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# Towards a Co-Evolution of Zoos, Aquariums and Natural History Museums

Jon Charles Coe

CLRdesign inc.

Since 2003: Jon Coe Design, P/L

jon@joncoedesign.com

## Abstract

Nineteenth century zoos, aquariums and natural history museums had much in common. All were organized taxonomically, housed in imposing buildings and ignorant of ecological principles. Though these institutions have evolved enormously and often independently in the last century, recent exhibits in zoos, aquariums and museums show major parallels indicating a kind of unconscious co-evolution. This paper traces several major areas of similar development, illustrating historic and contemporary examples, considers the evolutionary advantage of these adaptations and offers some conjecture on where this convergence may lead.

## Introduction

Zoos and natural history museums have co-existed for a very long time. Since they are both organisms shaped by their environments and the changing tides of culture over the last 400 years and longer, it is not surprising that they and their more recent ally, the aquariums, have evolved somewhat in parallel. Some might assume, taking Darwinism narrowly, that such organisms, feeding from essentially the same food supply, must compete aggressively. Alternatively, they could diverge, maximizing their differences to avoid competition. However, anyone who has recently visited progressive zoos, aquariums and natural history museums will find that they have become amazingly similar and are generally flourishing. In looking briefly at the evolutionary history of these organisms and it's possible to see what parallels emerge to explain this convergence.

## Royal Collections

As early as 2500 BC, Egyptian royalty had collections of wild animals and, presumably, natural history curiosities as well. However, our investigation will begin in 1752, at the royal palace of Schonbrunn, where Princess Maria Teresa enjoyed breakfast surrounded, at a respectful distance, by her menageries. The animals were caged in the last word of Baroque symmetry, as a fitting expression of royal wealth, power and indulgence. Although the collection was opened to the public 13 years later, the association between captive beasts and royal buildings was well established. Zoo buildings built as recently as the 1930s still resembled royal hunting lodges, basilicas or domed cathedrals.

Royal curiosity collections were also common. Aristocrats such as Duc de Berry, brother to Charles of France in the 15th century, had a famous collection, as did Sr. Ferrante Imperto of Naples a century later (Wonders 1984, p. 321). Churches often had "curiosity cabinets" along with religious relics. These may in fact have been the first public natural history museums.

## Public Collections

Bear pits, such as at Berne and elsewhere, and traveling bear shows were not uncommon European spectacles. These "exhibits" were neither elegant nor scientific, but they seem to have been very popular. Their counterpart in the museum world was establishments like Copenhagen's Museum of Ole Worm (1585-1654) (Wonders 1984 p. 34) where curiosities of every description covered the walls and display cases. Again, the organizing concept was based upon whimsy and entertainment.

## Linnaeus and Taxonomy

The publication of Linnaeus' *Systema Naturae* in 1735 had a profound effect not only upon the way specimens were organized, but even upon the world view of scientists and collectors. The rush was on to see who could identify and name the most species or collect the oddest or rarest or most dramatic specimens; animals, vegetable or mineral.

Furthermore, the specimens and journals of such renowned expeditions as those of Captain Cook and Alexander von Humbolt in the 18th century and others spurred great popular interest in natural history. Popular museums, such as the facility opened by Sir Ashton Lever in London in 1775, were said to exceed even the earlier British Museum in public appeal, if not taxonomic rigor (Wonders 1984, p. 38).

Regents Park Zoo, founded in 1828 by the Zoological Society of London, is often considered to be the first of the modern zoos, combining scientific (taxonomic) organization, zoological research and public recreation. This organization format has been widely embraced until most zoos had at least some "systematic" groupings of animals. Designations such as; "Carnivore House," "Reptile House," "Aviary," etc., are still very common. They are directly comparable to the "Hall of Birds," "Hall of Mammals," "Hall of Dinosaurs," etc., found in most museums of natural history.

Taxonomic or systematic exhibit organization allows careful comparison of anatomy and physiology. It is obviously ideal for taxonomists, clearly suggesting its origins. Museums eventually developed a dual display concept. Scientific specimens, organized according to strict phylogenetic order, are kept in back rooms for study by specialists. Separate exhibits,

organized for popular observation, are featured in the public halls. Obviously, such a double system is impractical for larger zoo animals, though often collections of smaller birds, reptiles and fish may be kept aside for special study and research.

## Habitat Exhibits in Museums

The habitat exhibits and dioramas of which our best museums are so justly proud probably had their origins in the extravagant attractions of William Bullock, an amateur naturalist who opened his collection at Piccadilly in London in 1809, "...where it quickly became a fashionable place of amusement, attracting more than 80,000 people in its first few months" (Wonders 1984 p. 51). These taxidermic exhibits included artificial plants and painted backgrounds.

In the United States, Charles Wilson Peale's celebrated collection opened in 1784 in Philadelphia and remained for 70 years (Wonders 1894 p. 44). Peale was dedicated to public education and sought to make his exhibits attractive, as well as systematically arranged. Peale was a painter, and it was natural for him to conceive the idea of putting painted landscapes in the back of some of his grass-fronted cases, displaying the natural habitat of the birds presented. This idea did not emerge again until almost 100 years later, when the British Museum developed the technique of presenting mounted birds in life-like poses surrounded by artificial props to simulate the habitat from which they are collected. Director Sir William Flower commented upon this approach:

*"Artistic reproduction of natural environments, illustrations of protective resemblances or special modes of life, all require much room for their display. This method of exhibition, wherever faithfully carried out, is, however, proving instructive and attractive, and will doubtless be greatly extended"* (Flower 1898).

The American Museum of Natural History installed a series of American songbird exhibits in 1901 which included very detailed and realistic nesting situations with painted backdrops. These displays, arranged under the direction of Frank Chapman, Curator of Ornithology, were so well received that other larger and more elaborate exhibits of colonial birds were soon completed, including the popular Egret Group and Pelican Group. Both these species were severely threatened at the time and the exhibits were intended to convey a strong conservation message (Wonders 1984).

In the same year that Chapman completed his earlier bird exhibits, Carl Akeley completed his four-seasons "Virginia Deer Group" at The Field Museum in Chicago, which utilized "...background painting to produce a more complete ecological environment" (Wonders, 1984 p. 115).

The great period of museum dioramas and habitat groups had begun and would last for the next 40 years until World War II. The great expense of such exhibits reduced their popularity among museum directors, if not the public. Carl Akeley's Hall of African Mammals at the American Museum of Natural History was praised in a contemporary article in *Time* magazine for its "...zoo-like panoramas" (*Time* 1942).

William Hornaday and F. A. Lucas, along with Akeley, were the chief architects of the habitat group/diorama movement. Lucas, a noted taxidermist in his own right, was appointed Director of the American Museum of Natural History in 1911 and immediately hired Akeley. William Hornaday, also a noted taxidermist and exhibit designer, was appointed director of the New York Zoological Park in 1896. One of his first moves was to develop an exhibition of

trophy heads (Wonders 1984, p. 137; Bridges 1974).

## **Habitat Exhibits in Zoos and Aquariums**

The concept of natural habitat exhibits for zoo animals probably was first proposed in 1801 by the French Count of Lacepede when he stated that the ideal zoological park "...is not an accumulation of buildings or birdcages or cages with bars but it constitutes a true scenery" (Van Den Bergh 1962). The concept that large natural exhibit areas would benefit the animals' well-being was also proposed by R. L. Gardner (1896) very early on. However, this conception was not to be realized until Carl Hagenbeck opened his tierpark at Stellingen near Hamburg in 1907. Hagenbeck, who already owned a popular circus and menagerie, created magnificent outdoor panoramas of towering landscapes reminiscent of the romantic European painters Loraine, Poussin and Rosa several centuries before. Typically, his panoramas featured foreground exhibits of waterfowl and wading birds, with hoofstock in the middle distance and large carnivores or alpine goat species on the jagged background pinnacles.

Hagenbeck's panoramas were a sensation and he repeated his triumphs at the Jardin des Plantes in Paris, working still with his chief technician, Urs Eggenschewiller, who developed several techniques of creating artificial rockwork still in use today. The first moated exhibit for large animals in the United States was created by Carl Hagenbeck at the St. Louis World's Fair in 1904. The exhibits are said to have featured a polar bear, a walrus and an Eskimo (Hoessle 1986, personal communication).

In 1918, Victor Borchardt, an exhibit designer with the Denver Museum of Natural History, created a highly realistic bear grotto in the Hagenbeck style at the Denver Zoo and soon after created a series of very handsome similar exhibits at the St. Louis Zoo (Freiheit 1986, personal communication). These exhibits were made from plaster castings taken from limestone outcrops along the Mississippi River. Bridges (1974) commented that these grottos are "...the first extensive dens of their kind in the country and are still striking." This is the first example I've found of a museum person actually constructing zoo exhibits.

Interestingly, Hornaday, director of the New York Zoological Society and himself a superb designer of museum habitat exhibits was unenthusiastic about the Hagenbeck approach because he felt moated exhibits put the animals too far away from the public to "...study to the best advantage." He added, "I think that the St. Louis Zoological Society is making a great mistake in putting all of its money into costly piles of rock and concrete to shelter far distant animals" (Bridges 1974).

Nevertheless, the influence of the Hagenbeck approach continued to spread. In 1922, E. J. Flavin, a chief engineer for Chicago's Forest Preserve, worked with Hagenbeck's sons, Lorenz and Heinrich, in Stellingen on plans for the proposed zoo at Brookfield, Illinois. These projects were completed in 1934. Lorenz Hagenbeck came to Detroit in 1927 where he helped to realize America's most complete example of his father's concept, which was built in the early 1930s (Austin 1986, personal communication).

Like the earlier popular dioramas of Bullock, Hagenbeck's emphasis was creating a romantic visual spectacle rather than showing true ecological relationships, although he did pioneer the predator/prey exhibit. But unlike the best museum habitat groups of the day, zoo visitors were allowed to actually enter the diorama or habitat, an idea 60 years ahead of its time.

The Hagenbeck concept of habitat exhibits was widely copied. Even copies were copied

until all but the most superficial similarities were often lost. Gone was the clever overlapping of sightlines and sequential experiences. Gone also, in most cases, was the sympathetic re-creation of rock forms.

While large outdoor exhibits were the most dramatic, mention should be made of indoor zoo dioramas. The vast pachyderm building constructed in the early 1930s at Chicago's Brookfield Zoo attempted to display its quadrupeds in vast diorama-like enclosures, complete with artificial trees in the foreground and painted mural backgrounds. On a much more modest scale, small animals, especially reptiles and birds, were often set in diorama displays, perhaps the earliest being the reptiles dioramas at the St. Louis Zoo opened in 1926 (Conway, personal communication). One of the best recent examples is the Bronx Zoo's World of Birds. Small animal dioramas at the Salt Lake City Zoo are also exceptional as are the new cat exhibits at the Cincinnati Zoo. Even large animals such as giraffe, zebra, antelope and ostrich are displayed in front of realistically painted murals at the Carter Giraffe House, a recent addition to Bronx Zoo.

Early development of aquariums paralleled that of museums. And since it was relatively easy to mix some species of fish and add appropriate props, aquariums soon had small aquatic dioramas of sorts. Still, like earlier museums, they tended to be organized taxonomically. Excellent aquatic dioramas were built at Florida's SeaQuarium in the early 1960s (Braker, personal communication). The first major mixed species aquarium habitat was probably the coral reef tank at the Shedd Aquarium opened in 1971. Obviously, the technology required to support such an exhibit is very advanced and was largely unavailable until then.

## Modernism

The movement toward modernism in art and architecture has had a profound effect on exhibit design. In art, modernism turned its back on realistic representational painting and sculpture in favor of greater and greater degrees of abstraction. The love affair with machinery and technology in the 1930s and 40s resulted in thinking of buildings as functional architectural machines. "Form must follow Function" and "Less is more" became the hallmarks of leading architects such as Gropius, Van der Roë and their students. Not surprisingly, this "International Style," as it became known had a greater effect on art museums than upon natural history museums. However, natural history exhibits were not unaffected. Kidney or painting palette-shaped motifs, favorites of modern painters such as Miro, were commonly incorporated into display background or interpretive panels. More importantly, exhibits became less complex and more abstract. The emphasis shifted from the pictorial to the informational. While the earlier dioramas assumed the visitors could gain some of the subjective experience of wildlife encounters by viewing a realistic diorama, modern exhibits attempted to teach more objectively, breaking the whole into abstract component concepts to help the visitor build an intellectual understanding of the scientific concepts involved.

Modernism had a more direct effect on zoo exhibits such as the Snowdon Aviary (with its tensile structure) and the penguin exhibit, (with its double helical ramps), both at the London Zoo. These works were widely pictured in books about modern architecture. Both took their forms from some abstract characteristic of the animals displayed but, like many exhibits of their type, were more successful as sculpture than as habitat, and totally dominated their small occupants.

The modernist concept that all problems could be solved by increasingly sophisticated application of technology presupposed that clinic-like habitats were the answer to increasing

survival and reproductive rates among zoo animals. The tile-lined room with a glass front and stainless steel furnishings became the norm for most of the larger zoo animals.

Modernist outdoor zoo enclosures often maintained the Hagenbeck concept of moating and walled exhibits. But, as elsewhere, the emphasis was on simplification, abstraction and universal application. The realistic rockwork of Eggenschweiller was reduced to ubiquitous synthetic-looking "zoo rock," typified by the vast expanses created at the Milwaukee Zoo and later at the Columbus Zoo's hoofed stock exhibits and many other places. The pseudolithic era of zoo design was in full swing.

Elsewhere architects abandoned "rockwork" altogether in favor of smooth concrete or masonry walls of geometric shape, which they felt to be more "honest" and economical. The large cat and large primate exhibits at the National Zoological Park are examples of this approach.

A noteworthy compromise between abstract modernism and natural landscape occurred with this large cat exhibit - the building was largely buried into the ground. This approach was also very successfully used with the National Zoo's administration building, Cincinnati Zoo's Insect Zoo and the Great Ape complex at the Lincoln Park Zoo in Chicago.

This later project is, in my opinion, a good example of the modernist approach. The exhibits are large and very high, offering an ideal opportunity for arboreal activities in abstract steel pipe "trees." Serpentine side walls of masonry give a more organic impression to the overall form and a view to natural plantings in the back abstractly represents the animals' habitat, as do a series of architectural waterfalls mounted high on the side walls. The Public views the exhibits from two levels through very large windows, giving excellent visibility. The whole effect is sculpturally attractive, well used by the animals and popular with the public. It also feels "hard" and machine-like and is deterministic and abstract, all major characteristics of the Modernist design style. More recent and spectacular examples of the modernist approach, such as the New England and Baltimore Aquariums, will be mentioned later under "*High Tech Design*."

## **Landscape Immersion in Zoos and Museums**

The publication of Woodland Park Zoo's *Long-Range Plan* in 1976 (Jones, et al 1976) established a substantial advance on the Hagenbeck concept based upon a highly interactive and systematic approach. Like other styles, it too had its precedents. The lovely Bazel Zoo had created "soft" exhibits using natural substrate and abundant vegetation while effectively screening views of "hard" elements such as walls and buildings. These exhibits also gave the animals' abundant choice of microclimate and position.

The exhibits at the Arizona Sonora Desert Museum were also important precedents. Here native animals were exhibited in a highly realistic, yet dramatic landscape exactly duplicating the surrounding Sonora desert, with geology, botany and climatology represented equally with zoology. The landscape immersion style applied this approach to re-create a wide variety of habitats from around the world, not just the locally indigenous landscape.

Hagenbeck's work strongly influenced the landscape immersion or natural habitat approach, particularly in terms of creating dramatic vistas and overlapping sightlines. However, even more than Hagenbeck's exhibits, the new approach allowed the viewer to become physically and psychologically immersed in the re-created habitat of the animals

displayed. Zoo horticulture moved from its previous role of providing ornament to become the central context - creating a "landscape with animals." This approach, like that of the great museum habitat groups, appealed first to the emotion and secondly to the intellect (Wonders 1985, Coe 1985). Also, like Akeley's dioramas, there is great emphasis in the realistic re-creation of habitat with details such as geologic expression and simulation of indigenous plants developed with great precision from field vistas and photos of actual site. Little is abstracted.

In this approach, public areas become more highly manipulated by the designers to create dramatic effects and ensure the complete perceptual immersion of the visitors (Coe, 1985), while animal areas are "softer" and less deterministic than previously. The modernists assumed that science knew or would discover everything needed by the animals. The new approach assumes that science indeed knows relatively little and attempts to re-create a close simulation of the animals' indigenous landscape. Thereby, it hopes to meet animal needs which are not yet even known to exist.

The first exhibits to be systematically designed from this pattern are found at Seattle's Woodland Park Zoo, Tacoma's Point Defiance Park Zoo and Aquarium, Portland's Washington Park Zoo and the Pittsburgh Zoo. New projects of this type are underway at the Toledo Zoo, San Diego Zoo, Bronx Zoo, Staten Island Zoo and Zoo Atlanta.

Parallel approaches were undertaken independently at the North Carolina Zoological Park and previously at the San Diego Wild Animal Park. Neither is as finely tuned in their attempt to authentically replicate wild landscapes as the northwest projects. They depend more upon large expenses of natural terrain to achieve their considerable success.

The San Diego Wild Animal Park also is the most dramatic example of creating theme public areas using abstracted African Village forms for public service facilities. Although some such vernacular forms were used at the Hagenbeck Zoo much earlier and at the Bronx Zoo African Plains, their use was on a more modest scale. A parallel use of vernacular structures exists at many museums and theme parks. Audubon Park Zoo also developed fine habitat exhibits including use of vernacular architectural forms.

It is much easier to develop large natural habitat exhibits outdoors than indoors, where the presence of the surrounding architectural envelope is very difficult to obscure. Bold and popular indoor exhibits of great size and complexity have been built at Chicago's Brookfield Zoo and earlier at the Toronto and Minnesota State Zoos. The new African pavilion at the North Carolina State Zoo in Asheboro, NC uses a huge translucent tensile covering which is amazingly inconspicuous for its size. Overall, the best of the smaller indoor tropical forest habitats is the R. J. Reynolds Aviary at the North Carolina Zoo. Jungle World at the Bronx Zoo is clearly the most realistic and exciting of the very large indoor habitat complexes.

As a result of all of this recent work, the technology of re-creating and maintaining multi-species exhibits in large open indoor habitats has grown enormously, holding the promise for many more excellent facilities of this type.

While the northwest zoo designers were opening up habitat areas and allowing the visitors to leave the urban parts of the zoo and to move through them, northwest museum designers were splitting apart dioramas and allowing public entry. The Northwest Coast exhibit at the British Columbia Provincial Museum is a splendid example. It not only features beautifully executed habitat groups of mounted marine mammals and birds, but includes living tide pools and forest plants. Even sound effects enhance the psychological immersion of the visitor into

the diorama. Another example of landscape immersion in museum exhibits occurred when the California Academy of Science renovated their 1934 African Waterhole Group by removing the glass front and extending the exhibit outward "...so that visitors could actually walk through the scene instead of being separated from it" (Wonders 1984, p. 246).

Landscape immersion is most difficult to achieve in the aquatic habitats, at least as far as the general public is concerned. The most successful example perhaps is the shark exhibit at Sea World in Florida, where visitors traverse the shark tank in a continuous transparent tube. The effect, needless to say, is most dramatic.

The Seattle Aquarium developed a highly successful underwater dome, but the massive structure required interferes somewhat with the feeling of intimacy with the aquatic habitat. The National Aquarium in Baltimore allows the visitor to penetrate the center of a simulated coral reef. Again, structural imperatives effectively isolate the public from feeling they are "in the exhibit." Monterey Aquarium's bay window view into a deep kelp tank is more successful in partially wrapping the visitor with a luminous undersea landscape. Portland Zoo's penguinarium did much the same thing on a smaller scale.

Other major underwater viewing situations in zoos and aquariums allow exciting views into the aquatic realm, but the viewer remains firmly in the terrestrial world. A few viewing stations have been submerged into real sea environments, as was done at Coral World in the Virgin Islands and elsewhere.

Two examples from theme parks also deserve mention. The submarine ride first developed by Disneyland provides a close, personal experience of moving into and through a simulated marine environment while the Seas Exhibit at EPCOT carries this approach to an extremely large scale. The EPCOT project might better be characterized under the next heading.

## **High-Tech Exhibits**

Advancing technology always fascinates us. The many excellent science and technology museums have long taken the lead in displays of this kind. However, they are certainly not the only places technologically based exhibits are found. Today, zoos, natural history museums and aquariums abound with such exhibits.

New technology is usually showcased at world fairs, and EPCOT Center, a type of permanent world fair, has excellent exhibits applicable to use in more traditional facilities. They pioneered interactive touch screen and laser disk video systems, holograms and robotics, to mention only a few examples. The latest in interactive interpretive gadgets can be seen at San Francisco Zoo's Primate Discovery Center, Toledo Zoo's Diversity of Life Exhibit, the Monterey Aquarium and the Philadelphia Academy of Natural History's Discovering Dinosaurs project.

Medium- and low-tech devices, such as binocular microscopes, touch boxes and similar items, were first developed at Louisville Zoo's Meta Zoo, at the Birdlab and Herplab of the National Zoological Park, and the Discovery Room of the Smithsonian Museum. The Bronx Zoo's Children's Zoo pioneered use of imaginative animal-oriented play features, a concept further explored at the Philadelphia Zoo's Treehouse. Many interactive concepts undoubtedly developed in a multitude of other locations as well, San Francisco's Exploratorium being one excellent example. Cincinnati Zoo's Insect Zoo is a particularly good early example of effective

medium-tech exhibits.

An important aspect of the high-tech approach is that it usually surrounds the visitor with a "high-tech environment" as well as a collection of technological hardware. Where this high-tech look juxtaposes naturalistic or habitat exhibits, the contrast can damage both. The high-tech ambience is probably best and most consistently developed at the National Aquarium in Baltimore and its design predecessor, the New England Aquarium. Here the visitor is immersed in a high-tech sculptural sound and light show, including live animal exhibits. Unfortunately, the animals often seem primarily to be ornaments to the visual display.

At the other end of the spectrum, portable science displays, pioneered at the National Zoo and Portland Zoo, allow low-tech hands-on participation within habitat displays. The use of "discovery carts" or "sidewalk naturalists" is an example of bringing the museum into the zoo.

## What's Next?

This paper began by postulating that zoos, natural history museums and aquariums were evolving along parallel courses because of shared cultural influences. We've shown how the imperial power of state or church gave form to early zoo, aquarium and museum buildings. We've mentioned how the Age of Exploration and the systematic methods of Linnaeus shaped the organization and popularity of collections. The concepts of the Romantic Age and the Enlightenment, and the American preoccupation with its unique frontier and wilderness character profoundly affected exhibit design in ways too lengthy to mention here, but which are thoroughly set forth elsewhere (Wonders 1984). The idealization of wilderness was fundamental to the great dioramas of Hornaday, Lucas and Akeley and to the dramatic panoramas of Hagenbeck. The landscape immersion movement also embraces the incalculable beauty and worth of wilderness, but presents it through a far more realistic understanding of ecological principles, while remembering its debt to stagecraft and to behavioral psychology. Advances in technology affect all of the movements and technology itself has, in effect, become the hallmark of its own design style.

While these effects are numerous and varied, the overall result is in fact a marked convergence of approach. Even the most rigorously realistic habitat exhibits of the future will have low and even high-tech interpretive adjuncts. One can easily imagine encountering an inconspicuous button on a tree trunk in a Borneo forest exhibit. Push it and a holographic projection identifies the plants and animals nearby, or illuminates ecological principles relevant to the exhibit. Release the button and return to the "wilderness." Perhaps farther along the path you might encounter a volunteer dressed as a field researcher. He would let you use a directional microphone to listen to the conversation of two chimpanzees and perhaps help you compare the skeletons of gibbons with other arboreal creatures.

A great many overlaps between zoos, museums and aquariums already occur. The Seattle Aquarium, opened in 1975, introduces its visitors to the wonders of aquatic life first with audio/visual and graphic displays, then with isolated marine animals displaying physiological or behavioral adaptations, and finally with natural habitat displays. The New England Aquarium's temporary "don't look now" exhibits had sea horses displayed in front of a video screen. The most elaborate of the modernist/high-tech aquariums, the National Aquarium in Baltimore, is crowned with a tropical forest habitat aviary.

The Toledo Zoo, completed in the late 1930s, began with a zoo, aquarium, museum and a

theater as part of its original construction. The Arizona Sonora Desert Museum and its northwest cousin, the Oregon High Desert Museum embraced the concept of full integration of zoo, aquarium, museum and botanical garden approaches from their very genesis.

Theme parks such as Disneyland, Walt Disney World, EPCOT, Busch Gardens, Marineland and Sea World have been leaders in innovative integration with special features that maximize entertainment and marketing. These are aspects which more traditional zoos, museums and aquariums are embracing of necessity as they seek to meet increasing operating and capitol costs.

Thus far, we have discussed parallel evolution and convergence, but what about co-evolution, the complimentary adaptations of one organization to the evolution of other organisms which affect its survival? In the purely biological concept of evolution, it is not necessary for organisms to be conscious of each other's development because such adaptations may take millennia. But in this era of socio-technical development, consciousness and communication are essential ingredients. Cooperation which avoids direct competition, or competition which strengthens both organisms, is greatly enhanced by communication. This requires zoos, museums and aquariums to converse and develop in relation to each other. The AAZPA has been very helpful in this respect, which is one reason this subject is presented here. Communication with museums can be improved, not only at the technical/exhibitory level, but also at the strategic planning level. This already happens in a few cases. The St. Louis Zoo, Botanic Garden and Art Museum are supported by a common tax levy. Large cities such as New York have departments of cultural affairs to coordinate programs among the many public-oriented facilities they support. Zoo Atlanta, as part of its rebirth, has undertaken discussions with the Atlanta Botanic Garden and with a group developing a new natural history museum in the area.

Co-evolution is a splendid tool for survival. It allows an organism to choose among styles and between technologies to find a hybrid approach best suited to its own needs. It can join co-travelers or set its own direction. It can copy, innovate or adapt, so long as it maintains awareness of the actions and directions of related organisms. This awareness of others and ourselves, together with a willingness to communicate, can lead us further into an exciting co-evolution of zoo, aquariums and natural history museums.

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