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An Aquarium for the future

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Abstract

Museums have a long and proud tradition in maintaining and developing public aquaria. However, to conform with modern requirements and with new zoo licensing regulations, they must increasingly justify their operation in terms of conservation, education and scientific study. The 'Living Waters' project at the Horniman Museum is the first public aquarium dedicated to underwater conservation. It is taken as an example of a substantial development which integrates the three aspects above, and which is strongly supported by public and private bodies and the World Wide Fund for Nature. It took four years in the planning and execution and cost about £300,000.

Introduction

Fishkeeping is an immensely popular hobby worldwide. In Britain about 3 in 21 million homes (or 14%) have fish (Andrews, 1990). In line with this, public aquaria are increasingly successful visitor attractions, as seen in the remarkable proliferation of 'Sea Life' and other similar centres. Historically, several museums incorporate aquaria and today these are invariably still among the most popular visitor draws (Reid, 1993).

London was the site for the world's first public aquaria. Fredrick Horniman, the founder of the Museum, had a lifelong interest in living creatures and, during the 1890's he organised public displays of live animals. A small Aquarium and Vivarium has existed at the Horniman since its opening as a free public Museum in 1901. It was established under the influence of Philip Henry Gosse - the man who coined the word 'aquarium' - and some of his original documents and illustrations of marine life are still held in the archives of the Museum Library. By the 1980's the Horniman's Aquarium was still popular, but the 'conservation, education and science' content was very limited and much of the structure was in urgent need of replacement. Gallery surveys indicated that it was an area that the public definitely wished to see retained but also to be considerably improved. John Toovey, the distinguished zoo architect, was commissioned in 1988 to undertake a feasibility and design study in conjunction with the Horniman team, which at that time included the author (Toovey,1992)(5). Building began in 1990 and was completed by the end of 1991. The 'Living Waters' exhibition looks at conservation in action worldwide, including practical field projects operated by the Horniman Museum (Reid, 1989; Teugels *et al.*, 1992).

Reception

There is a reception centre at the base of the stairs leading to the new exhibition. This incorporates a dispenser system for 'sound wands' (1) which provide a conducted tour through the gallery operated by a passive infra-red radiator system. Although critical as an introduction to the exhibition, the reception centre was, in fact, one of the last areas to be installed. It is designed with a view to being operated by an attendant who would regulate the large flow of visitors through the automatic doors to the exhibition foyer. At the discretion of the attendant, the automatic doors can be closed, allowing time to retrieve sound wands deposited by visitors at a collection point by the exit to the gallery. Fold-down facilities for dispensing literature are incorporated here, as well as a small 'shop window' which advertises merchandise available in the museum shop such as mugs, t-shirts and books - all with an aquatic theme. For security reasons, a cash register was not installed at the entrance.

Overall, the reception centre works well but the attendants find that adults (more so than children) can have trouble in operating the sound wands to the best effect. For safety there is no distracting sound commentary on the steep entrance stairs, an omission which irritates a proportion of visitors. The sound wand system differs from other audio guides in being specific to zones set within the exhibition. Visitors can return to the same point as often as they wish for a repeat of the message. There are several communication channels so that non-standard tours can be incorporated to cover, say, school parties or foreign languages. There is also a sound booster for the hard of hearing.

Water resistant graphics are installed throughout the gallery. These panels were designed as 'stand-alone' interpretation rather than as a supplement to the audio guide commentary. If the audio-guide is not in operation, for whatever reason, the visitor still has sufficient information to understand the display fully. The text is laid out in 'newspaper format' with eye-catching headlines, summary introductions, short sentences and short line-lengths; an average reading age of 13 years was aimed at. While the main theme of the displays is not taxonomic, basic identification graphics are included in each panel.

Conservation centre

The 'Living Waters' project first started with the development of a back-up facility to support the display and to serve as a Conservation Centre on view to visitors. Laboratory benching was retrieved from a disused local school. Modern filtration and water purification equipment was installed with a total recirculating volume of more than 14,000 litres (or 14 metric tonnes). The floor had to be reinforced with concrete to cope with this weight. Initially, much of the labour for development was provided through a government employment scheme and the back-up and animal kitchen services became fully operational in 1989. A review of the advanced aquarium technology in use is provided by Fletcher (1992). Essentially, three different aquatic

environments are controlled in the Conservation Centre and redistributed to the gallery: tropical freshwater, tropical marine and temperate marine. A localised unit on the gallery itself caters for a small British freshwater display. More than 90 individual tanks linked to reservoir systems are in operation behind-the-scenes and these are used as quarantine and breeding spaces.

A research programme centering on captive breeding was developed in the new facility. This mainly concerns rare and endangered cichlid fishes from Lake Victoria, East Africa, threatened with extinction due to the careless introduction of the predatory Nile perch into their habitat. The captive breeding programme established at the Horniman has contributed to our knowledge of basic cichlid biology and brought several species back from the brink of extinction. The origin and scientific development of the Lake Victoria conservation programme is detailed by Reid (1990a, 1990b) and popular reviews are provided by Smith (1990) and Tudge (1990, 1991).

The Conservation Centre is really the first 'exhibit' and it represents the 'heart and lungs' of the Living Waters experience. The public are fascinated by the hi-tech life support systems and the view of staff behind a glass partition working on various breeding programmes, such as that for Water Dragons, endangered aquatic reptiles from South East Asia. The first products of breeding - the eggs and larvae of invertebrates, fish, amphibians and reptiles - are on display in a glass 'incubating' cabinet.

Main gallery

The main gallery is 21 metres long and only 2.7 metres wide and lies at the head of a long and steep flight of stairs. Otherwise unusable, the stairs were utilised to make the 'Worlds' River' - an imaginary journey upstream showing the kinds of fish populations living at different points and the adverse effects that humans can have on them. The mirrored wall opposite increases the sense of space in the narrow corridor and reflects rippling highlights. Wave-formed ceiling panels extend up the stairs and through the main gallery. The elaborate acrylic cascade which forms the 'Worlds' River' is run on a partially deionised water supply to prevent hard water calcification on the clear panels and subsequent scratching during cleaning. Fluidised sand in a large acrylic column at the head of the stairs purifies the water in the cascade and the incessantly shifting particles fascinate visitors. Special disabled access was built into the stairway and, indeed, the viewing needs of the physically handicapped public, parents with pushchairs and small children were carefully considered prior to construction. In particular the main tanks are floor to ceiling so that the smallest and tallest visitors can see equally well. Other low-level open tanks provide the sounds, movement and smells of particular habitats and so enhance the experience.

Work began in the main gallery in 1990 and all the old tanks were stripped out (some of the historical Edwardian slate tanks were found behind the gallery facade). New all-glass tanks were manufactured in Germany by the Laging company and supplied in Britain through Aquamagic (2). On delivery, the tanks had to be hoisted into the building using a large crane. They were

then set into place in a specially designed fibre glass tray which would contain any leaks. Once the tanks were installed, an elaborate wave-form facade was fabricated around them. The tanks were, for safety, filled up under test by the local fire brigade. The largest tanks hold 1000 litres (or 1 metric tonne) and so the glass is triple laminated and 6 centimetres thick. Computer simulations of the pressure characteristics of the new tanks were conducted by consulting engineers who found the tanks to be fourteen times within safety limits. Even so, in the two metre deep tanks serious problems did arise with the silicone rubber adhesive holding the glass panels together and one tank leaked. An improved two-part formula adhesive has now been substituted in the critical tanks.

The first main exhibit concerns the Horniman Museum expedition field project in Korup rainforest, Cameroon. The scientific results of the expedition are discussed by Reid (1989) and Teugels, *et al.* (1992). A modest attempt was made, with the help of Kew Gardens, to re-create a jungle pool in the gallery. An oscilloscope display screen was used to track the electrolocation signals given out by elephant fish (mormyrids), typical of gloomy jungle streams. The relationship between fishes and forests is picked up in other exhibits in the same module : 'the hidden world of blind cave fish', 'piranha threatened' and 'monster lake, monster problem'. The latter deals with the Lake Victoria problem. All of the cichlid fish on view are extinct or near extinct in nature and were bred in the Conservation Centre.

The next module in sequence concerns 'coastal conservation ... local shore life and fisheries under threat'. Here, in the 'relating to rockpools' tank, are common inshore fishes and invertebrates that are becoming rarer due to pollution and overfishing. The cliff face backdrop was modelled in fibreglass from a real rockface on the south coast. High and low tides are simulated using a valve system fed from behind-the-scenes by a reservoir chilled to the appropriate temperature with a titanium coil. Wave effects are created by a simple dump bucket flushing down a tube. This system and others in the aquarium were developed by Philip Mayfield, aquacultural engineer (4). Some realistic seaweed models made in California by Carl Gage were used (6). There has been some success in maintaining real seaweeds in this section, and snakelocks sea anemones also do particularly well under special lighting conditions which favour the symbiotic algae that lives in their tissues.

The next exhibition module of five tanks concerns 'Coral in Crisis'. Digital readouts from the electronic systems monitoring critical water quality are on display in a perspex box. These systems supplied by New Technology (3) are linked to a computer for data logging. 'Vanishing variety' is the first tank in the sequence showing the colourful diversity of reef fishes and threats posed by destruction of coral reefs and global warming.

A detailed look at reef symbiosis is provided in 'Partners in trouble' - a 'desk top' tank which can be viewed from above. Cleaner shrimps which pick parasites off fishes can, for example, be viewed in great detail at their 'station'. A plankton tank and a seahorse tank, illustrate the close link between primary production on a reef and specialised feeders - a fragile relationship easily disrupted by pollution. The final showpiece is a 'Living Reef' tank

formed around a suspended acrylic plate using a special non-toxic polyurethane foam, kindly donated by New Technology. Living corals are embedded in the foam and gradually colonise it. Reef currents are simulated by oscillating pumps and sunlight by a special sealed-beam unit incorporating high intensity metal halide and actinic blue luminaires. The unit has a built-in timer control so that day length can be varied. In the evening, just before the visitors leave, a 'moonlight' function switches on revealing nocturnal activity on the reef.

The last section brings the visitor back home to look at our disappearing waterlife. London has lost 90% of its ponds since Victorian times with more lost every year. A small open pond display highlights the diversity which still exists in a few places and which needs conservation. Medicinal leeches are used as an unusual example of a medically important animal now extinct in most parts of Britain. Crayfish in the adjacent display represent the most threatened freshwater animal species in southern England: displaced in nature by introduced foreign crayfish and an associated disease. The last tank in the exhibition is 'Pure Rubbish', established to contrast the beauty of living waters with man made pollution.

Altogether, more than thirty contractors were involved in the construction of Living Waters, with most of the main framework being provided by Carlton Beck. The problems of working within a Grade 2 listed building were considerable. Also, to conform with new Museums and Galleries Commission Standards (Reid, 1992), the entire exhibition was designed as a discrete air-conditioned unit more-or-less separate from and not seriously impinging on atmospheric control in the rest of the museum.

Living Waters has gained several favourable reviews (Januarius, 1991; Fletcher, 1992; Newmark, 1992; Wheatcroft, 1992) and, indeed, has been described by the Horniman's Director (Boston, 1992) as: 'the best example of what we have achieved so far under independence ... it has received high praise and an influx of visitors, with queues at the weekends.'

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Footnotes

(1) Sennheiser UK Ltd (sound wands), B2 Knaves, Beech Business Centre, Londwater, High Wycombe, Buckinghamshire, HP10 9QY Tel.0628 850958

(2) Aquamagic Ltd (tanks), Marine House, Market St., Watford, Hertfordshire, WD1 7AN Tel. 0923 39637

(3) New Technology (N T Laboratories Ltd) (aquarium systems). Unit 3, Branbridge Industrial Estate, East Peckham, Kent, TN12 5HS Tel. 0622 871387

(4) Philip Mayfield & Co. Ltd (aquacultural engineering), 7 Harefield Rd., Rickmansworth, Hertfordshire, WD2 1LY Tel. 09237 75272

(5) John Toovey (zoo architecture), Toovey Lane Consultants, Ashcroft, Ashley Green, Chesham, Buckinghamshire, HP5 3RB Tel. 0442 864202

(6) Carl Gage Biological Models (seaweed models), 198 North Lima Street, Sierramadre, CA 91024, USA Tel. 0101 818 355 4680