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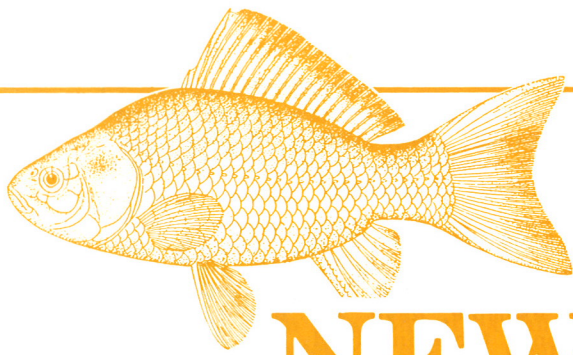
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NEWSLETTER



Vol 4 No 10

Live Animal Displays in Museums - the Lower Vertebrates

Proceedings of the BCG meeting held at Coventry Museum on 25 September 1987: five papers on the legal and practical aspects of keeping amphibians, reptiles and fish for public display.

and not to let the prime motive become obscured when reading through pages of dense legal terminology and official jargon.

Five main sub-principles can be discerned in the published literature, either separately or in various combinations. Two of these relate to the currently perceived 'public functions' of a zoo, ie Recreation and Education. A further two sub-principles can be distinguished regarding 'private or wider functions' ie Scientific Study and Wildlife Conservation. The remaining sub-principle concerns Health and Safety for the visiting public and for people employed by zoos. In short, the key aim of the legal or codified documents under discussion is to promote animal welfare, consistent with a zoo's public and concealed functions and the health and safety of visitors and staff.

Because the sub-principles mentioned above are interlinked, the individual upholding laws cannot be considered in isolation. Some of the definition of current zoo licensing legislation, for instance, comes from separate health and safety and conservation codes. While the underlying principles remain, it should be noted that with many legal statutes there can be subsequently appended modification orders and revised schedules which may alter the original intentions, coverage and application of the law. For example, the idea of what constitutes a 'wild', 'dangerous' or 'endangered animal' will change when particular species become added to or removed from existing schedules.

1 Law, Ancillary Documentation and Live Animal Displays

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Background

The Secretary of State for the Environment provides a list of over one hundred items of legislation of likely or possible relevance to a zoo operation (DoE, 1984). There are many more laws, codes of principles and practise and policy statements or guidelines which are not listed but which may have to be considered in relation to captive wildlife, the staff who look after the animals and the public who view them. Museum curators with responsibility for live animal collections may, understandably, find these various, often voluminous and sometimes apparently contradictory documents difficult to comprehend and implement. This paper seeks to indicate and interpret some of the most important and recent literature in this rapidly developing field and anticipates likely areas for future legislation. Although much of the current regulatory literature is of general application, the group of animals particularly referred to here are the 'lower vertebrates' - fishes, amphibians and reptiles.

Law and underlying principles

Law is a body of enacted or customary rules recognized by a community as binding. Although it may not always be evident, there is usually a definite principle upon which any particular law or code is based. The driving principle behind the confusing diversity of present zoo-related documentation is, of course, the welfare of animals in captivity. It is important to remain conscious of this

Law-making and the consultation process

From the above, Law is characterised as a body of rules or principles widely accepted by a community. In this particular context the 'community' is, essentially, those in museums and zoos involved in the management of live animals and also, ultimately, the employing authority (often a local or national authority but possibly a private body). Laws are usually made by (and modified or repealed by)

members of the community in conjunction with a legislative body (often acting for the government but possibly operating at a local or international level). Before a law comes into force there is usually a process of consultation between the legislative body or enforcing body and the community involved. Thus, current zoo licensing regulations (see below) came into force by an Act of Parliament only after an extensive process of consultation organised by the Department of the Environment and mediated through the National Federation of Zoological Gardens and other organisations. Similarly, the transfer of enforcement responsibility for the Health and Safety at Work Act in respect of zoos (see below) only took place after the Health and Safety Commission had circulated a consultative document containing draft regulations and guidance notes. Laws affecting live animal displays are thus, to some extent, what individual animal managers want them to be and 'bad' legislation or overly legalistic documents may simply be a result of apathy in that community and a lack of participation in the law-making process. There is certainly no reason to view the laws relating to live creatures on display as some kind of bureaucratic encumbrance imposed by a higher authority on animal managers.

Sometimes a main outcome of the sort of consultation exercise described above is policy statements, guidelines, recommendations, approved lists or other codified documents. This literature will often represent the 'spirit' of the statutory law and the customary practises to be associated with it; and so it will serve as a basis for interpretation. For example, the Zoo Licensing Act (see below) is itself a tersely worded eighteen page document; but the Department of the Environment provide at least ten other documents to assist in interpretation and implementation, including a Note on Environmental Education in Zoos and a bulky paper entitled: The Secretary of State's Standards of Modern Zoo Practise. Although such relatively informal documents can never serve as a legal substitute for the text of the Act itself (failure to comply is not necessarily an offence), the greatest opportunity for community participation lies in making a contribution to their formulation.

There would be few in the museum or zoo community who consider that every aspect of the management of living exhibitions is satisfactorily regulated at present. Vivarium keepers are, for example, regularly placed under pressure to accept into their displays red-eared terrapins *Chrysemys scripta* or large fishes such as *pacu Colossoma nigripinnis*. These are offered by members of the public who are no longer able to cope with their charge. This chronic situation arises from the unregulated bulk importation of these animals into this country (see section on 'conservation legislation', below). Certainly, the 'community' strongly disapproves of this lack of import control, but how many individual animal managers have expressed this view in writing to the Biology Curators Group (as a mediating body) or to officials of the

International Branch, Department of the Environment who administer the laws concerning the import and export of animals?

The common consequences of a lack of individual and community action are that animals suffer and/or animal managers suffer. How often, for example, have we heard the complaint, among those involved, of the lack of a career programme and training structure for keepers of aquaria and vivaria in museums? Unfortunately, the Biology Curators' Group and its individual members were not conspicuous in their contribution to a recent Government report by a working party of the Museums and Galleries Commission entitled: Museum Professional Training and Career Structure. As a consequence, there is in that otherwise worthwhile report no consideration of the very special training needs of those who care for live animals in museums (HSC, 1984: 8) and of the difficulties in getting that training within the existing Museums Association framework. Let us all ensure, then, that an appropriate contribution is made to the Museums and Galleries Commission before the recommendations of their working party become Government policy and before certain principles derived from these recommendations become codified documents.

Primary animal welfare legislation

Much has been written on the subject of the law in relation to the basic welfare of captive animals and many aspects of this are well summarised by Sandys-Winsch (1978) and Cooper (1979a, b; 1980) and in a document published in 1976 by the Universities Federation for Animal Welfare. The Cruelty to Animals Act, 1876, is a venerable early item of legislation (enacted law) which is primarily concerned with the welfare of captive animals undergoing experimental treatments. Lower vertebrates would here be included in the concept of 'laboratory animals'. It is unlikely, however, that experimental procedures of the sort likely to raise questions of cruelty would be conducted in a museum zoo situation. Benign investigations such as breeding programmes, which do not involve marked discomfort, would not be regarded as 'cruel'; but a study on feeding which involved starvation could be seen as 'cruel'. The use of hormones by injection to induce spawning would, however, not normally be interpreted as cruel in that the action of the hormone is predictable, the procedure relatively painless and the outcome 'natural'. The Animals (Scientific Procedures) Act, 1986, demands an assessment of pain, distress or discomfort so that rational conclusions can be drawn over acceptable levels. Methods of estimation are now under review by the BVA Animal Welfare Foundation.

The protection of Animals Acts, 1911-1964 are more broad-ranging than the Cruelty to Animals Act; they allow for more severe penalties for infringements and they protect both domestic and captive wild animals. They proscribe intentional cruelty or that resulting from an act of omission (eg a failure to provide

appropriate shelter for a reclusive species). The intention is evident that a captive wild animal should not suffer as a result of its confinement. More recently, the Abandonment of Animals Act, 1960, legislates against leaving an animal in an uncared for situation which is likely to cause unnecessary suffering. In this context, a failure to feed or water livestock over a weekend could possibly be interpreted as 'abandonment'. The Veterinary Surgeons Act, 1966 has important animal welfare implications for animal managers in museums. This Act requires appropriate veterinary consultation and treatment if a mammal, bird or reptile falls ill. Fish and amphibians are not included in this reserved group and so, here, the animal keeper apparently has the right to treat a sick charge without recourse to a veterinary surgeon. This would accord with the customary situation where the animal keeper has acquired a specialised expertise in disease recognition and treatment, whereas the veterinary surgeon will often have a limited knowledge of sickness in lower vertebrates and of the remedies available to effect a cure.

Legislation and the proper conduct of zoos

By far the most important piece of legislation directly affecting live animal displays in museums and zoological gardens is the Zoo Licensing Act. This is 'an Act to regulate by licence the conduct of zoos'. It came into force on 27 July, 1981 and it applies to all of mainland Britain but does not extend to Northern Ireland. It contains twenty-three sections concerning the licensing process, the Secretary of State's functions/standards, inspections, special cases, fees, enforcement and supplementary information. Fundamentally, it concerns all of the five underlying principles stated above. These principles have a wide international acceptance and they are already embodied in codes produced by the Federal Zoological Control Board in the United States of America (Pronek, 1976).

The detailed implications of the Zoo Licensing Act for museums with live animal displays have already been discussed by Reid (1984). It is now a declared aim of the Biology Curators' Group to (section nine): 'promote advances in the display and maintenance of living museum collection (zoological and botanical). In the case of live animals, to conform with the Secretary of State's standards for zoo licensing which require a high level of husbandry and which emphasise the role of licensed establishments in recreation, education, scientific study and conservation (captive breeding)' (Stansfield, Mathias and Reid, 1987).

By now, all museums which house a live animal display, however modest, should (following an application and inspection process) either be licensed as a 'zoo' under the terms of the Act or have been granted an exemption. If neither course of action has so far been taken then the museum or the employing authority (the putative 'zoo operator') is guilty of an offence and is liable to prosecution. It

should be stressed that exemption from the provisions of the Act cannot be presumed - it must be applied for.

The debate over exemption from zoo licensing

The question of whether an institution should go for licensing or for an exemption has provoked considerable debate in museum circles and different institutions have adopted different policies. For example, the Herbert Art Gallery and Museum, Coventry, applied for an exemption, while Bolton Museum and Art Gallery, Merseyside County Museums and the University of Manchester Museum all went for licensing. The Horniman Museum, London, initially applied for exemption and then, following a change in policy, sought a licence. One advantage of this mixed approach by museums is that firm precedents have been established for both options and so, in the future, no single museum should be forced to adopt a course of action in licensing which does not suit institutional policies. Whereas Reid (1984) strongly advocates licensing, an excellent summary of the case for exemption (and the advantages and limitations imposed by the granting of it) is given by Wright (1985). However, both authors are agreed that, even in instances where an exemption is applied for and gained, the Secretary of State's standards for licensing should still in large measure apply for the ongoing management of the unlicensed facility. Exemption is no excuse for shoddy displays, a lack of educational interpretation and poor quality animal husbandry.

In cases where the living displays are of a relatively limited size and scope, there may well be economic and administrative advantages in gaining exemption - as indicated by Wright (1985: 66; 1987: 137). But, for a small facility, the excessive costs of a full inspection can be radically reduced by applying (under section 14.2 of the Act) for a dispensation. Applications for an inspection limited under section 14.2 must first be channelled through the Department of the Environment. The DoE may, in turn, advise the Local Authority that sections 10.4a and 10.4b shall not apply. It would, however, be unlawful for an exempted (unlicensed) establishment then to develop an active role in research on and conservation of endangered species through captive breeding (two prime functions of a properly constituted zoo); or to afford such species shelter, were customs authorities to offer animals seized as illegal imports (as quite commonly happens).

A major reason for becoming licensed is the gaining of 'official status'. Official status is of value in formally reassuring members of the public, the media and animal welfare groups that the holding establishment accepts and conforms with currently accepted high standards. It should be understood that an exemption is always liable to be reviewed. An advantage for the curator employed by a licensed institution is that he or she has the opportunity fully to develop displays and adopt a wide-ranging livestock acquisitions

policy without the lingering fear of possible infringements of the Act. Very importantly, an otherwise reluctant employing authority may be galvanised into making funds available for any development or refurbishment work necessary to meet their statutory responsibilities in licensing. Last, the issue of 'animal rights' is now a subject for hot debate (see Lewisham Animal Charter, 1984) and there is now a growing public and official scrutiny of zoo set-ups and, in some cases, a pressure for their closure. It is a particular advantage here to have a license as a formal bulwark against actual and potential critics.

Health and Safety legislation

Common sense, morality and ethics dictate that no live animal display should be mounted which poses a real threat to the health and safety of the animals, the zoo-keeping staff or the viewing public. This basic principle is embodied in the Zoo Licensing Act (above), in the Dangerous Wild Animals Act, 1976 and in the Health and Safety at Work etc Act, 1974 - all of which laws operate in concert. The most immediate and obvious risk to staff and public are dangerous wild animals. Venomous reptiles (usually exotic snakes) pose a most obvious and dramatic threat, owing to their ability to escape and survive outside their enclosure. Animal managers holding such creatures should be acutely aware of their responsibilities under current codes (eg see HSC, 1985, para 53). The Department of Health and Social Security in document HN(86)9 updates the guidance (originally provided in HN(78)13) on the arrangements for the supply of snake antivenoms for treating foreign snake bites. A paper on the nature and availability of 'emergency drugs' (Meredith, Caisley and Volans, 1984) should be read in conjunction with the DHSS guidelines. It should be noted that, where an institution has been granted an exemption from zoo licensing, it cannot normally act as a holding facility (temporary or permanent) for venomous or otherwise dangerous animals (as scheduled under the Dangerous Wild Animals Act) such as may be occasionally referred to a museum by customs, police, the RSPCA and fruit importers. Should there be a requirement to hold any dangerous creatures in a 'zoo-exempted' establishment then a separate licence could be applied for under the Dangerous Wild Animals Act. The Horniman Museum Aquarium and Vivarium, for example, was until 1985 licensed under this Act by virtue of the presence of spectacled caiman (Caiman crocodilus).

The Dangerous Wild Animals Act and the HSW Act adopt slightly different views as to what constitutes 'dangerous; or 'hazardous' and this is an area for concern and, hopefully, reform. For instance, the deadly venomous stonefish Synanceja trachynis is, presumably from its lack of mobility and its usual containment in an aquarium, not scheduled under the Dangerous Wild Animals Act. But such an animal does not have to escape to be very hazardous and its cryptic colouration makes it a particular danger to

those having access to its tank. A careless or naive member of staff or a curious member of the public could possibly die if accidentally envenomated (Weiner, 1958; Southcott). Certainly, accidents (fortunately minor) involving venomous fishes other than stonefish have occurred in museum and zoo circles in the past. Probably in broad recognition of this infrequent sort of circumstance, the concept of 'hazardous' in HSW terminology would include venomous fishes as well as scheduled dangerous animals. Aquarium and vivarium managers should be aware that newly formulated antivenoms are now available for a wide range of lower vertebrates, including stonefish. The Horniman Museum Aquarium, for example, displays stonefish and holds a specific antivenom, obtained from the Commonwealth Serum Laboratories, Melbourne, Australia.

Most animal managers are far more likely to be electrocuted than envenomated and the perilous state of 'non-splash proof' or salt-encrusted electrical installations in many public aquaria and vivaria is well known to those staff placed at risk. There is a real need, here, for biology curators to press for mandatory high safety standards to apply to electrical installations. There is, for example, as yet, apparently no legal requirement to install residual current circuit breaking devices (RCCD's) and yet severe injury or loss of life could easily result from their omission from a circuit.

The Health and Safety at Work etc Act, 1974 is the primary legislation concerning human health, safety and welfare at zoos. The HSW Act, however, would in this context now be interpreted through the Health and Safety Commission Document: Zoos - Safety, Health and Welfare Standards for Employers and Persons at Work. This recent paper includes 59 sections which deal with topics such as: enclosures for hazardous animals, access provisions for enclosures, systems of work, escapes of animals, instruction, training and supervision of staff, veterinary procedures and aspects of basic health, welfare and sanitation. Matters of routine hygiene often seem obvious, and so a sensible member of staff would normally wash his hands following any risk of exposure to disease (eg Salmonella from reptiles) (see HSC, 1985, para 51). But how many operatives adopt customary veterinary procedures and carry out this operation using a powerful bacteriacidal soap (eg 'Hibiscrub') and use a scrubbing brush which is less than three months old? Also, how many animal managers are aware that routine monitoring of bacterial and fungal contamination of water (fresh and salt) can now easily be carried out using commercially available 'dipslide' tests? The standards for tapwater are already subject to international agreements and so one can anticipate that in the case of aquarium and vivarium water quality, specific permitted levels of recirculated or standing pollutants (eg ammonia, nitrite, nitrate, phenols) will eventually be introduced (eg see Franks, 1985).

The disposal of animal waste, post-mortem material and clinical wastes (swabs, scalpels,

needles) is also an area for increasing regulation. An acute public awareness of the fearsome risks of being pricked or cut by a contaminated needle or scalpel has only developed in the last few years. The environmental health departments of some local authorities may be willing to organise a special waste collection service, while in other circumstances private veterinary incineration companies may oblige. For some years there has been a high level of concern over incidents arising from the handling of such material and guidelines now exist on safe procedures, including the colour coding of bagged waste (HSC, 1982). The procedure for the disposal of waste from veterinary and allied establishments is apparently still under review by the Department of the Environment and other bodies (Oakland, D and Hooper, J, 1985).

Legislation and nature conservation

One of the declared objectives of the Biology Curators' Group is (section 9): 'To review and to seek to improve the ways in which natural history museums provide a service to the community including their role in disseminating information about the natural environment in conservation education.' (Stansfield, Mathias and Reid, 1987). Echoed here are the recreational, educational and conservation principles which underpin current zoo legislation. More than any other category of biology curators, animal managers in museums and zoos are uniquely placed to communicate conservation issues to the public through stimulating and dynamic living displays, particularly those which involve the products of captive breeding. The role of captive breeding as a major strategy in the conservation of fish species is stressed by Maitland and Evans, 1986, who also note that: 'despite the interest shown by zoos in the captive breeding of threatened mammals, birds and reptiles, little interest has been shown by public aquaria (including those maintained by zoos) in the breeding of threatened or rare fishes'. Indeed, few public aquaria which responded to a survey by Evans, 1982, showed any enthusiasm for displaying fishes of conservation importance or of breeding from them.

There are some signs of widespread and growing concern over the above problem. The Species Survival Plan of the American Association of Zoological Parks develops strategies for the conservation of lower vertebrates (McClain, 1985). This year (1987), for the first time, a proposal will be raised at a symposium of the European Association of Aquarium Curators (Löbbecke Museum and Aquazoo, September) to establish a programme for the captive breeding of fish, amphibians and reptiles. Similarly, the 2nd International Congress of Aquariology (Monaco Oceanographic Museum, February, 1988) are adopting 'conservation' as one of their conference themes. Last, as part of an international scheme, a Fish Rescue and Breeding Centre has been established at the Horniman Museum Aquarium to tackle some problems in the conservation of the endangered

cichlid fishes of Lake Victoria (Reid, 1987). However, the ability of this and other zoological institutions in Britain to offer shelter and accommodation to endangered or vulnerable lower vertebrates, to study them, breed from them and (where ecologically viable and desirable) to re-release to the wild, is now dependent on these institutions being properly licensed as a zoo (see above). There is also a requirement, here, for live animal displays to conform with the current relevant conservation legislation.

In the absence of captive breeding programmes, animal managers must ever look to wild stocks to replenish or develop their living displays. The removal of wild animals from their natural habitat simply for exhibition purposes poses considerable moral, ethical and, ultimately, legal problems. Limitations on re-stocking from native populations of lower vertebrates are given in the Wildlife and Countryside Act, 1981. Displays of sand lizards *Lacerta agilis* or midwife toads *Alytes obstetricans*, for instance, could not now be mounted without special permission (CoEnCo). The detailed implications of the Wildlife and Countryside Act for museums have already been the subject of a joint Biology Curators' Group/ Museums Association seminar held at the British Museum (Natural History) in 1982 and reported on by Stansfield (1983). There is also a useful summary of this Act given by the Nature Conservation Council (1982).

The animals on display in most museum aquaria and vivaria will often be exotic in origin and have been imported into this country. In order to import live freshwater fish it is necessary to obtain a licence under the Diseases of Fish Act, 1937 (as amended under the Diseases of Fish Act 1983, c 30). An application form for this purpose (DO7) can be obtained from the Ministry of Agriculture Fisheries and Food. The importation of certain species of fishes (though not freshwater tropicals or marines) will require an independent health certificate. A health licence does not remove the necessity to obtain a conservation import licence for the fish specified in Part 2, Schedule 1 of the Endangered Species (Import and Export) Act, 1976. In this connection, applications should be directed to: Department of the Environment, Wildlife Conservation Licensing Section, Tollgate House, Houlton Street, Bristol BS2 9DJ. It is an offence, under the Wildlife and Countryside Act, to release or allow to escape into the wild any fish or eggs covered by any of the above licences. A licence to effect such a release under this Act can, however, be obtained from the Ministry of Agriculture and Fisheries.

Trained personnel to carry out rapid and accurate identification are crucial to the exercise of import regulations and other legal controls over the content of live animal displays. Wright (1985: 63) has already pointed up perceived shortcomings at the Department of the Environment with respect to taxonomic expertise. Competent herpetile and fish taxonomists (quite likely museum

employees or government officers with museum training) need to be readily available to scrutinise shipments at the point of entry. Until this happens, unscrupulous livestock traders will be able to flout the law, almost with impunity. Also, the British Veterinary Association Animal Welfare Foundation consider that there is a prime need to review and consolidate the lengthy and complex legislation relating to the transport of animals into the country and within the country and it is understood that the Ministry of Agriculture and Fisheries will undertake this task. With new legislation and close monitoring, the often high mortality rate among imported lower vertebrates could be reduced to a minimum.

International wildlife conservation is an area for increasingly strict regulation and, as crises develop in nature, zoological establishments can expect many revolutionary new laws or codes or modification orders which will restrict or ban the supply of particular wild animals. It is, for instance, easy to anticipate increasingly tighter controls being placed on the (presently unrestricted) bulk importation of common tropical marine fishes, following a recent report on the exploitation of coral reefs for the aquarium trade (Woods, 1985). It is certainly difficult to justify the continued importation of common but highly specialised coral feeding fishes which will undoubtedly starve in an aquarium and cannot be bred from. It is important to establish the principle that an animal which is not endangered or vulnerable in nature may still require protection by virtue of the difficulties involved in maintaining it in captivity.

Much of the pace, direction and content of global conservation law is set by the International Union for the Conservation of Nature. This organisation, which is the scientific 'twin' to the World Wildlife Fund, has a Commission on Law and Administration and it also supports an Environmental Law Centre in Bonn, West Germany, where conservation legislation is monitored. The IUCN Species Conservation Monitoring Unit in England is, among other roles, responsible for the production of the famous Red Data Books - which are international registers of threatened species (see eg Miller, 1979, for fishes and IUCN, 1982, for amphibia and reptiles). These registers are now used as schedules for the 1973 Washington Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) and the Migratory Species Convention.

The Conventions may be used to frame European Economic Community directives and to interpret or implement UK conservation legislation which, ultimately, has a close bearing on the proper operation and management of live animal displays in museums. The IUCN Commissions, for their policy making, strongly rely on information provided by their Specialist Groups. The Species Survival Commission, Fish Specialist Group is, for example, now preparing a worldwide strategy for fish conservation (Maitland in MS). Such

Specialist Groups depend, in turn, on the expertise, assistance and support of volunteers which often include museum personnel. There is, then, an ever present opportunity for biology curators involved with living displays to promote or prompt helpful new legislation and codes or suggest ways to better utilise the powers under existing legislation.

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Bolton Aquarium - its History and Development

T. Henshaw
Bolton Museum

The technical aspects of keeping fish are
advancing at an alarming rate, so that
equipment used today very quickly becomes
obsolete. This causes various problems in an
established museum aquarium.

Bolton Museum Aquarium was built in the
1930's to a design similar to that at Chester
Zoo. On completion there were sixteen display
tanks and five quarantine tanks. The fascia
was tiled and a brass rail kept people away
from the front glass. During the 1970's, when
the aquarium was given a facelift, the rail
was removed and a new fascia was erected in
front of the existing tiled one. Although
this allowed people to get 'closer' to the
fish, it also allowed diamond rings to scratch
the glass, graffiti to appear on the fascia,
as well as the inhabitants having to suffer
the sudden shock of people thumping the
glass. The facelift, therefore, was not
necessarily an improvement.

Originally each tank had limestone rockwork
cemented in place. This produced two very
useful results. As the tanks are made from
reinforced concrete the act of cementing in
rocks effectively sealed them from leaching
carbonates into the water. This extended the
life expectancy of the concrete. Also the
limestone, being white, reflected the light
back into the tanks making them appear very
bright. The one drawback was that all the
spaces behind the rocks were filled with
gravel and this created an area which could
not be effectively cleaned.

The filtration system employed at Bolton
consisted initially of wooden filter boxes in
which there was some medium - gravel/filter
floss. The boxes were probably sited under
the display tanks and water entered them by
gravity feed and was then pumped back into the
tanks. This was altered during the late
1960's and the filter box, now of plastic
design, was sited above the tank and a
submersible pump employed to move water from
the tank to the filter box. The filter medium
now being used is one of the following: foam,
filter floss and gravel or filter floss and
bio granules. It is still not fully
satisfactory and it is hoped to improve it
again in the future.

From the time of opening until the mid 1960's
the aquarium tanks were all connected so that
water could enter at one end of a run of
tanks, percolate through to the other end and
then leave and run away to drains. This is
known as an 'open' system. By and large it
can be a very effective system when operated
competently. However, because most museum
aquaria are considered low priority,
inexperienced staff are often employed and
there is an initial period when experience is
being acquired when things can go wrong.
Unfortunately during the 1960's things did go
wrong on a major scale and quite a lot of the