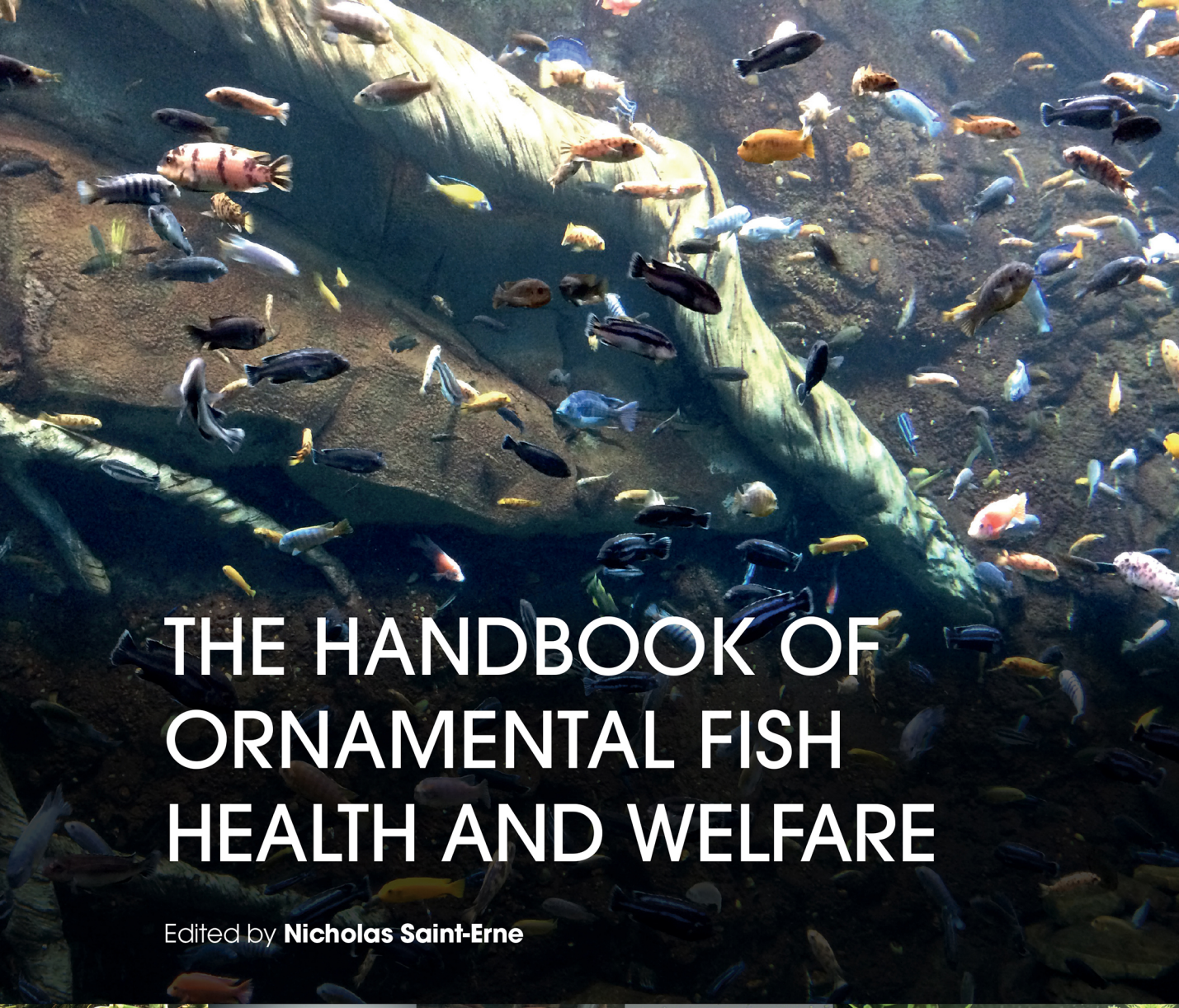
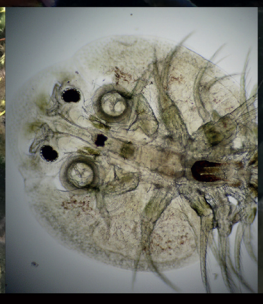
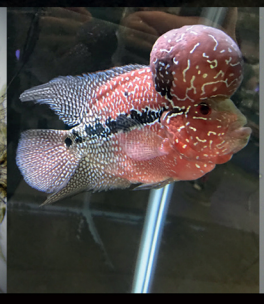


THE HANDBOOK OF ORNAMENTAL FISH HEALTH AND WELFARE

Edited by **Nicholas Saint-Erne**

CABI

The Handbook of Ornamental Fish Health and Welfare

Dedicated to my family:
Judy, Victoria, Alexandra, and Rachel

Cover photographs by Nicholas Saint-Erne, DVM, CertAqV

The Handbook of Ornamental Fish Health and Welfare

Edited by

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Foreword

When I graduated from veterinary school in 1988, there was not easy access to a single comprehensive text on ornamental fish medicine written by veterinarians. A lot has changed in the last 36 years, and there are now over three dozen fish medicine books written by veterinarians in circulation. While these books are all great resources, providing valuable information on fish medicine and health, most do not focus on ornamental fishes. Nicholas Saint-Erne, the editor and primary author, has over 40 years of experience as a fish veterinarian and is a WAVMA Distinguished Fellow. Dr. Saint-Erne and I have been friends and colleagues for almost three decades, and I can say without hesitation that he truly is a pioneer in the field of aquatic animal medicine with a wealth of experience in both corporate and private practice.

From anabantid to zebrafish, ammonia to zeolite, this marvel of a book is truly the A-Z of ornamental fish health and welfare. Written entirely by a carefully selected team of World Aquatic Veterinary Medical Association (WAVMA) certified aquatic veterinarians, the contents provide the reader with all the information needed to handle any ornamental fish health challenge competently and effectively. Best of all, this resource is in a handbook format, with pertinent and easy-to-find information at the reader's fingertips. The text is richly illustrated in color with figures that highlight key points and guide the reader in performing diagnostic and medical procedures accurately and safely. The handbook also contains numerous tables, including a comprehensive formulary, which provides valuable information quickly for the busy clinician with limited time. The book is very easy to navigate, with concise and accurate knowledge nuggets just a few page-turns away.

Readers will be happy to see that in addition to the essentials of husbandry, water quality, disease diagnostics, infectious diseases, environmental diseases, neoplasia, therapeutics, analgesia, anesthesia, and surgery, this book also addresses important topics like animal welfare, biosecurity, and zoonotic diseases.

Dr. Saint-Erne and his contributing authors have seamlessly meshed their many decades of personal experience with a rich survey of the fish health literature to provide a reference on ornamental aquarium fishes that all practitioners of aquatic animal medicine should have on their bookshelves.

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Preface

It was a great honor to be asked by CABI to compile a book on Ornamental Fish Health and Welfare and to work with some very talented veterinarians who have contributed material for this book, as well as working with the staff at CABI publishers, who were patient during the prolonged process of bringing it together.

When I published the book *Advanced Koi Care* in 2002, it was the culmination of my aquatic veterinary work with those amazing fish: Nishikigoi—the Japanese colored carp. It took all the knowledge and reference material that I had acquired in my 20 years of veterinary practice working with koi and other fish species to make a practical guide for veterinarians who wanted to care for these beautiful fish. Now, after another 20 years of aquatic veterinary medicine, it is time to make a complete veterinary reference book for tropical aquarium fish!

In recent years, there has been a surge in interest among veterinarians in aquatic veterinary medicine, including food fish production, marine mammal care, aquatic animals in the care of public aquariums and zoos, and in the ornamental fish industry. The growing interest by veterinarians ultimately produced organizations to help spread knowledge among veterinarians working with fish and other aquatic animals, including the International Association of Aquatic Animal Medicine, Fish Veterinary Society in the United Kingdom, the American Association of Fish Veterinarians, and the World Aquatic Veterinary Medical Association (WAVMA.org).

WAVMA is an international organization of aquatic veterinarians and holds an annual meeting and conference that rotates in locations throughout the world. It publishes a quarterly journal, *The Aquatic Veterinarian*, which contains news, research articles, case reports, book reviews, meeting announcements, and other material of interest to its members. It has student chapters in many veterinary colleges around the world. Their website has links to educational videos on various fields of aquatic veterinary medicine, listings of upcoming veterinary meetings, and a search section where fish keepers can find a local veterinarian that treats fish or other aquatic animals. And, most importantly, WAVMA has a credentialing program that certifies veterinarians who have knowledge, skill, and experience working with aquatic animals. These veterinarians are given the honorific title Certified Aquatic Veterinarian (CertAqV) to list after their veterinary degree initials. This handbook has been edited and written exclusively by veterinarians who have been awarded this certification.

In this handbook, you will find information about the history of keeping fish in aquariums, the pet fish industry, how to maintain an aquarium and proper water quality, fish diseases and treatments, anesthesia, surgery, and a plethora of fish-keeping information. It is our hope that this will be a useful handbook for aquatic veterinarians and anyone wanting to learn more about keeping tropical aquarium fishes and maintaining their good health and welfare.

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1 A Brief History of Keeping Fish in Aquariums

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Abstract

Keeping fish in artificial ponds for food dates back to antiquity. In the late Middle Ages through the Renaissance period, interest in keeping fish for ornamental purposes began to flourish as well, first in Asia, then in Europe. By the 19th century, keeping fish in glass aquariums was a popular pastime.

1.1 Early Aquarists

The ancient Egyptians kept fish in hollowed-out stone bowls; however, this was to keep the fish alive until they could be cooked and eaten. Other ancient and medieval cultures—such as the Romans, Chinese, and Hawaiians—kept fish in man-made ponds to harvest them as needed for food. Keeping fish for strictly ornamental reasons was most notably done in the Chinese culture as early as AD 1369, breeding goldfish that were kept in porcelain bowls (Fig. 1.1) and even in glass aquariums. Glass bowls began to be used in Europe in 1572, and in 1666, Leonhard Baldner, a Strasbourg fisherman and naturalist, produced a handwritten illustrated book on birds, fishes, and mammals titled *Vogel, Fisch und Thierbuch*, which discussed using glass bowls to study fish. The book *Der See im Glasse*, published in Germany in 1856, increased interest in keeping fish for scientific observation (Hoedeman, 1974).

On May 21, 1853, the first public aquarium was opened as part of the London Zoo. First called the "Fish House" in Regent's Park Zoological Gardens, it was made possible by English naturalist Philip Henry Gosse, who is credited with promoting the glass tank as a novel way of housing marine creatures and was also responsible for using the word "aquarium" for this glass vessel (Ganesh, 2023). Forty years later, it was written that "every European city and town of consequence has a public aquarium" (Samuel, 1894).

Nature in the home, including plants and birds, was very popular in Victorian England, and bringing fish indoors in glass bowls and aquariums became common. A book published in 1894, *The Amateur Aquarist* (Fig. 1.2), described the care of goldfish, paradise fish, and three-spined sticklebacks in glass aquariums without any filtration or aeration. However, it was noted that fishes all gasping with their noses partly out of the water was due to a lack of oxygen, with too many fish in the aquarium, and the cure was to dip water up and let it splash back many times and to reduce the number of fishes. A summary of the advice given in the book follows:

"The self-sustaining aquarium is arranged so that the water need be changed but once a year. Under favorable conditions even this time may be extended. The modern iron-framed aquarium (Figs 1.3 and 1.4) is made with the sides, ends, and bottom of glass so arranged that the plates just unite inside the frame, while the amount of cement necessary to insure its being watertight is placed between the metal and glass where the even pressure of water serves to make it more secure. A self-sustaining aquarium may be fitted for either marine or fresh water, but I shall in this preliminary work confine myself to the fresh water, it being a little easier to maintain and for that reason better to start with.

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Fig. 1.1. Chinese porcelain bowl for maintaining goldfish. The inside painting depicts aquatic plants as well as a Chinese Fringetail Telescope Goldfish. (Photograph by N. Saint-Erne.)

"The thing to be done is to supply air to the water in the aquarium as rapidly as the fishes exhaust it. Water-plants under the action of daylight give off oxygen and absorb the carbonic-acid gas exhaled by the creatures in the pond. Place the aquarium on a steady table . . . opposite a northern exposure if possible, and if not, near the window having the least direct sunlight. The main point being to obtain sufficient light to stimulate the growth of aquatic plants without allowing the sun to shine directly on the water. In a few words then, a self-sustaining aquarium simply means "balancing," to use a technical term, the animals and vegetable life, with the addition of certain little water-creatures to act as scavengers" (Samuel, 1894).

1.2 Aquarium Societies

As a way of exchanging knowledge about fishkeeping, interested people gathered to discuss techniques, and this resulted in the formation of aquarium societies. The first aquarium society was called the *Gotha Aquarium*, founded in Germany in 1882 (Bleher, 2004, p. 13). The first aquarium society organized in America was established in New York City in 1892, which held its meetings at the American Museum of Natural History, located in Central Park (Ferdenzi, 2019). The oldest continuous aquarium club still in existence is the Boston Aquarium Society, founded in 1916 (Meserve and Meserve, 1973). The Brooklyn Aquarium Society in New York City was founded in 1911, but disbanded mid-century, and later reformed in the 1950s with the same name (Wikipedia.org, 2023). Aquarium societies hold monthly meetings and have lectures and newsletters with current information to educate members about fishkeeping. Some even have fish shows to exhibit fish and aquariums, where prizes are awarded. Today, there are aquarium societies in most major cities, along with koi pond societies and even aquatic plant societies. There are also several umbrella organizations for the organized hobby, including the International Federation of Online Clubs and Aquatic Societies (IFOCAS.net), the Federation of British Aquatic Societies, formed in 1932 (fbas.co.uk), the Northeast Council of Aquarium Societies, formed in 1956 (NorthEastCouncil.org), and the Federation of American Aquarium Societies (FAAS). Find these organizations' websites or Facebook pages to locate aquarium societies in local areas.

1.3 The 20th Century

In the early 20th century, home aquarium keeping continued its popularity, and techniques gradually became more advanced. However, mechanical aeration had not been introduced, and it was still essential

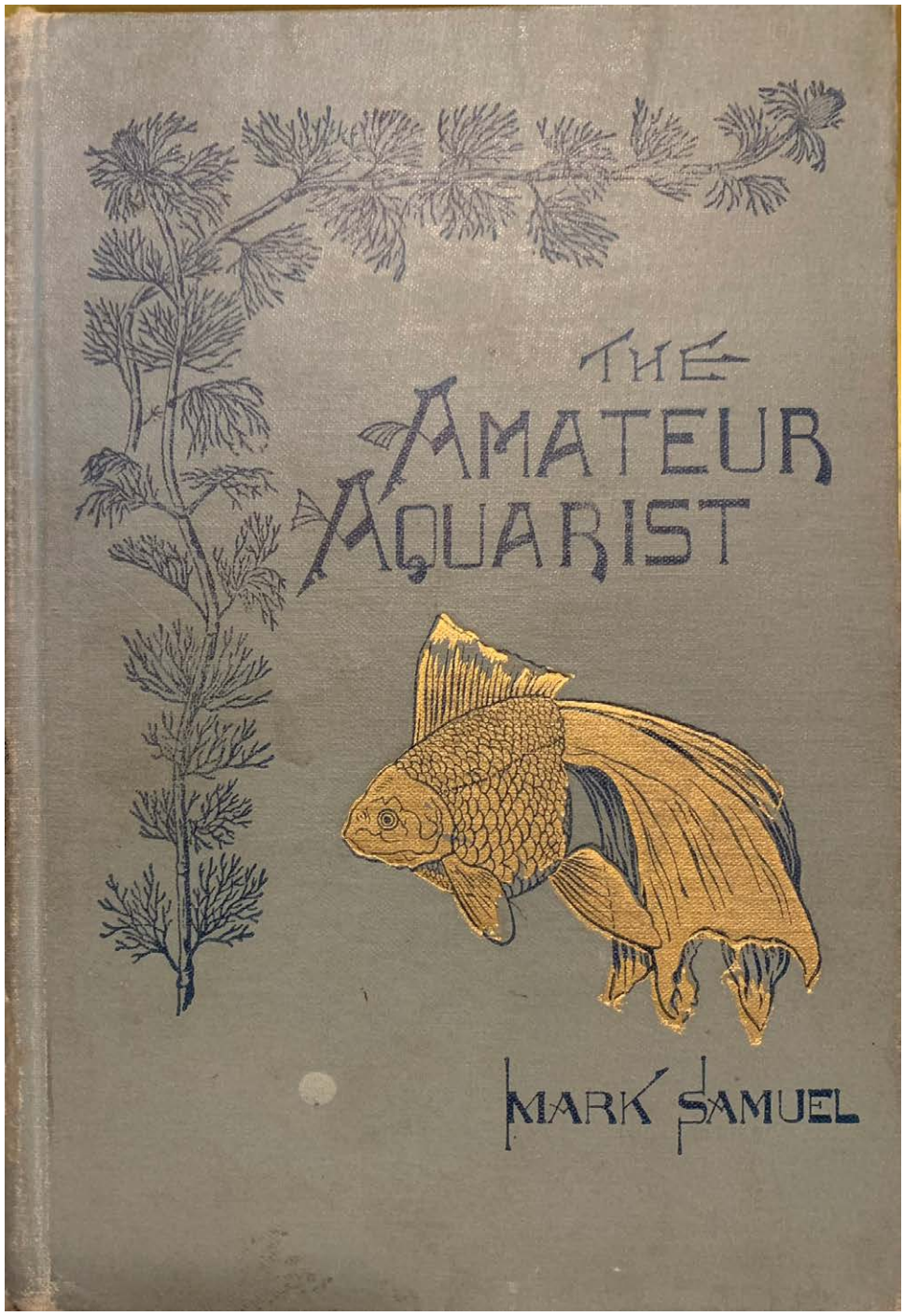

Fig. 1.2. Cover of the book *The Amateur Aquarist*, by Mark Samuel (1894). The illustration on the cover is a fringetail goldfish. (Photograph by N. Saint-Erne.)

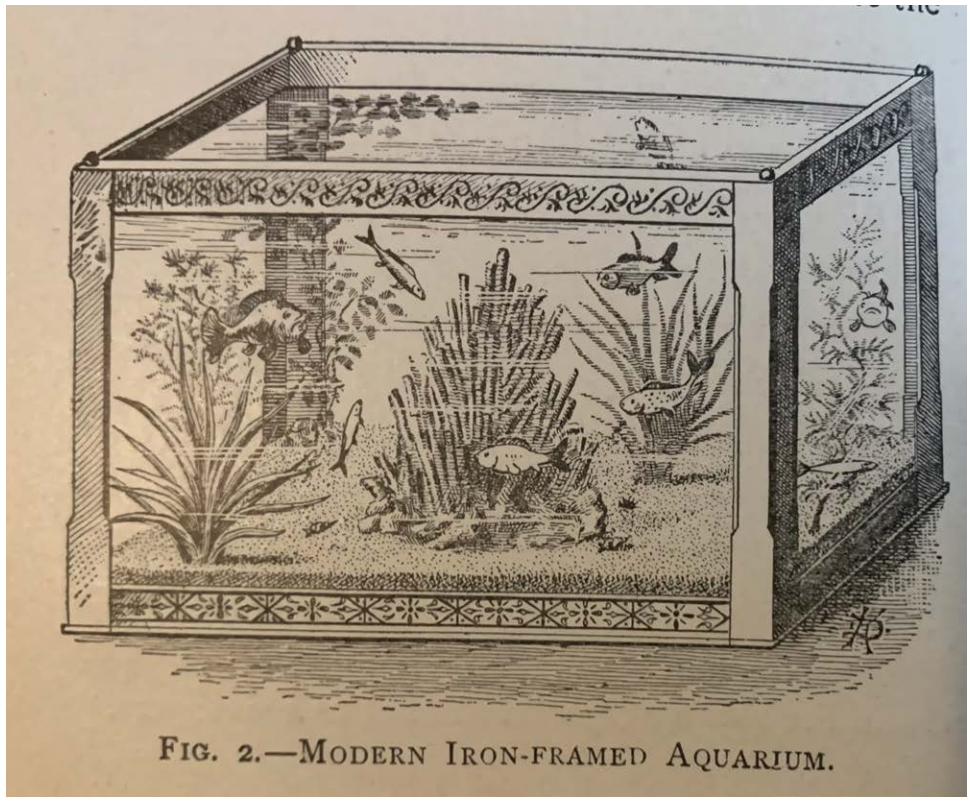

Fig. 1.3. Late 19th century metal-framed, glass aquarium illustration from *The Amateur Aquarist*. (Photograph by N. Saint-Erne.)

that if "the relations of plant to animal life correctly proportioned, the aquarium is virtually self-sustaining or balanced, and the water need only be changed at long intervals, often of a year or more" (Wolf, 1908). This same book also listed forms of aeration available at the time: a stream of water under pressure of a considerable elevation poured into the aquarium; use of a pressure tank filled with air by a bicycle pump and the compressed air admitted into the aquarium by a small tin pipe buried under the pebbles; by use of an elevated bucket and a rubber hose above the water line to create a fountain in the aquarium that would run for probably an hour. Despite the simplicity, a few hardy fish specimens could survive in these aquariums.

Today, one rarely sets up an aquarium for just one or two fish. In 1900, the fishkeeper had no choice. Today, we can keep many more fish in our tanks. The common rule of thumb for stocking aquariums is "one inch of fish to one gallon of water." This rule was already in print by 1921 (Innes, 1921, p. 7). Also, in the early part of the 20th century, one did not set up an aquarium without plants. Plants were required because they provided oxygen for the fish and removed carbon dioxide, which was the result of fish respiration (Hovanec, 2000). In his later book, *Exotic Aquarium Fishes*, Innes writes, "This is one of the modern developments in aquarium convenience. A small electric pump forces the air through a tube connected to a liberator at the bottom of the aquarium, sending up a spray of small bubbles" (Innes, 1935, p. 8).

As mechanical filters and air pumps were developed, the use of live plants in the aquarium decreased. However, one could argue that the increased use of filters and subsequent decline in the use of live plants resulted in the aquariums of the late 20th century having poorer water quality than the aquariums of the 1920s and 1930s,

Fig. 1.4. Brass-framed antique aquarium in the collection of ZooMed/The Museum of Aquarium and Pet History in San Luis Obispo, California. (Photograph by N. Saint-Erne.)

because the plants remove many things that filters do not, including carbon dioxide and nitrate (Hovanec, 2000).

In the 1950s, the undergravel Miracle Filter was introduced and became the most common filter in an aquarium in the United States. The gravel at the bottom of the aquarium became the filter media for biofiltration, and water was drawn through the gravel by use of an air pump blowing air through uplift tubes in the corners of the undergravel plate. The undergravel filter became so popular that for years, just about every aquarium was set up with one (Hovanec, 2000). When the "power head"—an underwater motorized pump that drew water through the undergravel filter plate and up the airlift tube—was added, the undergravel filter became even more effective than when it was operated using air bubbles from an air pump outside of the aquarium.

By the 1960s and 1970s, the tropical fish hobby had grown rapidly. Thermostatically controlled aquarium heaters, plastic canister filters, and power filters (also called the "hang on the back" filter) were developed, as well as many books and magazines published to spread the latest information about fishkeeping. All glass and acrylic aquariums became affordable, replacing the leaky metal-framed aquariums. The New England Aquarium opened in Boston in 1969 and started a trend of large public aquariums, which is still going strong today (Hovanec, 2000). There are now even more public aquariums, at least one in every US state and major European

city, just as described by Samuel in 1894. Aquarium keeping became not only a thing of beauty to have in a home but also became an active hobby. In the 1970s, it became the second-largest hobby, second to stamp collecting. It topped photography and coin collecting (Jailer, 1973, p. 112).

In the 1980s and 1990s, the cutting edge of the hobby became the marine reef tank (Hovanec, 2000). Keeping a variety of corals, anemones, and other marine invertebrates in a natural-looking aquarium became common. The "Nature Aquarium" became the craze in Asia and Europe with the publication of Takashi Amano's book in 1994. Reminiscent of the early aquariums from the 1800s, Nature Aquaria are full of plants, with only a few fish, usually a small school of one species (Fig. 1.5). These waterscapes attain one of the main goals of Zen Buddhist gardening: to create the impression of a great space in a small area (Amano, 1994, p. 17).

In the 1990s through 2010, koi ponds were a major growth area in fishkeeping. Koi and pond clubs were common in large cities, with monthly meetings and annual springtime pond tours of the members' ponds. The economic crisis and housing market collapse of 2010 brought an end to the rapid growth of pond keeping. The COVID-19 pandemic of 2020–2022 also affected pond keeping, with the largest US magazine for koi enthusiasts, *KOI USA*, ceasing publication one issue shy of 45 full years, the last and final issue was March/April 2020 (Chandler, 2020). To end on a positive note, during the COVID-19 pandemic, when many people were spending more time at home, keeping pets of all kinds became even more popular, with a resurgence of interest in fishkeeping.

1.4 Conclusion

Even as early as 1935, the theory that water changes are necessary more than once a year was documented. Innis wrote, "It is the experience of many leading aquarists that a systemic replenishing of water in small quantities is of marked benefit to most aquarium fishes—say 10 per cent weekly in winter and 25 per cent in summer" (Innes, 1935). Modern LED lighting, powerful canister filtration, water treatment chemicals, and water testing kits have made aquarium maintenance easier today than ever before. And once again, live plants are plentiful in aquariums, thanks to the Nature Aquarium concept. But one should still do partial water changes on the aquarium every month, not yearly!

Fig. 1.5. Nature aquarium displayed in Takashi Amano's studio in Japan. (Photograph by N. Saint-Erne.)

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