Sue Dale Tunnicliffe · Annette Scheersoi
Editors

Natural History Dioramas

History, Construction and Educational Role

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Chapter 1
Introduction

Sue Dale Tunnicliffe and Annette Scheersoi

In the second half of the twentieth century, natural history dioramas went out of fashion and many were dismantled and even demolished. However, their renaissance has started. Some are carefully restored and new dioramas are being constructed with techniques to augment reality.

This book celebrates dioramas as unique and essential learning tools for biological education for all. It provides information about their historical development, demise, and more recent renaissance, past and the modern developments in their construction, the technique of taxidermy, as well as aspects of interpretation and educational research about learning processes including different methods to engage audiences, such as performance and storytelling.

We describe the journey of dioramas from their inception through subsequent developments to visions of their future. We also present a complementary journey of the visitors to dioramas, their individual sense-making and construction of their understanding from their own starting points and cultural context, often as they interact with others (e.g. teachers, peers, parents) and media (e.g. labels).

The book consists of three parts: the past, the present as well as future trends together with visitors' interaction with natural history dioramas. Contributors from different countries, from the west coast of the USA across Europe to China, and from different professional backgrounds demonstrate the different ways is which they use and observe dioramas.

The concept of the habitat diorama was developed at the end of the nineteenth century in Europe and North America and also included aspects of nature conservation. Diorama exhibits contain animals and plants with their characteristic features, and enable visitors to be able to classify the organisms and recognise the 'exhibit furniture' which creates the context in which to view the plants and animals. This

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context is usually a realistic representation of the natural environment in which the species live in the wild and provides a complete reconstruction of characteristic features such as the substrate, the vegetation, other biofacts such as bones, eggs or what remains of a carcass. Additionally, the background painting, which is a skilled creation, illustrates the meteorological situation of the region as well as providing a view of wider topographical features such as hills or the sea. Such painting blends into the vegetation and other environmental features in the diorama. Thus, a diorama creates a total illusion of an animal's habitat with the salient features of associated flora and fauna. In skilfully constructed dioramas this illusion contributes to a sense of place, inspires memories and connections to places, real or imagined.

Dioramas of natural scenes inform visitors about the specific ecosystem being represented contemporaneously, or from the heritage of their own country or other lands that imparts information about the changes in local fauna and flora. Furthermore, the construction of dioramas can reflect changes in socio-cultural attitudes or the ethos of different countries. For example, some historical dioramas inform visitors about the culture in which the animals were collected and may highlight historical social differences such as the male white hunter, or the colonization of the indigenous population.

Dioramas can vary in size from small showcases to large displays. They may depict actual locations or fictitious scenes to illustrate concepts deemed important to portray for visitors such as fauna and flora of different ecosystems, for example in the Royal Museum Scotland the evolution of fauna and flora of the region since the last ice age. Reiss and Tunnicliffe (2011) offer several categorisations of natural history dioramas, which are briefly considered: Traditional classic dioramas comprised of three parts—a *background* painted to provide perspective and a context which blends into 3-dimensional *artefacts and biofacts* at the front of the diorama's case and the *animal and plant specimens*. However, dioramas have evolved. Whilst some are represented as 'little landscapes' (Insley 2008), others resemble a section of a full size diorama and are build in small exhibit cases with a focus on a specific animal and habitat, that could be a part of a bigger life-sized diorama. Increasingly, dioramas are without glass and more recently, such as in Shanghai Museum of Science and Technology and at the Koenig's Museum in Bonn, there are large scenarios of artefacts and animals with a limited backdrop and no sides or ceilings that do not provide a total immersion viewing experience. On occasions specimens are presented on island sites, which stand alone with a stand or base but no other interpretative means, such as early man in the American Museum of Natural History, New York.

Start of the journey…

In terms of museum theory, dioramas pose a dilemma: Are the animals, plants and other items in dioramas to be regarded as objects or are they biofact/artefact amalgams or are they to be regarded as individual specimens? Some specimens are freeze-dried before being displayed in a diorama whilst others, mainly plants, are constructed from materials to simulate the vegetation of the area.

The animals are still. As such to some visitors they have the appearance of statues as this seven year old boy announced when viewing an African Diorama at the Powell Cotton Museum in Kent, England.

Mother: Kids, what can you see?
Children responded by identifying some of the animals.
Mother: Are they real?
Boy: No they are just made out of stone.
Mother: Do you think they are made out of stone?
Boy: Yes!

But, as a representation of a moment in time, like a photograph albeit in two dimensions, the diorama in three dimensions or augmented reality can also create images to view in a context. Thus should diorama animals be considered in a cultural object way or should they be considered as a sub-genre of objects with particular characteristics and properties?

Live animals can be handled in certain circumstances such as at petting corners and children's zoos, as can some cultural objects in museums. Yet another aspect of object handling is that of virtual artefacts and virtual reality. As a result of computer simulations various aspects of an object can be viewed that might not be possible with a real object; these techniques could be developed in relation to animals as 'exhibits'. Diorama specimens are not handled. Together with their context they are the focus of the diorama and form the scene of a unique journey. Therefore where do they fit into museum theory?

They are not cultural artefacts and hence objects because they are naturally occurring not man made. However, the organisms are presented after treatment to provide an illusion of the real animal or plant in its living form. Whilst some geological specimens and tools are presented in their natural state and can be touched and even handled in the same manner as can other cultural objects. When 'read' by a knowledgeable handler the information inherent, for example in the rock is interpreted and thus through this articulation some artefacts can shape the understanding of others such as a flint tool. Can such information be obtained from diorama organisms? Are visitors able to 'learn' as a result of viewing a diorama? We believe they can.

Animals in natural history dioramas, unlike most museum animals as standalone exhibits, are shown within a context, and tell a story. Visitors can look with meaning not only at the animal but also the context in which it lived. Plants provide a realistic view of the ecology of the habitat in which the animal lived, hence creating a naturalistic effect which is seldom achieved in zoos or botanic gardens even when animals and plants are shown together.

Animal and plant exhibits are the three dimensional essence of natural history dioramas. Encounters with them and the context in which they are shown form the focus of the journey for visitors and these in-situ encounters go hand in hand with their previous experiences, knowledge and understanding, as well as interest and therefore aid understanding. Furthermore, such an amalgamation of biological, geological, meteorological and, even in some dioramas cultural, topics provide an opportunity to study environmental interactions, potential, or as portrayed such as predator/prey encounters of the real world. Therefore dioramas have a unique

position in learning biological concepts and assisting in the viewer's development of aesthetic awareness and understanding of the dynamic interactions of the living world. They provide opportunities to observe with meaning and at the species at length. As such they provide a more manageable opportunity for dialogue and the co-construction of further understanding than often is precluded when viewing live specimens.

We consider that natural history dioramas are one of the most effective genres of museum exhibits for the teaching and learning of many aspects of biology as well as the cultural aspects of the societies that house the exhibits. They are part of our cultural heritage and should be treated as such.

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Part I
History and Features of Natural History Dioramas

Chapter 2
History of Dioramas

Claudia Kamcke and Rainer Hutterer

1 Introduction

Dioramas in Natural History Museums are generally considered as the three-dimensional depictions of animal-landscape sceneries that include real or artificial models of animals in combination with background paintings and natural or artificial requisites. However, the meaning of the term "diorama" changed through time and is still not clearly defined and covers everything from miniature cardboard cases (such as Japanese Tatetonka paper dioramas) to the highly artistic installations in the world's leading museums. Although Daguerre (1839) coined the name in 1822, the origin of illusionary presentations of landscapes or natural scenes roots deeper in history (Wonders 1993b) and may well have been invented independently more than once. The development of dioramas and related techniques in Europe was certainly influenced by the idea of "picturesque beauty" (Gilpin 1792), or by the philosophical idea of the "sublime and beautiful" (Burke 1757; Kant 1771), a new way of looking at landscapes with the eye of an artist by extracting and arranging beautiful and sublime components from the natural world and forming a piece of wonder.

Here we review the various technical innovations which led to the habitat dioramas which can be seen in many natural history museum of the world.

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2 Early Panoramas

At the turn of the eighteenth to the nineteenth century a new form of display, the panorama, was developed by a combination of art and technology in order to achieve a maximum effect of the illusionistic representation of landscapes. The term panorama was derived from the Greek "pan = everything" and "hórama = view", meaning "to see everything". Panoramas aimed to depict scenes or objects as accurately as possible by an application of optical principles such as tilted planes, curved painted backgrounds and modified scales of objects to reinforce the illusion through false perspective of a realistic view of a large scene in a compact space (Buddemeyer 1970). They depicted objects found in natural surroundings in the form of circular paintings or lengthy images which could be looked at from one central point. The Scotsman Robert Barker (1739–1806) and the German Johann Adam Breysig (1766–1831), are both considered as the inventors of the panorama. Barker painted a view of Edinburgh as the first panorama in 1787. He had this procedure patented as "panorama". The breakthrough was an unusually large circular painting of London which was exhibited in a rotunda of 30 m in diameter, especially built for that purpose and completed in 1793. The motif on display was not a city view but the Russian fleet at Spithead, the main roadstead of the British fleet, which could be viewed from the deck of a frigate built in the middle of the rotunda. The success with the public was enormous. Twice a year the panoramic image was replaced by a new one, in order to keep the flow of visitors constant. Old paintings were afterwards sent to other cities and re-used.

In 1800 the cities of Paris and Berlin gained independence from London and opened their own panoramas. Paris did this under license, while, in Berlin, old and independently developed blueprints were used. Soon there were panoramas on display in all major cities of Europe. Particularly panoramas of battles were popular, but also historical or religious themes, often combined with interesting cityscapes and landscapes.

The prosperity of the panoramas led to developments with similar names. Due to the abundance of these "-oramas" and their complex history (reviewed by Oetterman 1980) we mention just a few examples.

Neorama: Most closely related to the panorama. On a circular painting the interior of a building was depicted including people and changing illumination. Developed by the Frenchman Pierre Alaux (1783–1858), who exhibited the first one in Paris in 1827, which showed the interior of St. Peter's in Rome. One to two years later an interior view of Westminster Abbey in London followed which however was not successful, probably due to a lack of artistic skills of Alaux, and no more paintings followed (Oettermann 1980).

Myriorama: A kind of strip panorama. It is a laying game consisting of a painted landscape with an infinite horizon line cut into compatible playing cards. Each margin suits to another one so that the individual pieces of the scenery can be combined to form various landscapes. It was invented in 1802 by Jean-Pierre Brès (1760–1834) in Paris and subsequently improved by John Heaviside Clark (1771–1863) in

London. Though originally intended to compete with the panorama at a large scale, it turned out to be more profitable when scaled down and marketed as children's entertainment through the book trade (Oettermann 1980). As a laying game the myriorama has survived until today.

Cosmorama: Also called room panorama, cosmoramas were a kind of small panoramas. Usually they measured 6 × 1.20 m, showing mostly topographical views on paper painted in watercolors. They were constructed in a semicircle, built into a box and viewed through optical glasses to let them appear life-sized and with more plasticity and spatial depth. Six to eight glasses of up to 12 cm in diameter were installed in the front wall of the box, which was built at a distance of 1 m from picture plane. Cosmoramas were mostly illuminated by daylight and allowed more varied performances. They soon attained equal footing with the exhibition of large panoramas and became more and more popular, especially in the first half of the nineteenth century (Oettermann 1980).

Georama: A gigantic hollow globe construction with continents, oceans, rivers, mountains etc. displayed on its inner surface, so that the public could wander around within the globe and look at the side-inverted displays. The first georama by Mr. Delangard (life data unknown) opened in 1826 in Paris. However, it was really successful only after the expansion and development by James Wyld (1812–1887) in London. Wyld's Great Globe was exhibited there from 1851 to 1862. The building consisted of a huge hollow sphere of about 12.2 m diameter and the inside was provided with four stacked galleries for the visitors. On its inside the surface of the earth was formed true to scale with a three-fold super-elevation (Oettermann 1980).

Length panorama (moving panorama): The most consequential variation of the panorama was probably the length panorama. Here the panoramic view of 360° was replaced by the depiction of landscapes on long canvas, causing an illusion as one would look out of a window of a train or from the deck of a ship. The canvas was wound up from one cylinder to another. Often the canvas length was up to 10 m, on which an equivalent of 30 km or more of landscape were depicted. The date when the moving panorama first arose can not be determined with certainty. Since the 1820s this kind of exhibition enjoyed more and more popularity, especially in English speaking countries. Moving panoramas were an essential part of stage equipment in the drama theatre of the nineteenth century (Oettermann 1980).

Pleorama: A kind of moving double length panorama. Architect Carl Ferdinand Langhans (1781–1869) and writer and artist August Kopisch (1799–1853) opened the first one in Breslau in 1831. In this exhibition the audience sat in a boat floating in a pool of water between two large, parallel-running length panoramas, which, while passing, enhanced the illusion of a boat trip in the Bay of Naples. Probably due to its complicated equipment and the great technical effort, the pleorama found no subsequent imitators (Oettermann 1980).

Nowadays all these names are no longer in use and only the word "diorama" survived. However, new digital techniques combined with robotic cameras just led to a new and exiting form of panorama, the "GigaPan" (http//www.gigapan.com).

3 Dioramas in the Original Sense

The diorama was originally focused on the representation of movements, because their absence in panoramas was felt as a deficiency. The new method was introduced to the Parisian public in 1822 by Louis Jacques Mandé Daguerre (1789–1851) and Charles-Marie Bouton (1781–1853). Daguerre was a stage painter specialised in lighting effects and very famous for his sunrises and sunsets, while later on he played an important role in the development of photography.

The first dioramas were 22 × 14 m large paintings which were painted opaque or translucent on transparent canvas. The light came from the front or back of the canvas and was regulated by different colored apertures—therefore, the patented name diorama = translucent image. The audience was sitting in a dark room. The lighting effects could range from moonlight to sunlight with wafts of mist, moving clouds, sparkling waterfalls, oncoming and unleashing thunderstorms etc. During the presentations, there was rarely a moment in which nothing moved or altered. The lights merged continuously, and with the changing light intensity the colours also changed, regulated by the different apertures. That kind of motion in a picture was the overwhelming novelty at that time (Verwiebe 1997). The diorama quickly spread from Paris to the capitals of Europe. Daguerre kept his special painting techniques of translucent images as a secret, so all other dioramas were dependent on the paintings of Daguerre and Bouton. After being shown in Paris, the dioramas went on tour.

In a time of economic downturn new attractions had to be found. Bouton had emmigrated to London, and, in 1832, Daguerre presented a view of the valley of Chamonix with the Mont Blanc in the background and a complete Swiss chalet with all the associated devices in front. Real trees, scattered devices and a live goat feeding on hay from a manger completed the scenery. During the presentation alphorns resounded and a choir sang Swiss folk songs. Daguerre painted over the real objects to make them even more attuned to the image, whereby the boundary between reality and illusion actually disappeared in the eyes of the observer. This manner of representation, however, apparently did not meet the taste of the paying public sufficiently so that Daguerre largely renounced on real objects afterwards and developed his diorama to a double effect diorama. A picture was painted on the front of the especially prepared canvas, and another variant of the same motif, usually the night effect, was painted on the back. This resulted in a presentation of several images on one single surface by the use of different levels of brightness such as dawn, bright noon and dusk, passing even into full moonlight scenery.

Daguerre succeeded best in 1834 with the representation of a midnight mass in the church of Saint-Etienne-du-Mond, which he could put on display for three years continuously. At the beginning the Church was in full daylight, which decreased slowly and finally gave way to the night. As the light faded outside, more and more candles lit up in the Church and the benches were filled with worshippers, with the sounding of an organ as a highlight. A new quality of representation was achieved.

With Daguerre's diorama destroyed by a fire in 1839, the history of his invention ended. Attempts of revival brought no significant innovations. The panorama, however, experienced a new boom between 1880 and 1900. The panorama "Battle of Sedan" in Berlin was opened in 1883 in the presence of the emperor. Here, the precise documentation of a historical moment was more important than the creation of an illusion. Reminiscence and envision of a glorious historical moment was the main interest. The panorama was supplemented by three dioramas, which were also in the service of the documentation, but had lost the clever achievements of Daguerre, like changing lighting effects. Only a static top light and the darkened auditorium remained (Oettermann 1980).

4 Precursors of Habitat Dioramas in Natural History Museums

The ideas and techniques of the dioramas were soon adopted by the Natural History Museums of Europe and North America. The terminology for diorama-like objects or installations is still inconsistent, both in the literature and in public use. In the following we concentrate on the development of dioramas in Natural History Museums because this is where they prospered until today.

4.1 Artificial Groups

Artificial or mixed groups show an unnatural large number and diversity of individuals and species in a particular landscape. All animals may occur in this landscape without biological context, the fox peacefully next to a rabbit. Cabinets of curiosities were already common in the Renaissance. Shells, fossils, skulls and stuffed or fluid-preserved animals were arranged in cases following no obvious order. Wonders (2003b, p. 425) figured an example from a Swedish natural history cabinet of 1804, where 169 stuffed birds from around the world were arranged, apparently by taxon group, in a huge wall case. Such showcases with artificial groups persisted in museums until recently. The old galleries of the National Museum of Natural History in Paris, first opened in 1889, were famous examples of the same principle (Berenger and Butor 1994). A further development was the installation of a painted background, and sometimes terrace-like or pyramid-like structures in the cabinets which allowed arranging many large and smaller animals in a given space. Some of the early "dioramas" by G. von Koch in the Darmstadt Museum (Koch 1910) are of this type, and were found also in the Natural History Museum in Hamburg (Köstering 2003, Fig. 32) and many others.

4.2 Geographical Groups

A way of displaying animals or plants from a specific geographical region (Africa, Asia, etc.), or from a specific environment (tundra, desert, etc.) were the geographical groups. Background painting and foreground requisites were not required but often added, but no attempts were made to create an illusion of reality. Examples of this type of presentation were (or are) found in the museums of Darmstadt (Feustel 1968), Tervuren, and many others. Their purpose was more education than illusion. Voss and Sarkars (2003) argued that the early geographical groups performed in Darmstadt by G. von Koch were stimulated by the book "Geographical Distribution of Animals" of Wallace (1876), and that his book was influential to the further development of dioramas.

4.3 Biological Groups

Biological groups are often called dioramas, but they lack the curved painted background and the illusion of space, and often also any protection by cases and glass. They showed a piece of nature with a natural combination of habitat, plants, and animals, as if taken from the wild. The principle was already shown by Albrecht Dürer in his famous water colour, "Das große Rasenstück" (large greensward) of 1503, in which he painted a small piece of meadow with all its details. Biological groups can be "little landscapes" (Insely 2008) but also large open installations, such as the (lost) group "Wolves and moose" by August Sander of 1901 (Köstering 2003, Fig. 30), the group "Animal life in the Arctic" of 1907 in the Berlin Museum (Kretschmann 2006, p. 278), or the new African savanna of 2003 in the Museum Koenig, Bonn. A critical condition is that these groups reflect the biology and ecology of the species shown (e.g., a flock of birds feeding on berries; a pack of wolves chasing a moose; a family of foxes in front of the burrow), and not just the phantasy of the taxidermist.

A famous example of biological groups are the bird groups of Bengt Berg (1885–1967) in Bonn, a Swedish preparator and writer who worked for the Museum Koenig from 1909 to 1913 (Berg 1926; Bechtle 1978). For his biological groups he collected substrate, plants, rocks, birds and their nest and eggs from the original nest site, mostly in Scandinavia, and combined everything in Bonn into a few square meters to show the bird's habitat. These bird groups were originally shown in daylight in separate show cases which could be examined from all sides. Around 1960 they were moved into a new gallery with dimmed light, furnished with curved painted backgrounds and artificial illumination, and thus turned into real habitat dioramas. In 2000, these were dismantled during a renovation of the building; some were renovated and transferred into new showcases, and thus were made biological groups again.

Small and large biological groups are common in museums around the world and have a long tradition, particularly in the British Islands (Morris 2003, 2010),

Fig. 2.1 Example of an early bird case dating from 1793 (Museum Koenig, Bonn), composed of a stuffed *Turdus pilaris,* real plants, and artificial leaves and flowers. (Photo R. Hutterer)

Germany (Köstering 2003), Eastern Europe (Hutterer and Elzen 2007), and North America (Quinn 2006) Fig. 2.1 shows an early example made in 1793, but the poet Johann Wolfgang Goethe kept an even older case (c. 1776) in his collection, a kingfisher in a glass-covered box amidst a naturalistic foreground and a painted background (figured in Wonders 1993b).

5 Habitat Dioramas

Habitat dioramas are the result of a development of fine biological groups into "windows on nature", as Quinn (2006) called them. Well-made habitat dioramas are perfect combinations of the "sublime and beautiful" with scientific accuracy, art, and technology. Necessary requisites of habitat dioramas are a domed back wall with naturalistic background painting and effective illumination, perfectly merging into the foreground and its real components like animals, plants, rocks, water, and so forth. A clever use of perspective and foreshortening in the background painting increases the impression of a large space or open landscape. The diorama can be viewed from one side through a large "window". The viewer rests either in a dark area (for example, Staatliches Naturhistorisches Museum in Braunschweig, Fig. 2.3), or in a bright hall (American Museum of Natural History, New York). Some dioramas are window dioramas where the viewer looks over an opaque barrier, higher than floor level, into the diorama, as in the new backyard diorama at the Natural History Museum of Los Angeles County. There are also waist-high window dioramas, exemplified by some of the dioramas in the Museum für Naturkunde, Berlin, which reduce the breadth of the depicted scene in order to focus on a limited

number of specimens and their immediate environment. After Reiss and Tunnicliffe (2011) dioramas can also be classified according to their mode of representation of the specimens, which can be two- or three-dimensional and, in the case of animals, static or moving. Animatronics are examples of three-dimensional specimens with the capacity for movement, while two-dimensional versions of the specimens are shown through technologies such as video projection (e.g. the elephants walking on the background of the Somali arid zone diorama in the recently renovated African Hall of the California Academy of Sciences), or even holograms.

A habitat diorama usually has a message, either directly or indirectly. One general message is to provoke wonder and emotion about nature, sometimes even fear (Quinn 2006). A further (unspoken) message is to increase awareness about nature conservation. Particularly in the United States specific dioramas have had an important impact on decisions about the creation of nature reserves. The Pelican Island diorama in the American Museum of Natural History, when first displayed in 1902, assisted in the creation of the first Federal bird reserve in 1903 (Quinn 2006).

Karen Wonders laid the foundation to a scientific study of habitat dioramas and discussed their possible origin and evolution (Wonders 1993a, b, c, 2003). She argued that the long history of bird taxonomy (Schulze-Hagen et al. 2003) has driven the development of the habitat diorama, as only the invention of new techniques for the permanent preservation of birds allowed a further development of more sophisticated displays. Bird relief pictures fabricated in Silesia (today in Poland) in the early nineteenth century seem to support this view, as they met all criteria for a habitat diorama and thus represented an important step in the development of early bird taxidermy to the highly sophisticated art of habitat dioramas in the twentieth century (Hutterer and Elzen 2007). In the same region small city dioramas had a long tradition (Glanz 2005). Also bird cases with background painting and sometimes furnished with artificial or natural requisites (Hevers 2008; Morris 2010) can be regarded as an early form of habitat diorama.

6 Examples

6.1 Europe

The first European museums which adopted a naturalistic approach to zoological exhibits were the so-called biological museums in Sweden. In these privately founded museums animals were integrated into visual representations. Biological museums were invented by Gustaf Kolthoff (1845–1913), a Swedish hunter, naturalist and taxidermist. He developed an exhibition concept that associated public education with entertainment by illusion. According to Kolthoff, the visitor had the complete picture in front of him in a biological museum, and could therefore see immediately what words can not describe. His habitat dioramas were mixed groups. Three largely preserved original dioramas by Gustaf Kolthoff and his son

Fig. 2.2 Detail of the diorama "In the outer archipelago" in the Biological Museum in Turku, Finland, which was set up by Gustav Kolthoff and his son Kjell until 1907. It belongs to the first series of dioramas in Europe, developed by Kolthoff in Sweden. (Photo J. Hevers)

Kjell in Turku were called "In the outer archipelago", "In the inner archipelago" and "Mountain landscape of Lapland", each of them depicted numerous species of animals (Puhakka et al. 1996) (Fig. 2.2).

The first private biological museums, which no longer exist today, were built by Kolthoff in Källeviken (1875), Kalmar (1882) and Uppsala (1889). Some of his work has outlasted until today, for example the biological museums in Stockholm (1893), Abo, the Finnish city of Turku (1907), Uppsala (1910) and Södertälje (1913). Kolthoff's exhibition concept was improved by Olof Gylling (1870–1929), who also was a naturalist and taxidermist. His dioramas can still be seen in Gothenburg.

Only a few dioramas existed in Germany at the beginning of the twentieth Century. They presented a kind of supplementary addition to the exhibitions and were not seen as a fundamental alternative of the traditional way of making exhibitions. Following Darmstadt in 1904, some other European museums built habitat dioramas: Paris 1906, Berlin 1907, Frankfurt 1907 (Becker 1997), Kent 1908, Leipzig 1908 (Becker 2004), Bucarest 1908 (Pinna 2011), Amsterdam 1926, and Bonn 1912–1933 (Bechtle 1978). More recent examples are known from Milan (Alessandrello et al. 2011) and Helsinki (Granqvist 2012), but a full inventory of dioramas in European museums has not yet been made.

Hunting played a pivotal role in the development of taxidermy techniques and the use of habitat dioramas. This was obviously caused by the personal interests of private museum founders—a clear parallel to the Swedish model. Major Percy

Fig. 2.3 Habitat diorama from 1977 showing a male and female roe deer in summer in a grainfield at the foot of the Elm hills, Germany. The reaped crop strip draws the eye into the distance and nicely merges with the painted background. (Photo Staatliches Naturhistorisches Museum, Braunschweig)

Horace Gordon Powell-Cotton (1866–1940) in England, Louis-Philippe-Robert, Duke of Orléans (1869–1926), in Paris and Alexander Koenig (1858–1940) in Bonn presented the results of their game hunting in this way. The hunter and taxidermist Rowland Ward (1848–1912) was specialized in the mounting of big game trophies collected in Africa by the European nobility. He established a business in London in 1872 that became the largest and most famous taxidermy firm in the world. The majority of the trophies of Major Percy Horace Gordon Powell-Cotton or of Louis-Philippe-Robert, Duke of Orléans were prepared and mounted by Rowland Ward in his taxidermic studio in London. Ward was always up-to-date on the latest display methods and played an important role in the development of habitat dioramas in Europe, although he was more interested in displaying an entertaining spetacle than in objective re-creation of nature. Many of the species he mounted were purchased by the British Museum (now the Natural History Museum, London). Ward even established a fund in his name at the museum for purchase of specimens (Wonders 1993a). From 1951 to 1960, the remaining funds were used to create the Rowland Ward pavillion, which consisted of three dioramas of African mammals, dismantled in 2004 (Morris 2010; Reiss and Tunnicliffe 2011).

The trend towards big game dioramas was limited in continental Europe. An exception was the museum of Bern in Switzerland. The Natural History Museum had 228 dioramas with a total of 882 specimens (Huber 1982), of which 41 showed African animals. The dioramas were created between 1934 and 1936. Many mammals shown in these dioramas originated from a hunting expedition by Bernhard von Wattenwyl (1877–1924) in 1923/1924. He shot the animals for the museum

and donated them (Bundi 1998). Von Wattenwyl knew the biological museums in Sweden, and they were certainly a role model for him when he submitted this offer to the museum of his home town in 1922.

6.2 North America

In the United States of America the development of habitat dioramas went a different way. While the European natural history museums primarily fulfilled a scientific function, the main goal of the American museums was public education. Private foundations, fundraising and large donations for the improvement of museums were common. This resulted in a competition among museums for the most spectacular exhibitions with the highest attraction to the public, thus impressing even sponsors.

The actual development towards dioramas began with the so-called group method. It corresponded largely to the biological groups in Germany. Interacting animals of different ages and sexes were combined into natural groups. They were shown in a portion of their natural habitat and placed in a glass case visible to the visitors from all four sides. Trailblazers were depictions of birds at nest. After exhibitions during the first Annual Meeting of the Society of American Taxidermists in Rochester and inspired by biological groups of birds in London in 1887, the first 18 groups of birds were built at the American Museum of Natural History, New York. After a few years over 70 bird groups were created (Hevers 2003).

To apply the group method to large mammals, much larger exhibition areas were needed. It started with William T. Hornaday (1854–1937), chief taxidermist at the National Museum of Natural History in Washington DC. At that time, the American bison or buffalo was already considered extinct, and despite its importance for America, no collection had any specimen. When the news emerged that few small groups of buffalos might have survived in the West, Hornaday was sent on a collecting expedition. He had the order to bring home 80–100 buffalos (skins, skeletons, skulls). In the second attempt 1886 Hornaday succeeded to hunt down 25 animals, including the most powerful bull that was ever recorded. This is considered the last successful buffalo hunt in the U.S.!

For a group Hornaday selected six animals from small calf to trophy bull and in 1888 he presented the mounted specimens in a glass/mahogany display case of $5 \times 4 \times 3$ m size. The success was enormous, especially because of the buffalo being such a symbolic animal for America. Soon the President of the American Museum of Natural History in New York wanted to have a group of buffalos, too. However, a hunting expedition failed, and they had to buy expensive skins from the Washington museum. Now it was possible to build the largest bison group on a floor space of $6 \times 10 \times 4$ m. It was finished in 1891, considered a masterpiece of taxidermy and exhibited in a prominent place for many years.

While developing true habitat dioramas, the group method was supplemented by a painted background, thereby giving a more vivid impression of the entire habitat. This required the foreground of the group merging imperceptibly into the painted

background. The back wall was bent and the diorama was visible now only from the front. Like so often, birds were ahead of the mammals. Between 1898 and 1909 about 34 bird groups were set up as true habitat dioramas in the Hall of North American Birds at the American Museum of Natural History, which it opened in 1902.

Carl Akeley (1864–1926), famous taxidermist, hunter and sculptor, was an inventive pioneer of the habitat concept. His muskrat group of 1889 is regarded as one of the first true habitat dioramas. It depicts muskrats in a re-created marsh against a mural of a wetland. He constructed it while working at the Milwaukee Public Museum where it is still on display today (Quinn 2006). From 1896–1909 Akeley worked as chief taxidermist at the Field Museum of Natural History in Chicago (Metzler and Carter 2008). There he constructed the remarkable habitat dioramas "Four Seasons", in which he depicted the development of a family of white-tailed deer during the year. They were mounted in 1902, being the first true habitat dioramas with large mammals in a museum.

Akeley was also the inventor of a preparation method to attain a very realistic and lifelike appearance of large animals. He sculpted a life-size model of the animal's skinned body with all the necessary details like muscles, wrinkles and veins. By moulding this model he got a hollow cast, on which the tanned skin was arranged. This method is still one of the two standard methods in taxidermy.

From 1909 to his death in 1926 Akeley worked at the American Museum of Natural History in New York City. There he conducted the production of a grand gallery dedicated to African wildlife. The Akeley Hall of African Mammals created a sensation when opened in 1936, ten years after his death. The opening marked the birth of the golden age of the diorama (Quinn 2006). It is his impressive memorial. Twenty-eight dioramas in this hall framed a central group of eight African elephants. The dioramas presented African big game in typical family groups. Each diorama contained as many animals as scientifically acceptable. A large corner diorama of the equatorial Tana River displayed impalas, monkeys, a crocodile, turtles, a number of birds and several hippos on a sand bank. The background paintings were an important element. In their entirety they should show a condensed impression of the beauty of Africa from the East coast to the West coast and from the Mediterranean Sea to the Table Mountains in Cape Town. They also show the natives living in relationship to the animals. The impressive central herd of African elephants included among others an elephant cow, which President Roosevelt had shot on a hunting with Akeley in Kenya in 1909, a calf hunted by his son Kermit, and two bulls, which Akeley had shot himself. Akeley wanted to show the intelligence of this species for which he had the utmost respect. Akeley made several expeditions to Africa for the purpose of hunting animals and studying their habitats.

The extension of the African Hall began shortly after the outbreak of World War I, was then interrupted and resumed in 1921. Akeley suddenly died on an African expedition in 1926. The completion of the dioramas followed Akeley's original plans. For the foreground of the gorilla diorama 75,000 artificial leaves and flowers were produced. The painting was one of the most impressive and showed the area in which Akeley had been buried—thus it received a special significance in remembrance of him.

The African Hall exerted such an astonishing fascination at that time and more African-halls were built in Los Angeles (1928), Chicago (1932; Metzler and Carter 2008), Minnesota (1911–1960; Luce et al. 1980; Nelson 2012), San Francisco (1934), Philadelphia (1936), or Yale (Anderson 2012). In the American Museum of Natural History the Hall had a considerable influence on the exhibition policy. There was even a hall of the birds of the world and a hall for South Asian mammals set up. In 1929, five habitat halls were completed or under construction, including one for birds of the oceans. Two-thirds of the museum expenditure went to fund exhibitions. This increasingly deepened rifts between the scientific staff and the public relations department, culminating in the accusation that the habitat dioramas were without any intellectual content.

Nevertheless, a Hall for North American Mammals was rebuilt and opened in 1942. The impressive nature of North America was shown in gorgeous dioramas. No didactic information interrupted the grandiose optical effect of the hall. Tables, maps and graphs on distribution, evolution, vegetation, climate, and topography of the various scenes were limited in size so that they did not distract from the dioramas.

6.3 Worldwide

Nowadays, habitat dioramas are found in most Natural History Museums of the world (Quinn 2006; Hevers 2008). Examples are the Shanghai Museum of Science and Technology, the dioramas in the National Museum Bloemfontein, South Africa, in the Museum Satwa in Batu, East Java, Indonesia, or in the Museums of Wellington, New Zealand, and Melbourne, Australia (Walliss 2011).

Conclusions

The history of the diorama was a gradual process over a few centuries, from the curiosity cabinets to the highly sophisticated habitat dioramas of our times. Important steps were the intellectual discovery of the beauty of nature and of landscapes, the technical innovations of Daguerre and others about optical illusions, the improvement of bird and large mammal taxidermy, and the artistic skills of background painters. The concept of the habitat diorama was developed only at the end of the nineteenth century in Europe and North America and at that time also considered aspects of nature conservation, which culminated in the superb examples of habitat dioramas of the major North American museums.

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Chapter 3
Habitat Dioramas as Historical Documents: A Case Study

Rainer Hutterer

1 Introduction

"Creating a diorama is a multidisciplinary task, requiring technical input from artists, zoologists, botanists, and lighting specialists, to say nothing of the carpenters, taxidermists and model builders needed to physically build them." (Morris 2010). The great habitat dioramas, as exemplified by some of their finest examples at the American Museum of Natural History (Quinn 2006), were the summit of a long tradition of conceptual, technical and scientific innovations. Important steps were the discovery of the picturesque beauty in nature (Gilpin 1792), the philosophical idea of the sublime and beautiful (Burke 1757; Kant 1771), the development of techniques to permanently preserve animals, particularly birds (Schulze-Hagen et al. 2003; Wonders 1993b), the invention of optical illusions (Daguerre 1839), the perfection of highly sophisticated paintings on curved backgrounds (Hill 1987; Wonders 1990), new techniques to perfectly mount large mammals (Becker 2004; Morris 2003, 2010; Völkel 2004), the scientific study of ecological relationships (Wonders 1993c), and finally the emergence of conservation ideas and strategies, particularly in North America (Quinn 2006).

Today, early panoramas, photographs and technical optical equipment are valued as highly priced collector's items and are displayed in art exhibitions (Buddemeyer 1970; Oettermann 1980; Verwiebe 1997). The same holds true for early small framed city dioramas (Glanz 2005). By contrast, habitat dioramas in natural history museums always had a hard standing and were threatened by dismantling (Norris and Granqvist 2006). Constructing them required space, their creation was expensive, and their maintenance labour-intensive (Reiss and Tunnicliffe 2011). In times of changing didactic concepts towards a more scientific (or more politically correct) presentation of museum exhibitions the value of dioramas in natural history and their illusionistic effect was questioned (Meyer 1982; Norris and Granqvist 2006),

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Fig. 3.1 European bison and moose in oak-birch swamp forest. Composite view of a diorama in the Museum Koenig, Bonn, 1912 to 1933. Taxidermy by B. Korf and R. Fendler, background painting by V. Stoetzner-Lund (Photo Museum Koenig)

at least in Europe, and many dioramas were carelessly dismantled and cleared space for other purposes.

In the following I try to demonstrate, in accordance with Norris and Granqvist (2006), that habitat dioramas are part of our cultural heritage and of equal significance as some installations in art museums. In addition, many habitat dioramas have an interesting history, often unknown and untold, which if unravelled could increase their relevance and interest for the public. As an example, I discuss one of the twelve habitat dioramas in the Museum Alexander Koenig, Bonn.

2 Case Study: European Bison and Moose in Oak-Birch Swamp Forest, Bonn 1912–1933

The Setting

This diorama formed part of a series of 12 dioramas planned by Alexander Koenig (1858–1940) for his new Zoological Research Museum in Bonn. The building was constructed from 1912–1914, but immediately confiscated at the beginning of World War I and subsequently used as a military hospital and barracks (Hutterer and Oesl 1998). Work on the interior fitting could only be continued from 1927 onwards, and in 1934 the museum was finally opened (Koenig 1934).

The European bison-moose diorama is the largest of all dioramas in Bonn, with a surface area of about 81 m^2, and an inner height of 5 m. The diorama is visible from the front through a slightly bent glass window of 5.1×2.3 m. Artificial light comes from behind the front wall and from further lights fixed on the left and right inner walls, and behind the central oak tree.

The Animals

Five large mammals dominate the diorama (Fig. 3.1); they were grouped in a half-circle around the observer standing in front of the window. On the left, a male and

female European bison (*Bison bonasus*) fix the observer from the margins of an oak forest. On the right, a group of European moose (*Alces alces*), a bull, a female and a calf standing in a birch swamp, approach the observer, each from a different angle.

Plants

The European bison look out from between three large trunks of oak tree (*Quercus ruber*), spread from the left corner to the centre of the diorama. Real bark and dried branches were used for modelling them, but the tips of the protruding branches bear artificial leaves in a fresh autumn colour. Ferns, heather and moss complete the botanical inventory of the oak forest. The swamp and moorland on the right are composed mainly of grass bulbs and intermingling water holes in which young birch trees grow.

Taxidermy

As the diorama was already drafted in 1912, the taxidermist Robert Fendler sen. (1881–1918), who worked for Koenig at that time, was most certainly involved in the beginning. However he died in 1918, after having served on the battlefields of World War I. His son, Robert Fendler jun. (1911–1981), was adopted as a child by Margarethe and Alexander Koenig and later employed at the museum (Hutterer 2011). He must have worked on the diorama, along with the new chief taxidermist Berthold Korf (1893–1981). Korf was a very good taxidermist (Koenig 1934) and a member of the German Taxidermist's Association (Völkel 2004). The European bison-moose diorama is one of his major works. He also modelled small animal statues; a bronze of a sessile giraffe is still kept in the museum.

The specimens came from different sources. The two bison specimens were purchased by Alexander Koenig and shot in the Bialowieza Forest in eastern Poland in 1905. It is to be assumed that they were already mounted when purchased. Koenig bought entire groups of mounted mammals and birds from the Austrian natural history dealer Franz Schillinger (1875–1914+), who sold the bison as well. Schillinger was based in Nizhniy-Novgorod, Russia, from where he undertook expeditions and collected birds and mammals for the museums in Vienna and Bonn (Keve 1948).

The moose female and calf were also bought (from the forester and taxidermist A. Sondermann), and collected in "*Ostpreußen*" (formerly Eastern Prussia, now part of Kaliningrad, Russia) in 1912. It can be assumed that they had already been mounted in 1912, perhaps by Robert Fendler. The male has no record in the Museum files or catalogues. Not a single bone is left in the scientific mammal collection, just the mounted male stands in the diorama. A lucky instance shed some light on this mystery: undated and unlabelled photos from the work album of B. Korf in the archives of the museum show him and the freshly killed moose, along with a group of hunters, and among them Hermann Göring (1893–1946), the Nazi minister and "*Reichsjägermeister*" (chief of all hunters in the German Reich). Another photo shows the sculptured body of the moose and the finished mount, made by the talented hands of Berthold Korf. The photos suggest that Göring shot the moose and gave the skin and antlers to the museum for the incorporation into the diorama, and that Korf acted as some kind of agent in this business.

Fig. 3.2 Detail of the background painting and signature of artist V. Stoetzner-Lund, displaying an impressionistic style (Photo R. Hutterer)

The diorama is still in its original condition. However, it was partly damaged during the general renovation of the Museum building since 1999, and had to be thoroughly restored. This was done by H. Schmiese and the staff of the taxidermy group of the museum in 2006.

Painting

All background paintings for the Bonn dioramas were performed by the Berlin artist Victor Stoetzner-Lund (1883–1947) between 1929 and 1933, as shown by his signature (invisible from outside) which he left on the lower left corner of the wall painting. No other documents about his work in Bonn survived. Little to nothing is known about his life. He also painted backgrounds for dioramas in the Berlin Museum, and a few of his wildlife paintings are known from auctions. It is also said that he painted canvas for theatre sceneries.

The quality of his work is excellent (Fig. 3.2). From the distance of the observer the forest and birch swamp look very detailed and natural, but a close look (only possible inside the diorama) shows that he used an impressionistic technique with dots and blotches in bright colours. Some of his wall paintings are so beautiful that one could cut out a piece (as in Fig. 3.2) and take it as a painting on its own. The artist used blue and violet colours for the shades in the forest, which reminds one of the great French Impressionist Claude Monet (1840–1926), or even on the contemporary German expressionists such as Erich Heckel (1883–1970) or Ernst-Ludwig Kirchner (1880–1938), both artists that were banned by the Nazis. In this respect Stoetzner-Lund was a modern painter, although he obviously followed the tradition of wildlife painters such as the Swedish Bruno Liljefors (1860–1939) (Wonders 2006).

Historical Interrelations Alexander Koenig saw his dioramas in the tradition of the great Swedish artists Gustav Kolthoff (1845–1913) and Bruno Liljefors (1860–

1939), who both worked together on early habitat dioramas in Uppsala 1889 and Stockholm 1893 (Hill 1987; Wonders 1993a, 2003). Koenig knew them personally and was familiar with their work (Hutterer and van den Elzen 2007). For his own (private) museum he demanded for the highest possible standards of taxonomy and display (Bechtle 1978). He hired the young Swede Bengt Berg (1885–1967) from 1905 to 1913 and asked him to prepare 12 unique bird groups for his (then planned) museum (Berg 1926), and also later hired the best taxidermists he could get for the taxidermy workshop. As the plans and taxidermy work for his great dioramas already began in 1912, they must be seen in the tradition of the Swedish habitat dioramas of Gustav Kolthoff, as described by Wonders (1993a).

The diorama depicted animals not known to most people in Germany at that time. Moose occurred only in the very eastern province of East Prussia, and European bison was almost extinct in Europe, producing an illusion of a prehistoric setting. The centre and left half of the diorama is dominated by old oak trees and the right half by moorland, both habitats not common anywhere. The diorama communicated an illusion of untouched wilderness, and in combination with oak trees and almost vanished mammals a reminiscence of ancient Germanic primary forest ("*Urwald*") (Rusinek 2000), an ideal cultivated for a long time in Germany but misused by the Nazis as part of their ideology (Göring 1939; Zechner 2006, 2011).

The two European bison from Bialowieza Forest represent original vouchers of the last European bison population before its final extermination in 1919 (Mohr 1952). In 1923, the "*Internationale Gesellschaft zur Erhaltung des Wisents*" (International Society for the Conservation of the European Bison) was founded in Berlin by a group of German and Polish institutions and private persons in order to collect the last surviving animals from zoological gardens and parks, to build up a breeding group and to monitor the group by the international society. Their work was successful, and a herd of European bison could be released in the Bialowieza Forest again. In 1939, the Nazis took over the society by order of Hermann Göring, and the Polish members became victims of the German invasion of Poland. Bengt Berg, the Swedish preparator and writer who developed sympathy for the Nazi movement, tried to convince Göring to establish a Nature Reserve in NE Germany (Schulz 2000). At the end of World War II, most of the European bison in the Biolowieza Forest had been killed. The Bison Conservation Society was re-established after the end of WW II, and finally the international cooperation succeeded in the breeding of more than 3500 European bison. A large herd was again established in what is now Biolowieza National Park (Krasinska and Krasinski 2008).

Göring hunted moose in the Nature Reserve "*Elchwald*" (moose forest) in Eastern Prussia. He was obsessed by big trophies and did excessive hunting in the moose forest and elsewhere (Gautschi 1999). During an official visit to Bonn, he also came to see the newly opened Museum Koenig on May 15, 1935 (Fig. 3.3). He was shown around by the 77 years old Alexander Koenig, and was particularly impressed by the mounted mammals and by hunting trophies. Shortly after his visit, he made Koenig a member of his "*Reichsjagdrat*" (State commission for hunting), a position that Koenig never filled.

Fig. 3.3 Hermann Goering in front of the museum building during his official visit to Bonn in 1935 (Photo Archives of the Museum Koenig)

During his visit of 1935, Göring most certainly met Berthold Korf, staff member of the museum and the person who had joined him in the hunt for the moose. Korf had become a member of the NSDAP and was agitating in the museum against other members who were not in favour of the Nazi movement. Koenig admonished him to stop his propaganda, and when Korf continued, Koenig fired him in 1936. Korf made a case against Koenig, but the Court in Bonn judged that Koenig acted rightly. The following year, Korf was made leader of the police division (SA) in Bonn (Bothien 2005; Klein 2006). From then on, however, conflicts between the museum personnel and the Nazi Party and bureaucracy (Hutterer and Oesl 1998) increased, with the obvious intention of the Nazis to destroy the museum and its staff. Göring himself intended to overtake the Museum Koenig and other regional museums and incorporate them into his planned gigantic "*Reichsjagdmuseum*" (Hunting Museum of the Reich) in Berlin (Gautschi 1999). Political conflicts with his 'best preparator' led Koenig's museum almost to the brink.

We do not know much about the artist Viktor Stoetzner-Lund. His background paintings still await a detailed analysis, as does his life and work. Being an artist he signed his work, although not visible to the observer of the diorama. All twelve background paintings were completed (or signed) in 1933, which seems to be impossible to accomplish in only one year. Wonders (1990) in her careful review of background paintings in North American museums stated that some paintings took one to three years to be finished. I therefore assume that Stoetzner-Lund performed his paintings between 1929 and 1933, the year of the re-establishment of the museum as a governmental institution and the opening to the public in 1934 (Hutterer and Oesl 1998).

Concluding Remarks

At first sight, the European bison-moose diorama is a beautiful reconstruction of a piece of nature which fascinates the observer. At second sight, it turns out to be the result of a complex mixture of historical biology, political history, personal fates, specimen histories, skilled crafts and fine arts. Wonders (2003) pointed out that habitat dioramas may carry a potitical meaning, besides the notion of biological nativeness. As taxidermists and artists seldom leave written documents on their own work, the unravelling of the various histories is a challenge for historians with biological background knowledge. Documenting the historical network behind the illusion increases the value and understanding of the habitat diorama. A superficially treated assemblage of "stuffed animals" then turns into a unique piece of art and history, and even individual specimens may have a history of high interest to a wide audience (Alberti 2011).

There are many dioramas in museums around the world which tell interesting stories. I mention only two examples. Frank Chapman in 1902 designed the diorama "The Pelican Island Group" at the American Museum of Natural History, New York, featuring a breeding ground in Florida where plumage hunters had destroyed so many birds that some species faced extinction. The beauty of this diorama contributed to the decision of President Theodore Roosevelt to establish the first Federal Wildlife Refuge on Pelican Island (Wonders 1989). The pelican diorama is therefore a milestone in the development of the conservation movement.

The second example is the small diorama "Man-eaters of Tsavo" in the Field Museum Chicago. It shows two maneless male lions which were responsible for the deaths of numerous Indian construction workers on the Kenya-Uganda railway in 1898 in their thorn-bush habitat. The two lions were modelled on the basis of two incomplete floor rugs of the real lions finally shot by Lt. Col. John Henry Patterson (1867–1947) in December 1898. The habitat diorama not only recalls a dramatic historical incidence described by Patterson (1907) himself, but subsequently was catalyst for a number of research projects exploring the scientific background of J. H. Patterson's book and the phenomenon of man-eating in African lions (Kerbis and Gnoske 2001; Patterson 2004), and also for two movies based on this story.

As previous authors pointed out, habitat dioramas can be considered as pieces of art (Norris and Granquist 2006; Quinn 2006; Granqvist 2012). Evident similarities between habitat dioramas and art installations (which often use mounted specimens from other museums) also raise questions of the intellectual rights on creations such as habitat dioramas. Artists who contributed to habitat dioramas remained often anonymous, or their names were omitted on purpose (Wonders 1990; Norris and Granqvist 2006). In some North American museums background painters were not even allowed to sign their work (Wonders 1990). This sometimes led to the bizarre result that installations in art museums were credited to the artist, while the creators of the incorporated specimen mounts, biological groups, or even dioramas were not mentioned (Norris and Granqvist 2006). The relatedness and intermixture of the art of composing a habitat diorama and the fine arts should be accepted and further

explored (e.g. Blühm and Lippincott 2007; Adolfs 2009; Alberti 2011). Changing concepts (Köstering 2003) and personal preferences are no excuse for the dismantling and destruction (Wonders 1993a; Norris and Granqvist 2006; Morris 2010; Granqvist 2012) of the cultural heritage of natural history museums. The artistic, historic, and scientific value of habitat dioramas deserves a tactful acquaintance, careful study and preservation for the forthcoming generations.

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Chapter 4
A Window on the World—Wildlife Dioramas

Pat Morris

For most of the nineteenth century, the focus of museum taxidermy displays lay in showing variation within species and how each species differed from others. For this purpose, birds especially, were set up in identical poses to aid comparisons (Morris 2010). By the 1870s the idea of 'habitat groups' had developed, showing animals in a representation of their immediate surroundings (Hornaday 1891; Webster 1945), and were first seen in the Booth Museum, Brighton (Booth 1876), later at the British Museum (Stearn 1981). Dioramas grew out of this, to be re-creations of whole scenes, within which the animals were posed. The individual specimens often became almost subsidiary to the overall display, which was intended to convey a sense of place rather than a catalogue of species, an idea most vigorously promoted by Carl Akeley in America (Osgood 1927; Bodry-Sanders 1991). Major American museums, in particular, vied with each other to develop bigger and better dioramas, each generation being even more realistic than the last. Exhibits were often financed by wealthy big game hunters, such as George Eastman (founder of the Eastman Kodak Company) almost like giant souvenir postcards of their expeditions, with taxidermists accompanying the expedition to ensure total veracity in their recreations (Rockwell 1956; Clark 1966). Sadly many dioramas are now lost, due to new exhibition policies and the need for space to be re-deployed (Morris 2010).

Like photographs, dioramas serve to bring the outdoors inside. They make accessible places and things that would otherwise be beyond the personal experience of most people. Both offer the viewer an opportunity to see details of the wildlife of six continents, juxtaposed and in close up, without the discomfort, difficulty or expense of long-distance travel. The most dangerous situations can thus be experienced by proxy and in complete safety. In addition, it is possible to view groups of extinct creatures going about their daily lives. Today, television has become the principal medium for achieving this accessibility. Nowadays we are so accustomed to seeing wildlife depicted on screen, moving and in colour, that dioramas may sometimes seem false and frozen in time. Yet when many of them were first built, they were

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hailed as a major escape from the even more false depiction of nature provided by photography, offering only two dimensions and frequently lacking all colour.

In the past and even today, wildlife dioramas play a significant role in exhibiting preserved animals in a three dimensional display. Like photographs, they seek to convey messages about nature, but each medium succeeds, or fails, in a different way. Diorama exhibits represent a pinnacle of museum display technique, bringing wildlife to the people and recreating the illusion of nature, up to a point, by concentrating on recreating every last detail of scenery and vegetation (Mintorn and Mintorn 1850; Butler 1930), well as the finest taxidermy by the very best taxidermists such as Rowland Ward of London and the Van Ingen brothers of Mysore (Morris 2003, 2006). Unlike photographs, they are three dimensional, life size and with real texture to the objects within. Good dioramas can be constructed to convey many messages about ecological context, habitat, behaviour, structure and movement, whereas a photograph is limited by what is actually happening in the frame at an instant in time. This is rarely as rich in messages as it is possible to create in a diorama. I have several times been asked for a photograph showing at least five species of mammals and birds, to illustrate "Biodiversity in Africa" for example. Even in the species-rich Serengeti it is almost impossible to achieve this. Animals big enough to recognise fill the viewfinder, but using a wide-angle lens to fit in some more means the smaller ones are no longer individually identifiable.

Yet in a diorama, animals can be grouped together in less space than is natural. Dioramas can show various forms of animal behaviour simultaneously, each of which a photographer might spend a week trying to capture on film. They can include the big and the small, because the latter can be inspected closely in way that is impossible in the wild- for example flies on the prey of a lion. Dioramas can also cheat the hours and seasons by sneaking a nocturnal species into the corner of the display, perhaps in its lair underground. Seasons can be cheated by showing birds in their full breeding plumage, when the surrounding vegetation would no longer be in flower in the wild. Photographers cannot cheat in this way and so their images will inevitably contain fewer messages.

Creating a diorama is a multidisciplinary task, requiring technical input from artists, zoologists, botanists, and lighting specialists, to say nothing of the carpenters, taxidermists and model builders needed to physically build them (Quinn 2006). For added realism, samples of soil and actual vegetation are often collected from the scene depicted and added to the diorama itself. Leaves and flowers will be photographed in the field and modelled later in wax or resin. Rocks will be photographed and casts taken so that lightweight substitutes can later be cast using polyurethane foam.

Success depends on cheating perspectives to fit a thousand-hectare view into a mall room. Photographers can cheat perspective, by using lenses of differing focal lengths, but in doing so they achieve different effects to a diorama, particularly the foreshortening effect of telephoto lenses. Crucial to diorama design is solving the problem of linking the actual three-dimensional material forming the foreground, with the two dimensions of a painted scene background. Normally the latter is curved, to avoid the obvious unreality of having right angle corners in a distant view. However, making this curve blend with the foreground or a flat ceiling, with-

out a visible joint is exceedingly difficult. Painting on a curve also requires the artist to adjust his style in subtle ways (for example on alignment of the horizon and its level in the overall view). Creating a realistic diorama is a major challenge (Wonders 1993). Nobody notices when it is successful, but everyone is immediately conscious of the smallest failure. Photographers face none of these problems, but instead wrestle with depth of focus, an issue that doesn't arise in a diorama.

Lighting is also critical. In real life, as the photographer knows, light normally comes from above, but simple top lighting in a diorama causes awkward shadows and destroys the illusion of space. Deer in the magnificent dioramas of the American Museum of Natural History have the lower surface of their antlers painted white to soften the shadows created by overhead lighting. Hidden spotlights can be used to create special effects, lighting up a patch of ice in a gloomy winter scene for example. In some habitats the light has to be diffuse and sometimes augmented from lower down and some forest dioramas even have lights concealed inside tree trunks to obtain subtle lighting effects that mimic nature in an extraordinarily effective way. Some early dioramas in Sweden still rely on diffuse natural light, so they look different at different times of day in a very natural way (but are almost invisible at night or during the long winter!).

Dioramas can illustrate perspectives that would be difficult for a photographer to achieve in the wild, for example low down and close up in a herd of animals that normally are very wary of any approach. A diorama foreground can illustrate details of behaviour, for example the 'bill up' display of albatrosses or their single egg, whilst the receding scene and background depicts the regular spacing out of nests within a large colony. A photographer has difficulty accommodating such depth and also ensuring that the distant details are still recognisable. Dense tropical forests pose special challenges. Convincing dioramas are extremely difficult to create, just as photographs of the real thing are frequently disappointing. Natural light levels are very low indeed, creating a green gloom that looks very flat and dull in photographs. Addition of artificial lighting to the diorama overcomes this, but at the expense of naturalness. By contrast, the wide-open spaces of grassy plains are well lit, but often have no detail in the foreground. Both a photograph and a diorama will be enhanced by framing the view, using a foreground tree or shrub to create proximal detail and add a 'side' or 'top' to the scene. Underwater scenes are especially difficult to create as dioramas (Anthony 1933). Even the addition of flickering lighting fails to mimic the true sense of being submerged. Sometimes a diving bird or seal will be shown in a diorama. In life they would be glistening with air trapped among the fur or feathers and be accompanied by a stream of moving bubbles. These effects add greatly to the dynamic appearance of underwater photographs but are virtually impossible to recreate in a diorama. Fish often look dull (and sometimes dusty!), colourful invertebrates such as corals are hard to depict, and translucent specimens such as jellyfish rarely look convincing. By contrast, we are now so used to wonderful underwater photography, that we scorn the diorama's attempt to persuade us that we are in a watery realm.

The purpose of a diorama is to depict a whole scene and the actual specimens of birds or mammals may seem almost an afterthought, although they are central to the

purpose and artistic composition of the whole (Wonders 1993). Often scale models are built to try out various postures and positions for the key characters, just as a photographer might move his models about in the studio before pressing the shutter release. The difference is that a photographer can take a dozen different versions of his scene because each costs little or nothing. A diorama costs many thousands of times more; so the preliminary planning has to be right. There can be no second tries.

The taxidermy has to be right too. It takes upwards of six months to prepare an animal the size of a deer, sculpting an exact muscle-perfect copy of the body, taking a mould, then using it to cast an artificial body. Nowadays hard foams are used, but in the past the body was made from papier maché or chicken wire covered by plaster, with the skin laid on and modelled carefully to recreate wrinkles and folds in the body (Rowley 1925). This is a far cry from the concept of "stuffing", which many people assume still takes place, but which is as obsolete as the horse drawn plough. Sometimes small models can be inserted towards the background, enabling a group of elephants or giraffes, for example, to be accommodated within a modest space and also enhancing the sense of distance and perspective.

All this attention to detail can be severely undermined by a few specks of dust on the glass eyes of a bird or beast. Shiny leaves and lustrous petals become dulled by dust. Some dioramas are hermetically sealed to avoid this, others have their own air conditioning; expensive features that are invisible to the museum visitor. Ironically, it is air-borne dust that often forms a vital part of reality, and may play a key part in imparting dynamic to photographs of moving things. This is normally absent from dioramas, one of the things that makes them look staid and static. Yet a diorama in the Denver Museum of Natural History features a cheetah pursuing leaping antelopes. They are suspended in mid air, with no evidence of support and there are puffs of real dust hanging in the air bellow the galloping feet. Reality recreated, almost!

Photographic Note

Most public museums will not allow photographers to use lights and tripods to take photographs during visiting times, and charge high fees for special access arrangements. Photographing dioramas as a normal visitor is quite a challenge. Some modern dioramas have sloping glass to avoid reflections. More usually, the flat glass reflects a flashgun, so this has to be held well out to one side or high above the scene. Finger marks and nose prints on the glass, invisible to the visitor, are revealed by flash as though by magic! However, flash from outside the diorama represents a form of lighting that was not part of the original design concept, so the resultant photographs tend to be disappointing, not least because of the hard shadows that are cast on the supposedly distant background.

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Chapter 5
Dioramas as Constructs of Reality: Art, Photography, and the Discursive Space

Geraldine Howie

1 Introduction

The Powell-Cotton Dioramas are displayed within three galleries in the Powell-Cotton Museum, Birchington-on-Sea, Kent. The museum is adjacent to the home of the museum's founder, Major Percy Horace Gordon Powell-Cotton (1866–1940). The first diorama was started in 1896 and the final diorama was completed in 1955. In relation to other museum collections, the Powell-Cotton Museum has similarities in the culture of collecting and collectors, which established the Pitt-Rivers Museum in Oxford, the Ashmolean Museum in Oxford, the Natural History Museum at Tring, the Horniman Museum in London, and the Burrell Collection in Glasgow.

The viewer's experience encounters a number of natural habitat dioramas in large galleries, through which Major Powell-Cotton wanted to tell the story of the natural world for local people in Kent. The sizes of the dioramas are, in each case, deceptive. Panelled wooden screens approximate proscenium arches to frame large expanses of glass at the front of the dioramas. Behind the glass screens are depictions of nature and wildlife featuring taxidermy exhibits primarily created by the company of Rowland Ward, the noted taxidermist. Staged within the illusional space of these dioramas are the contradictions of spatial illusion in depicting the diversity of natural habitats drawn from predominately African locations.

While the Powell-Cotton dioramas exist behind large glass screens, their purpose follows an aesthetic relationship with the emergence of the natural habitat diorama and the ability to transfix perception through the re-interpretation of an idyll (Howie 2011). These natural habitat dioramas affect a remembering of a sense of place where a diorama reflects in Mieke Bal's view a three-dimensionality that draws on architectural space; it then considers the *three dimensional representation of the landscape within the diorama itself; the two-dimensional illusion of a trompe l'œil landscape painting; and the exterior space occupied by the viewer* (Bal 2001,

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pp. 114–115). With landscape, a sense of place anticipates various positions and numerous delays; it recollects the cognitive knowledge brought to the prospect that involves aspects in, of and about landscape.

The potential of the Powell-Cotton dioramas inspired an inquiry into developing an aesthetic for sculpture and architectural space, which would also be considered by means of reflected and mediated illumination. However, in focussing on the Powell-Cotton dioramas, the notion of a derived aesthetic attitude would lose ground due to their artificial, extraordinary and idiosyncratic nature. Therein it prepared the basis of interpretation in establishing 'theatres of landscape' as an open concept. Their particular idiosyncrasy was therefore described in comparison to the technical expertise given to the diorama landscapes of the American Museum of Natural History (AMNH) dioramas. Major Powell-Cotton would have been aware of the considerations of an aesthetic attitude as he had an extensive library and an active interest in art, culture and travel. However, according to Malcolm Harman he was methodical in wanting to tell the story of the natural world, (M. Harman, personal communication, March 8, 2007). In this regard his primary concern was to represent reality through the taxidermy specimen and thereafter include an aesthetic of romantic naturalism in developing a topographical landscape.

2 Museography

A 1993 Doctoral thesis written by Karen Wonders: *Habitat Dioramas: Illusions of Wilderness* (Wonders 1993b) was a critical resource in critiquing the Powell-Cotton dioramas to develop the argument within this research. Wonders' text was a constructive authoritative resource that was noted by experts in this field and alongside several papers. It enabled the research to consider the natural habitat dioramas as an ecological theatre. In addition, by providing an accessible visual account for the museum visitor and the wider public on factors important for the successful illusion of a natural habitat diorama, Stephen Quinn's *Windows on Nature* (2006) presented a documentary account of the natural habitat dioramas in The American Museum of Natural History in New York. Quinn's work therefore offers a second visual analysis of the craftsmanship reflected in the AMNH dioramas in their architecture, sculpture, painting, trompe l'œil, botany, zoology, and taxidermy, i.e. the technical skills that are evident to the process of creating the AMNH dioramas. Of the more discrete, diverse and distinct processes that were noticeable in Wonder's and Quinn's studies, the documentation and communication of these skills as socio-cultural documents was evident with regard to the demonstration of technical expertise and the convincing portrayal of a natural habitat diorama. In this regard, with the representation of taxidermy specimens in an artificial landscape, they provided necessary supporting documentation to critique the Powell-Cotton natural habitat dioramas.

In addition, their existence has been offered as an argument for the diorama's capability in developing educational awareness of the natural world. Therefore,

they reflect separate critiques in regarding the disparity between museums and ecological issues of the twentieth century. Although it was possible to relate to this area of knowledge from many different aspects, for example as *galleries of exhibition design based in the natural sciences* as opposed to *dead stuffed animals in the landscape*, in the US however, the foregrounding of natural habitat dioramas has continued to contribute to the knowledge of art as it relates to the communication, education, and widening relationship to the environment.

3 Representing the Landscape

Wonder's thesis was largely focussed on the dioramas established in Scandinavia and North America. However, no specific comments were made about the Powell-Cotton dioramas, although the sportsman's trophies were mentioned, albeit briefly, *as being on display in his museum at Quex Park in Kent*. (Wonders 1993b, p. 239 n. 74). In comparison Quinn's *Windows on Nature* gave a detailed photographic account of natural habitat dioramas in the American Museum of Natural History (AMNH), formalising the technical and aesthetic aspects of the various taxidermy objects in relation to fieldwork and the construction of the landscapes in the museum (Quinn 2006). Accounts of how the paintings made on the AMNH field studies of African locations were translated to model constructions to enable the accurate transcription of a diorama. From this initial information it appeared unlikely that this would be the case with the Powell-Cotton dioramas.

4 Illusion and the Early Diorama

While Quinn and Wonders are cited in the text for their specialist knowledge to critique the Powell-Cotton dioramas in their gallery setting, the inclusion of Louis Daguerre's (1787–1851) diorama was developed as a comparison to theatrical effect. Augustus Charles Pugin (1762–1832) an émigré and architect working for John Nash on the terraced houses of Park Square and Park Square East had been chosen to design Daguerre's Diorama. As the first diorama building in England, it was situated on Park Square East a terrace located on the corner of Regents Park (Altick 1978, p. 163). This was an art historical influence that could not have escaped Major Powell-Cotton because Pugin's son A.W.N. Pugin (1812–1852), a famous architect and designer in his own right, had lived a short distance from the museum in Ramsgate. Altick's work, held in the Zoological Society of London archives, shows that when Daguerre's Diorama was opened in 1823, it was a short walk from the Society's headquarters while close by, and in the opposite direction, London Zoo had opened in 1828. It then became influential in understanding how Daguerre's diorama preceded the natural habitat diorama in a separate and credible manner, as Daguerre was renowned for *trompe l'œil* and illusional effect (Altick 1978, p. 163).

Due to a pronounced ability to communicate visually various aspects of art, theatre and stage design, Daguerre's diorama had created both performative and illusional affects that markedly transported the viewer immersed as they were in a 'suspension of disbelief'. As such a 'suspension of disbelief' is a necessary element that would affect the nineteenth and twentieth century viewer with varying degrees of success. In this respect Bal indicated how ... *endorsing the willing suspension of disbelief* (is one) *that rules the power of fiction* ... in contrast to a *discourse of realism* and the … *contract between the viewer or reader and the museum or storyteller* (Bal 2006b, p. 175).

In comparison, Louis Daguerre's diorama, in 1823, shares the same relationship as cinema, as the viewer is seated in a fixed location and reliant on both narration and the camera respectively in/ or in not showing different perspectives yet *creating a sensory environment of light and colour*. Daguerre would have observed success in relation to the darkness of the viewing area (Altick 1978, p. 165). Altick pointed out there were two reasons for the exclusion of light—to maximise the use of available lighting and to increase the sense of illusion. Daguerre and his partner Bouton would have been aware of this, as Altick states, *theatre auditorium lighting was not extinguished during a performance*. There was also a suggestion of the moving image—as Altick says, the image of Canterbury Cathedral *seemed to moving out of the field of vision. Actually*, stated Altick, *it was the theatre in motion, as it turned from one tunnel to another* (Altick 1978, p. 165). It is in this respect that the archaeology of the moving image has one of its precedents in Daguerre's diorama and continues to develop 'the potential for the interdisciplinary study of art and film' (Bruno 2007, p. 60, 428 n. 24).

5 Historical Background

Several generations of the Powell-Cotton family have contributed to Quex House, the collections and the Quex Estate as it exists today (The National Archive—East Kent Archives Centre, Jordanova 2000). Between 1719 and 1881, three generations of the Cotton family worked for the East India Company, travelling and trading in China. Thereafter, and over successive generations, individual members of the family would contribute to the diversity of the museums wider collections including the natural habitat dioramas, and the anthropological, ethnological, ethnographical and archaeological collections.

There is a great deal of evidence about the nineteenth century and the opportunities that had come from the industrial and agricultural revolutions, which lead to an explosion in travel, travel writing and collecting. This could have motivated Powell-Cotton, however active service was a family tradition and from this historical perspective Powell-Cotton would have begun to develop his knowledge of the art and culture of foreign countries, and a burgeoning interest to explore other countries and their cultures. It is obviously easy to speculate, but if he did want to tell the story of the natural world, Powell-Cotton had to find the means to do so

and this would have developed over time. Powell-Cotton's interest in society and different cultures was reflected in his role(s) in the local and wider community He was for example: a Fellow of the Royal Geographical Society, Fellow of the Zoological Society and Fellow of the Royal Anthropological Institute, his rank with the Northumberland Fusiliers was Major, and he became a Justice of the Peace. Therefore, once Powell-Cotton had become aware that he wanted to display the growing volume of taxidermy and various artefacts in the museum, along with the knowledge and understanding that he began to acquire from the expeditions, these activities would also contribute to exhibiting the taxidermy within the natural habitat dioramas.

6 Photographic Documentation

How can we now interpret his actions or evaluate or measure his achievements? To a large degree the information about the dioramas relies upon their physical visual evidence and their documentation in the archives. In observing a number of the early photographs of landscape in the archives there was an immediate overriding sense of emptiness in the landscape. A number of these images held little description or narrative while others are re-developed photographs and scans which therefore alter the temporal effect of the photograph as a result of later technology and different processes.

The visual and archival evidence primarily relates to Powell-Cotton's interest in travel, hunting, collecting, taxidermy and his relationship to the topographical landscape. This would have been increasingly well documented as the biographical detail on Powell-Cotton includes a reference in the Pitt-Rivers Museum: "*During their expeditions Powell-Cotton and his wife Hannah made field notes and took numerous photographs. From the 1920's he also recorded many of the cultures encountered using cine film.*" (http://southersudan.prm.ox.ac.uk/biography/cotton/ accessed 14/07/08).

This evidence brings into question the architectural significance of constructing these dioramas in forming his recollections, and questions any assumptions we might have about visual memory. That is, to what extent are the dioramas an imaginary construction or an attempt at authenticity capturing the inspiration and stimulus offered by a foreign topographical landscape?

A museum pamphlet held in the Royal Anthropological Institute (RAI) archives listed the extent of Powell-Cotton's hunting trips and expeditions between 1889 and 1927. It also stated the museum collection already held 3,000 zoological specimens and the dates would correspond with the archive boxes referencing the early hunting expeditions and his activities in the Northumberland Fusiliers. As was the case with many families at that time, the political culture of the period and a background of military service would have accustomed Powell-Cotton to the disposition of expansion of the British Empire (Cain 2004). A military background with the Northumberland Fusiliers then enabled the exploration of different continents,

regions and terrains, these experiences would have supported and contributed to the skills and abilities necessary in exploring, collecting and then developing the museum dioramas. It is the perception that it is because of these experiences that his hunting expeditions had become increasingly well organised. Although it appears there are no images of the Himalayan hunting expeditions in the collections, the archive boxes of photographs include boxes referenced as Northumberland Fusiliers—dated 1885, 1889, and 1891.

In total 26 years were later spent living and exploring many areas of the African continent, breaking for the First World War and then resuming until the outbreak of WWII in 1939. According to his son, the late Christopher Powell-Cotton, the expeditions were frequently made with him as a lone European backed by a team of assistants (Lang 1998). There is some evidence however that on at least one expedition he was accompanied by an F.C. Cobb. Furthermore, after marrying Hannah Brayton Slater in Nairobi in 1905, his wife and later his children to some extent took part and contributed to the museum collections.

Following the earlier military manoeuvres and expeditions in Burma, India, Pakistan, Tibet and China, it was apparent from his journals, that his first hunting expeditions were in the Himalayan region of Baltistan, Ladak and Kashmir. This would indicate routes like the Karakoram Pass; and Silk Road to China were known to him and that he would be fully aware of the Himalayas as a dramatic backdrop. On his return from these expeditions he would have organised each stage of the building of the original museum pavilion and the later extensions, in addition to any concerns regarding the progress of the mounted taxidermy and dioramas.

This is reflected in other photographic evidence of the museum and dioramas in construction. These include images viewed through the scenes of accumulation—the animal skins, horn, bones and skeletons, traversing the empty spaces of the museum in the early photographs. Thereafter, there are images of taxidermy being delivered to the museum. To some extent his wife may have influenced further documentation due to Powell-Cotton's absences' as Hannah Brayton-Slater was Powell-Cotton's secretary before becoming his wife. However, the photographic documentation indicated that the trompe l'œil painting, particularly in the Kashmir diorama, did not occur until a later date, and that further alterations to the interior tableau were predominately due to later inclusions of taxidermy. The boxed collections of photographic evidence indicate that Powell-Cotton and his family were clearly interested in photography, which by its nature in the field was also monochromatic. It would, however, be reasonable to assume that this may not have influenced any decisions in painting the early dioramas; certainly there are early photographs of landscape in the archives that are less than inspiring.

According to Karen Wonders, A.E. Parr (a former director of the American Museum of Natural History), *noted that in the early days of photography, the camera was to slow to capture living scenes from nature*. (Wonders 1989, p. 136). As such this may be a further consideration that could have inspired Powell-Cotton to construct these dioramas.

7 Taxidermy and the Diorama

Within the museum Powell-Cotton eventually built eight dioramas to accommodate the taxidermy specimens obtained from the hunting expeditions. Several of these are of a vast scale to artificially describe the various locations, and the wildlife and the natural world he had experienced. As the museum visitor enters the galleries holding these dioramas, they find interpretations of artificial idylls virtually unchanged since the first installations a 100 years ago. They also find taxidermy specimens of 'wild life' previously unknown to that period, e.g. the Mountain Nyala discovered in 1908 and different sub-species of, for example, Zebra, Antelope and Gazelle, amongst many different varieties of wildlife. These are all described through the illusory aspects of modelling which are intended to describe animal behaviour.

According to Karen Wonders, Roland Ward's craftsmanship had been established and his position was demonstrably furthered by *his wildlife sculpture displayed in international exhibitions, beginning in 1862 in London* (Wonders 1989, p. 137). Thereafter Rowland Ward & Company's considerable skills in the taxidermist's art form enabled them to become internationally successful with their craftsmanship and reputation acknowledged in numerous collections today (Illustrated London News 1874). Although not the only taxidermist to be employed, Ward's expertise had enabled Powell-Cotton to re-create his mounted exhibits from the skins, skeletons and bones deriving from his expeditions for the purpose of display, while other specimens would be donated for scientific study and exhibition. Within the archives there are records that relate to the Rowland Ward taxidermy as well as accounts of the animal's classification, original location, and the costs of taxidermy. The photographic documentation references the transportation and delivery of e.g. the elephant specimen by steam wagons, and the storage and later installation of the mounted exhibits in situ. In its day taxidermy was considered a fine art form, and primarily this was due to the taxidermist's skill in the '*fidelity to nature—as opposed to theatricality*' (Wonders 1989, p. 138). Wonders in '*Habitat Dioramas—illusion of wilderness*' then refers to articles that cited the: … *scientific and artistic truth of Mr. Ward's reproductions of animal forms by a correct anatomical use of their natural covering, which is not stuffed, but placed on a cast, moulded to show the muscles in action* (Wonders 1989, p. 138, 1993b p. 38)

This attention to detail in which taxidermy had begun to be viewed as an art form is recalled by Stephen Quinn. However, Quinn makes the following statement: *The Hall of North American Birds opened at the museum in 1902 and was the world's first museum hall entirely devoted to the habitat group method of display, which today we call habitat dioramas* (Quinn 2005, p. 16). Obviously Quinn may quibble that a Hall as opposed to the gallery is quite different, but the habitat group as he describes it, clearly references Powell-Cotton's first natural habitat diorama, which had begun construction in 1896. However Quinn also indicated that the 'golden age of the diorama' was made apparent with Carl Akeley's 'Hall of African Mammals' in 1936, when "nature seemed enshrined in a grand architectural space" (Quinn 2005, p. 18).

Within the AMNH dioramas, the successful illusion of the painted landscape merging with the foreground also translated to their picturesque qualities, in addition to an aspiration to interpret an American natural wilderness, amongst others, as descriptions "*in a lighter spirit of sentimental romanticism*." (Wonders citing A.E. Parr 1990, p. 100). Quinn draws upon the taxidermy process of working with measurements taken in the field, using the animal skins, and the skeletal bones, each exhibit having their mass re-introduced from these calculations and then artificially reconstructed using clay and plaster moulds for papier-mâché casts. These illusionistic devices included glass eyes selected to develop a sense of realism for each exhibit. From the early beginnings of working with birds and smaller animals built up from wire frames, examples of larger exhibits described how: … *taxidermists would construct a crude mannequin on which the skin would be sewn or they would literally stuff the sewn elephant hide with various fillers such as rags, sisal, and excelsior, hoping that when they finished, the end result would come close to resembling a living elephant*. (Quinn 2005, p. 161) The move from 'stuffing to sculpture' was noted by Quinn in describing the work of Carl Akeley, a taxidermist at the AMNH. Akeley's method would create the '*realistic folds and the characteristic wrinkles in the elephants*' *hairless skin*…' and by '*manipulating the elephant's real skin with the pliable clay*'. (Quinn 2005, p. 161) This method was used to create a major centrepiece in the museum—the herd of African elephants; to depict the stance of these large exhibits armatures were built into the animal's skeleton. To display the animals musculature the clay sculpture was modelled onto this framework before the skins were stretched over the reinterpreted carcass and then sewn into place. A series of steps would then be methodically taken which Quinn details to enable the end result that would reveal: "*an anatomically correct, lightweight mâché model of an African elephant inside its own skin*." (Quinn 2005, p. 163)

8 Animal Studies Group

An alternative view in regard to taxidermy and hunting was considered through the Animal Studies Group as they deconstruct historical views through different perspectives and reflect upon the debates that have surrounded '*human power over animals*' (Baker et al. 2006). They stated collectively in their introduction: *Killing an animal is rarely simply a matter of animal death. It is surrounded by a host of attitudes, ideas, perceptions, and assumptions*. (Baker et al. 2006, p. 4). In *Killing Animals* several essays reflect this Groups' ideas: Diana Donald debated the different attitudes surrounding the paintings of Edwin Landseer; Garry Marvin considered the views of John Abbink on violence toward animals. In drawing upon these, as well as Steve Baker's reflections on animals in contemporary art, the Animal Studies Group sustain an area of contemporary research that has resonant links to this study. What was also determined from Wonders and the Animal Studies Group research is that the hunting and killing of animals have a conceptual and ideological basis that is defined at a distance to hunting as a popular sport in the nineteenth

and early twentieth century. These debates therefore go beyond the evidence of the sportsman's trophy or the numerous books on hunting written as biographies and autobiographies. Even so, the taxidermist's craftsmanship had successfully entered the family home and the public museum (Robertson 2006; Wonders 1989, 1990, 1993a and 1993b); the animal skins and skeletal remains that were destined for the taxidermist provided the evidence of the sportsman's kill through the trophy and the mounted exhibit.

Because of the considerable evidence of the wanton killing of wildlife during the nineteenth and twentieth centuries, these debates have centred on many contentious issues, which are also informed by colonial and post-colonial positions. Further concerns that regard the exhibition of large numbers of dead stuffed animals are exacerbated by the condition of the 'mounted exhibits' (the preferred term of reference for the taxidermist's craftsmanship). A contemporary exhibition at the Horniman Museum in 2007 had demonstrated this point, *The Cultural Life of Polar Bears/ nanoq: flat out and bluesome*, in which photographic images of polar bears in different states of repair was strongly connected to the issues surrounding the actual plight of the polar bear today (Snæbjörnsdóttir et. al. 2005). At the time the loss of the polar bears' natural habitat was alarming those communities who are concerned with the ecological issues of the melting ice cap (The Independent on Sunday, 2007). It shows how and why the destruction of natural habitats is of palpable interest to the general public today. It contrasts with the diorama displays in North American museums in receiving a massive investment programme involving millions of pounds that would support the educational programme.

However, Major Powell-Cotton had become disturbed by the extent of killing on these hunting expeditions and therefore increasingly worked in a scientific manner with regard to the classification of species in the field (M. Harman, personal communication, March 8, 2007). This in turn led to certain species that have been identified and then classified with Powell-Cotton's name—evidence of which were displayed in the photographic displays within the Sainsbury African Galleries at the British Museum in 2007. The significance of the Powell-Cotton Museum's archived resources is demonstrated by the bones of the gorilla; as an archive and resource for scientific study it is available to scholars and research students from around the world; this has arisen entirely because of the extent and condition of the archived resources.

9 Art and Architecture

The Powell-Cotton dioramas range in size from compressed shallow spaces to large volumes of space that contain numerous exhibits and various representations of a natural habitat; they were built specifically to allude to the animals' natural environment within the landscape. The aim of the dioramas was to contrive a natural habitat in a realistic illusion of the natural world; as such they are artificial representations that were derived from Powell-Cotton's perceptions of landscape and his experiences as a traveller and explorer to then interpret these sightswithin the diorama.

In moving through large open spaces of the galleries containing these dioramas, the viewer is moving through a low-lit environment designed to increase the effect of the illusion. In 1994 Henri Lefebvre had described 'representations of space' which are: *"… tied to the relations of production and to the* '*order*' *which those relations impose, and hence to knowledge, to signs, to codes, and to* '*frontal*' *relations*" (Lefebvre 1994, p. 33). However, to solely perceive the Powell-Cotton dioramas in this way does not fully recognise how these dioramas were viewed in the early twentieth century or the twenty-first century (Bruno 2007/2002; Crary 1992, 1999; Gombrich 1996; Wonders 1993b). Recognition implies the perceptions and feelings that can describe pleasure, awe and wonder that a convincing natural habitat diorama can inspire, and a recollection of the ambivalences and ambiguities, both positive and negative, which were explored in the thesis (Howie 2011). For the viewer looking into spaces that open onto different 'idylls' there is a false sense of security in the sensed movement because there is no sense of threat; these taxidermy specimens are long dead, they have been stilled, they may watch but they do not see. They stand behind large sheets of glass in a setting that plays with the idea of another place, but you are here and so are they and you are very much alive. In contrast to these views Victor Burgin (1996) distinguishes different approaches to spatial practice, he says: "*The most fundamental project of Lefebvre's book is to reject the conception of space as* '*container without content,*' *an abstract mathematical/ geometrical continuum, independent of human subjectivity and agency*" (Burgin 1996, p. 26, 27).

Powell-Cotton's journals contained many entries about looking at art and architecture between 1889–1891 with numerous visits to museums and sites of architectural and archaeological significance. However, in Paris the transcribed notation from his journal described the Paris Exposition of 1889, where the central attraction had been the Eiffel Tower and the exposition itself was considered as a celebration of French achievement in the centennial of the French Revolution. A number of locations and attractions at the Exposition were mentioned and while there is reason to think he used his camera, the journal notation briefly stated 'the French colonies and villages are good' and that the Edison phonograph was 'clearer than in London'. According to Jonathan Crary *… the Exposition of 1889 was unprecedented for its extensive presentation of colonial peoples and lifestyles as object of spectacle. Simulated "villages" inhabited by Congolese, Javanese, New Caledonians. Senegalese, and others became contents of imaginary imperial space, contents that were assimilable into the rationalizing "taxonomy" of the exposition's organizational schema* (Crary 1999, p. 231). Colin Rhodes also developed an ongoing critique of this and later expositions in addressing the concept and roles of Primitivism. It offered a number of contrasts to the historical relationships of culture, primitivism and modern art, where for example Gauguin famously left France in search of the primitive, which says Rhodes "*was spurred on by his by his experience of the colonial pavilions at the Paris Exposition.*" (Rhodes 1997, p. 69).

The anthropological and ethnographic exhibits that were mentioned by Powell-Cotton included: a panorama of Paris; dioramas that had a work-based theme; the History of Habitation Exhibits, and several mentions of the Annamite Theatre. The latter therefore provoked further research and identified the Vietnamese theatre and

a number of Javanese dancers that would become synonymous with the cultural quest for new sounds and new experiences (Fauser 2005, p. 183). While various accounts derive from the Vietnamese Theatre and the Javanese dancers, the different sound of the Gamelan had created a great deal of interest at this Exposition. As such the Gamelan has attracted a degree of scholarship to reconsider how music was received and re-interpreted at the turn of the nineteenth century. In particular, Professor Annegret Fauser's: *Musical Encounters at the 1889 Paris World's Fair* (2005) as a reconstruction of these musical events was helpful in developing an understanding of the Gamelan and the performance that Powell-Cotton had heard and seen. The actual sound of the Gamelan would have been of particular interest to Powell-Cotton firstly due to the Campanile, a bell tower that was built on the Quex estate in the same period that the house was rebuilt by John Powell Powell (1767–1849), and, secondly in relation to the growth of the museum's porcelain collection (Lang 1998), in which porcelain when struck has a high ringing tone denoting the acuity of its provenance (Savage et. al. 1985, p. 227). Whereas the Gamelan's authenticity would 'strike' its relationship to bell ringing, it also influenced Debussy and the Impressionists due to its particular qualities of sound and affect (Fauser 2005, p. 200).

Following the Exposition, travelling on to Spain, Powell-Cotton visited the Prado and the Alhambra Palace as well as catacombs, palaces and exhibitions before arriving in Cairo, and by way of the Nile he then went on to India, finally arriving in Bombay on the 26th November 1889. The transcriptions in the journals described the places he visited and his thoughts with several mentions of zoos and hunting expeditions. Of these hunting expeditions, some at high altitudes, he had noted walking quietly across bare rock to pursue his target. However, his journal notation also described an evocative journey and beautiful places that included the 'Adhalu jungle', the 'river at Kallubar', the 'temples at Jurnagadh' and many tombs, wells and underground temples. This sensual awareness in his early journals therefore performs an important link to the physical interpretations of the dioramas. From this perspective the traveller explorer has (at times deservedly) a negative and often destructive image. Petrine Archer-Straw has stated: *From the 1860's, Africa operated on the level of the real and the unreal, at once the site of civilising missions and scientific expeditions and the 'heart of darkness' where every expedition was like a personal journey into the unknown to confront one's own fears and phobias. Africa was the dark continent in both geographical and psychological terms, fuelling fantasies for the driven, disillusioned and disaffected of European society who sought a place to lose, to find or to expand oneself* (Archer-Straw 2000, p. 30).

The historical aspects of the museum's collections then develops a relationship to the 'architectonics of embodiment' considered as an *open dialectical structure* (Veseley 2000, p. 38, 40, 41). Within this relationship was the floor plan held at ground level, the elevated height of the galleries and the overall size and scale of the museum as the museum began to grow. However, this reality was not only a functional practicality—there was a relative status to the foundation of the museum and the museum dioramas.

10 Diorama Construction at the Powell Cotton Museum

Fifty sub-species of wildlife were named after Powell-Cotton with 48 sub-species still carrying his name. The Major, was a serious hunter, collector and naturalist who sent specimens to the British Museum and the Royal College of Surgeons. Definitive longitude and latitude references for an animal killed in the field therefore indicate each animal's original geographical location, which provides valuable resources for further scientific research material (M. Harman, personal communication, March 8, 2007). However, there is no written documentation, or very little, about the construction of the dioramas by Powell-Cotton and only a small amount of photographic documentation, consequently much of what is known was passed down orally. Few curators have come into direct contact with these dioramas or the museum collections, therefore background knowledge on the taxidermy, the dioramas and the archives pertaining to them, seems to have been held by the family and through the memories of the curators they employed. The taxidermy correspondence with Rowland Ward & Co. forms an extensive archive and there were, he stated, very large amounts of money spent on the taxidermy. Harman also stated Major Powell-Cotton did not tan the skins, which may have been unusual, and therefore the preparation of the skins is such that there was little fading or deterioration.

11 Constructing a Three-Dimensional Topographical Landscape

Powell-Cotton, who died in 1940, was precise about the construction of the dioramas in his care. The structure of the 'rock-work' in his dioramas was created from packing cases and the labour of the estate workers, while concrete was used on the surface exterior. According to John Gloag's *A Short Dictionary of Furniture* '*Rococo is a word derived from the French rocaille, which means rock-work … it is a term used originally to describe the artificial grottoes and fountains in the gardens of Versailles*' (Gloag 1952, p. 392). As such Gloag's notation created a visual and theoretical link to Watteau, together with the influence of the Rococo and trompe l'œil. While John Bull Scenics, a theatrical prop company from Margate had been employed, a Mr. Woolls painted the main scenery in what is now Gallery 1– this was finally completed in 1947 and although in 2007 the employment history of Mr. Woolls was not known his painted scenes were regarded as the finest landscape painting within the museum, (M. Harman, personal communication, March 8, 2007). The main diorama in Gallery 3, also known as the 'Angola case' and completed much earlier in 1908, is the largest diorama. To date the only record of landscape painting in Gallery 3 was assigned to a recuperating 1st World War Belgian soldier, when Quex House and the museum was used as a hospital during WW1, (M. Harman personal communication, March 8, 2007). Furthermore. when the first diorama was started in 1896 the wall mounted exhibits of animal heads and skulls

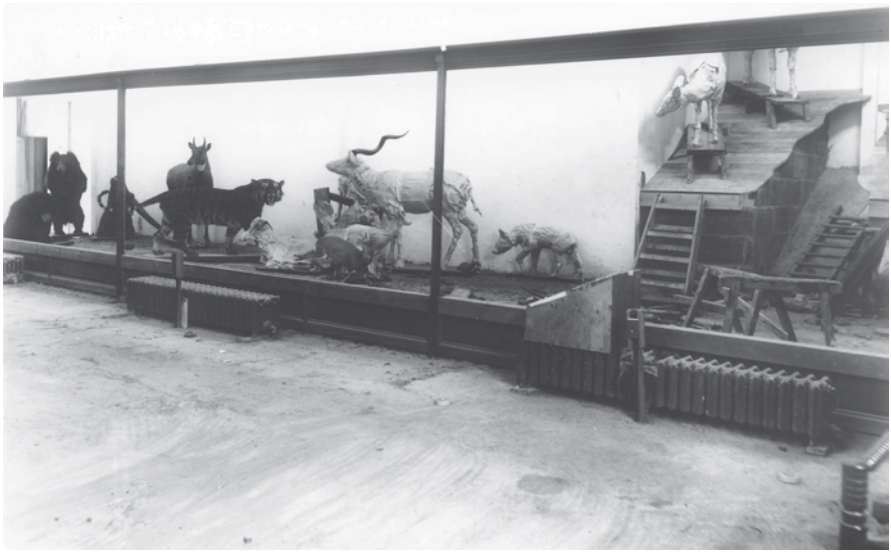

Fig. 5.1 PCM Case 3 Gallery 1—Red Sea Hills 1938

i.e. the 'sportsman's trophy' would be displayed adjacent and opposite the newly built Kashmir diorama. A letter written by Powell-Cotton in 1925 in Nigeria had indicated the idea for a new gallery as the third and final phase. Later photographic evidence had demonstrated the glass for Gallery I being delivered in 1939—that is Gallery 1, as we know it today.

Powell-Cotton's increasing knowledge and experience of the landscape and the diorama (which implicates the inconsistencies in different styles of the diorama case), would justify eliminating a straight re-interpretation of the landscape from photographs alone. In these black and white images supplied by the Powell-Cotton Museum (Figs. 5.1, 5.2) we see an emerging landscape that formed the topography in the diorama as we view it today (Fig. 5.3). Topography and landscape were obviously important to Powell-Cotton; he had also wanted to place his taxidermy specimens so that they would be seen in their most natural settings, as such it is a different comparison to the 'pastoralist presence' with regard to the story and the overall nature of natural history in these dioramas.

The effect of these ideas considers how sensorial affect could imply a growing anthropological knowledge that stimulated the response to the dioramas. In this respect the depiction of a topographical landscape in these natural habitat dioramas also recollects the sensual experience that develops both conscious understanding and comprehension as it corresponds to different types of knowledge participating in cognitive experience.

Powell-Cotton's interpretations of his own experiences, although communicated in a very practical manner through these dioramas, had also demonstrated an

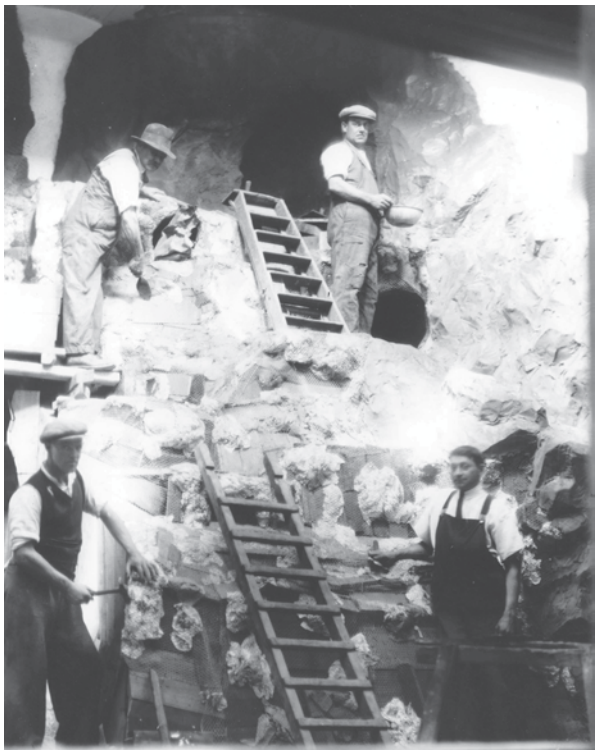

Fig. 5.2 PCM Rockwork Case 3 Gallery 1 1930's

underlying interest in rhythmic movement particularly in the Angolan diorama with the placing of the varied taxidermy exhibits. Therefore it questions the intentions in creating the topos of flora and fauna, i.e. in wanting to tell the story of the natural world this contrasts to a scientific exploration of wild life. It therefore contrasts to the fictions that are inherent in these three dimensional topographical landscapes where the viewer's participation is required to complete an illusory staged effect. It is conceivable that Powell-Cotton had inadvertently tried to formalise aspects of the savannah and river diorama in Gallery 1 into the more widely known biome today. Furthermore the majority of people at that time, would not have seen or known of the transposition of salt plains to equatorial forests—both dry and wet, to sudden luxuriant growth in the savannah, creating the further possibility this may have strongly motivated him to create these unusual dioramas within the museum.

12 Gallery 1

There are four cases in Gallery 1, they include the savannah diorama on the left of the entrance archway. Adjacent is a case of great height known as the Primate display and this is the first case seen as it is directly in front of the entrance arch. On the

Fig. 5.3 Case 3 Gallery 1—KwaZulu Natal & Red Sea Hills—9th March 2007

right is case 3, which has a small division—the closest display to the Primate case is a case said to represent the central forests of India. But on the nearest side of the partition is the final case that comprises various locations depicting a river scene, alongside 'the Red Sea Hills', and desert sand scene.

13 The Savannah Case

In the large Savannah case the painted grassland backdrop drops away into a distant horizon on the left-hand side with a stream populated by trees along its edge. The move from a physical topographical landscape to a painted *trompe l'œil* landscape is fairly subtle. As such, *trompe l'œil*, as a two-dimensional illusion would inform Mieke Bal's views on narrative and performativity (Bal 2006a, 1994), in doing so Bal re-positioned *the cognitive relationship of a diorama to the concept of a discursive space* (Bal 2006b, p. 175, 201–202). In contrast, Susan Stewart considered *trompe l'œil* through presence: … *One of the ways in which a painter can explore the cognitive boundary between displays of death and displays of life is through the art of trompe l'œil—tricks of the eye that suspend animation*… (Stewart 1994, p. 214).

Within the Savannah case (Fig. 5.4) the painted landscape is a spatial illusion of distance and perspective it creates a panoramic view of a savannah that includes long grasses, acacia trees and a blue horizon well into the distance to draw the attention of the viewer to a sense of place. Here a line of trees has a foreground of real trees to enhance the illusion, there is the sense of an artistic influence at work, which is more methodical than intuitive in its approach and where colour describes rather than explores the view. Topographically the main section has an illusion of a grassy hilltop in the immediate distance while blue mountains are depicted in the receding

Fig. 5.4. Savannah Case—viewed centre right

distance. The scene moves from open savannah to woodland and then to the right hand section, which portrays a forest area; this builds towards the foreground and completes the scene.

The width of the diorama is 47 ft and 22 ft 6 in. in depth; while on the right the forested area drops back a further 15 ft (this then is matched to the primate case adjacent to it with the cases separated by a narrow passage). At the sides and overhead wooden panelling performs the approximation of a proscenium arch above and at each end of the large glass screen, that was installed in sections using large plate glass. Each section of glass has a width of 14 ft 2 in., while a low wood panel reaches 16 in. from the ground to the glass. The height of the glass is 5 ft 9 in. before meeting another wooden panel overhead; the actual interior of this diorama is higher but this was not measured. The far corners of this diorama are skilfully painted to disguise the rectangle of the diorama, with vegetation and mounted exhibits placed specifically to draw attention away from the rectangle. For example a giraffe in this left-hand corner is grazing the land. Its neckline takes an approximate 45º angle to the floor, while the neck is in a direct diagonal to the corner when viewed from the mid-centre section. The front legs are splayed, widening the viewer's angle of vision and the back legs are upright in keeping with the stance of the giraffe's behaviour. An indication of the height a giraffe can reach is given with a second giraffe beside it, but this is a different species indicated by the markings and the information panel. As you walk into the gallery this second giraffe's neck appears as if it is cropped off due to the low height of the front screen. This lowered height is a standard device in constructing the diorama and useful in concealing both spot and indirect lighting (Wonders 1993b, p. 209). Drawing nearer the giraffe begins to seem twice the height of the glass screen and you have to stand close to the glass to see the full size of the giraffe.

In the foreground the topography on the left and mid-section is of a rock like ground. It is constructed from concrete with dried scrub grass and trees inserted into the diorama floor; while the ground has been divided by an artificial stream and alongside the artificial waterside are dried bulrushes and reeds. The right hand side uses dried palm leaves, reeds and small trees to increase the contrivance and illusion of an equatorial forest. Behind the taxidermy and this foliage is a hidden door and beyond this is the maze of corridors feeding the museum. Numerous taxidermy specimens of wildlife have been staggered in their placing to 'crowd' the foreground and midground while several trees are placed to the back of the centre section with a type of net dangling from the branches. These are probably birds' nests 'Groups of oropendolas' who 'hang their woven nests from tree branches'. Confusingly it was noted this bird lives in the habitat of the tropical rain forest not the savannah, therefore although these birds place their nests on the edge of the forest; this questions if their perspective here may be slightly off.

On the right hand side where the woodland merges into forest, the palm leaves, which may originally have come from the estate hothouses, mingle with reeds and small trees to also cover the hidden door—the impression is that a densely painted artificial construction of foliage that attempts to represent the equatorial forest but it retains the impression of idiosyncrasy. This construction has a further function as it is placed across the hidden door and either side of it and this may account for the foliage being excessively overdone. Behind the taxidermy and the door is a narrow passage to the corridors feeding the internal routes of the museum. The artifice used to interpret artificial glass pools that have been set into a forest floor was demonstrated by a strong blue colour painted on the sides, which draws upon the depth, fragmentation and glitter of lapis lazuli that Powell-Cotton might well have seen on his travels. Amongst the mounted exhibits of the wildlife, a Nyala stands floor to the tip of its horn at 6 ft and a Buffalo stands floor to the shoulder at 5 ft. Other animals include the Giraffe, Hartebeest, Antelope, Oribi, Zebra, Wildebeest, Bushpig and Warthog. In '*The Journal of the Royal African Society*', dated July 1904, no. XII, Powell-Cotton gave an account of a journey from Mombassa to Northern Uganda in 1902. The account details the places and animals he had seen and mentioned: the banana trees amongst the vegetation, the giraffe, dik dik, and hartebeest and the herds of roaming elephant. By travelling and writing about Mount Elgon, he was participating in the growing accounts describing this particular area that is renowned for the fauna and flora discovered there (Powell-Cotton 1904a, b, c; Royal Botanic Gardens, Kew 1907, 1933 and 1937; Cotton 1932).

14 The Primate Case

The Primate display case (Fig. 5.5) has a glass façade, which is 24 ft high. It is an amazing sight directly opposite the entrance; it also contains a structural 'narrative' that indicates to the viewer how monkeys, chimpanzees and gorilla inhabit their domains at cliff, tree and ground level. The lighting of the display is romantic and evocative of an idealised scene, although the painting is discrete as the structure

Fig. 5.5 The Primate Case

and vegetation takes precedence. At first glance there is the impression of a huge cinematic screen, until you approach closer, and realise the three-dimensional contrasts behind the glass screen are solidly still and artificial. It could be described as a showstopper, but your imagination cannot travel through this artificial landscape because of the nature of the shallow space. The display of taxidermy when compared to the spatial volume and exhibits in the Savannah diorama on the left also lessens in impact when seen in close proximity. This case appears to have replaced the original 'monkey tree' suggested by photo-documentation in the archives. As a consequence not only is the current Primate case more successful, but the older photographic image is another reference to the period of transition between the linear display and the diorama case.

15 The Asian Case

The Tiger case is located in a space just 13 ft 6 in. wide with an accompanying narrative "*an Indian forest by moonlight*" and thought to be the central forests of India, now Madhyar Pradesh (Quex Museum 1990). Unfortunately it was not well presented and a visible strong blue light used for preservation purposes also detracted from the diorama's depiction of a natural habitat. The taxidermy exhibits

Fig. 5.6 Red Sea Hills Case—KwaZulu-Natal

reveal and conceal themselves, according to which description is read and where you look within the case; this is because the narrative structure dictates (in 2007) that some mounted exhibits are partially hidden. While one description reads that the case contains a tiger, leopard and four horned antelope, another indicated an Indian Tiger, Leopard, Sloth Bear, Striped Hyena, Nilgai or Blue bill and porcupine.

16 The Red Sea Hills case

This case (Fig. 5.6) is adjacent to but separated from the Asian case by a thin partition on the left; the partition is disguised by dried bamboo covering the wall. It is a much larger scene at 27 ft wide with the same contouring in panelling as the savannah case. It depicts three locations in one display with the following narrative to describe the diorama, "*the river scene in Zululand*, *the sands of the Sahara and the rocky hills of the Red Sea, Ethiopia and North Africa*" (Quex Museum 1990). I have quoted the idealised setting directly from the 2007 museum brochure which also indicates that Zululand is now known as KwaZulu-Natal, and one of the many areas in Africa which has since been renamed (Cassell 1998; Reader 1998; Dowden 2009). The brochure appears to have been published after 1984, the terminology was confusing through fudging and at times overly romantic as it verges on a fictive narrative in the quotes mentioned above. It therefore becomes contradictory but possibly this happened because there were no substantial written records on the dioramas other than the classificatory pamphlets and Powell-Cotton's published work—whereas the museum brochure had taken its precedence from publicising the attractions of the museum, house and gardens. However, narratives are also indicative of the strong narrative theme that is ascribed to the diorama phenomenon and to the reconstructions of landscape depicting the natural world. The case itself is evocative of the areas it is said to portray.

The landscape painting that runs from behind the bamboo is an idyllic river scene; it has a painterly style reminiscent of Antoine Watteau. Watteau was historically significant, due to the connotation that his paintings have to 'staging' landscape (Sund 2009). Watteau's significance to the art historical influences on the dioramas and Powell-Cotton, is reflected in the personal connection to John Powell (1721–1783), an ancestor who bought the Quex estate in 1777, and a Secretary and former Paymaster General to George III (1760–1820). This connection is of interest as George III was also a major collector of Rosalba Carriera's work who was in turn linked to the Rococo and Watteau (Chadwick 1996, p. 142). Judy Sund, although primarily focussed on one painting by Watteau—*Les Charmes de la Vie*, stated: *Watteau's unique contribution, the fête galante, was grounded in art* (*painterly and theatrical*) *rather than nature, he routinely tempered such scenes*' *inherent artifice with actuality in the form of people, places, and incidents he had observed* (Sund 2009, p. 62).

As a *trompe l'œil* painting the image of KwaZulu-Natal is possibly the most picturesque and it certainly equates to the most romantic in style. The painterly affect is in the style of naturalism, and it is the most successful backdrop apart from the *trompe l'œil* painting of a glacier in the next gallery. This backdrop is also on a par with Quinn's images of the landscape painting to be found in the American Museum of Natural History dioramas. The romantic style of this *trompe l'œil* painting depicts an idyllic scene; the water level is very low trickling along the bottom of the riverbed, the banks and large trees are bathed in sunlight and there is a sense of light and warmth in the painting. On the right of the painting, the artificially constructed vegetation is painted with a brightly coloured tempera that visually is disconcerting. The vegetation is placed adjacent to a rock formation, but in using it to break up the scene while disguising the break between the river scene and the rock formation, it appears slightly amateurish.

As the craftsmanship in forming the clefts and fissures in the rock-work holds the gaze a full description regarding the construction of rock-work will follow within the analysis of the Angolan diorama in Gallery 3; while here in the foreground of this diorama, the floor is covered with sand to imply desert. Further to the left the riverbed's transition from painting to three-dimensional topography in the mid ground is convincing as it narrows behind the topography of riverbank and low-lying reeds; the river then swung off to the left behind the bamboo, finishing at the partition wall on the left side of this diorama. The wild life specimens feature Nyala from KwaZulu-Natal and Ethiopia Barbary sheep, ibex and wild ass from the Red Sea together with addax, white oryx and gazelle from the Sahara region. It is a peaceful scene as the notion of stillness strongly imparts itself to the viewer.

17 Gallery 2

The Kashmir diorama was the original diorama in the museum; it has been partitioned off from the rest of the exhibits in the gallery setting. A reasonable assumption is that this was due to being the first gallery to be built and it has the smallest

gallery space. Therefore with a lot of glass reflection from both the diorama and other glass display cases, which includes a linear display of bushbuck specimens, the diorama was later flanked by tall partitions.

18 The Kashmir Case

While this diorama case was started in 1896 the *trompe l'œil* painting was started later, the landscape backdrop at the back appears to be the Baltoro Glacier although the description given is the Vale of Ladak and Tibet with the snowy peaks of Baltistan in the background. It is not known who painted the background, as there is no signature and no photographic evidence. The *trompe l'œil* painting would have been quite stunning when introduced, cinematic in its style, effect and perspective and highly reminiscent of much later colour photographic images of the Himalayas. There is however a large three-dimensional rock structure situated on the left protruding into the mid-ground which jars with the overall impression. In identifying the scene from one of the early archived photographs it also looks as though the wildlife exhibits were changed at some stage, and a small brick on the right of the rock-work revealed notation that faces out to the viewer. The glass screen is constructed differently to the later dioramas as the glass sections are held together in an iron framework of an extended H frame; which gives an indication of its greater age. This diorama could not be entered so an approximate depth is about 15 ft. and in height approx 24 ft. The width of the glass sections is approximately 7 ft 6 in. either side of an 8 ft 4 in. mid section. The visual narrative describes a mountain goat tumbling off the rock face and further mounted exhibits are located in the three dimensional terrain of the rock-face, with the painted landscape of the glacier set in perspective in the distance.

19 Gallery 3

This gallery contains the Angola case, which is also referred to as the 'jungle case'. A second diorama—the Desert Case on the left is less arresting in drama, context and content and from the viewers' perspective as they walk through the archway there is another stand-alone display case which is placed immediately in front of the Angola case which can be viewed from all four sides. It contains the tableau of a lion mauling a wildebeest, a spectacle that was a popular device of the taxidermist's skill in the nineteenth century. Formerly this type of display, says Wonders, was not acceptable to institutions such as the British Museum who expected and demanded some degree of classification i.e. *They conceived of the proper display of scientific collections as systematic, uniform rows available primarily for scholarly examination* (Wonders 1989, p. 135). Wonders observed this attitude had signs of change by the mid 1860's with a purchase by the American Museum of Natural History, where

she states: "*The purchase attested to the Museum's compliance with the public's fascination with exotic creatures from far-off lands*." (Wonders 1989, p. 135).

20 The Angola Case

This full-scale diorama is the most dramatic accentuated by the lighting, which is more subdued than the dioramas in Gallery 1. The full width of the screen is 46 ft 4 in., the panels of glass measuring 15 ft on the left and right hand sections, and 16 ft 4 in. in the midsection. The topography of this artificial landscape surpasses in scale all of the previous dioramas as a rocklike mountainous structure has been reconstructed as the main feature of the diorama and positioned centre left. Further to the left, this scenic device is reduced to a shallow depth and as it recedes it drops back against the back wall behind a large elephant and then from this farthest corner the rock formation reaches up to ceiling height. The scene then moves into tall reeds that continue to the front of the glass screen. As the eye falls to floor level there are artificial mud baths of a glossy dark brown colour. To the right of this rock structure, the rocky landscape falls back to merge with tall reeds/grasses and the dioramas hidden door, beyond which is a large workroom and storage area. On the other side of this entrance/exit the rock structure picks up again, it builds up close to the ceiling's height in the right hand corner and then coming forward drops in height to ground level and the concrete and sand floor covering.

The foreground of the diorama's mid-section features a terraced rock formation that eventually drops away in the foreground to an artificial water pool edged with reeds. The water has a thick coating of a glossy 'paint' and layers of varnish to create a sense of depth but this is not quite as realistic or successful as the illusion of rocky landscape. Vegetation has been inserted into clefts and fissures and at ground level small stones and rocks lie scattered amongst a shallow covering of grit. Small clumps of grass are inserted into the concrete floor, and dry dead grasses are left to fall into place. There are natural divisions between the large plates of glass; these are partially disguised by hollow tree trunks, with further vegetation such as trees and tall reeds used to disguise the door to the workroom and to increase a sense of illusion.

Standing in front of the main section a realistically painted cathedral mountain range rises behind the main rock structure and the atmospheric light portrayed in the *trompe l'œil* painting appears to accurately pick up the mountain's clefts and fissures. The impression is closely related to the early stages of cinematic realism. According to Bennett, Hickman & Wall (2007, p. 203) this concept of realism still arises when: *Artists,* (*including film-makers*) *have always hankered for more than this, for a realism that is more than merely recognisable* (Bennett et al. 2007, p. 203). They then indicate a separation from what is perceived as naturalism, which is in stark contrast to realism. In this respect Bennett et al, draw extensively on Susan Hayward's work (Hayward 2006), to demonstrate naturalism as *a surface image of reality* (2007, p. 204). In comparison realism *comes from a literary and art move-*

ment of the nineteenth century which went against the grand tradition of classical idealism and sought to portray '*life as it really was*' (Bennett et al. 2007, p. 205).

From the midground the artificial rock strata has started to fall in terraces down towards the viewer. The texture, colour and form of the rock had been well crafted with a concrete layer that had been modelled and stippled to appear as realistic as possible. The concrete has been distressed, aged and coloured with tempera to resemble rock, with loose grit and dirt added to the lower areas of the rock formation. Although artificial it appears realistic as an illusionistic device. The overall structure is made possible by what is known as the 'cave', the interior of this rock formation. At first the interior structure appears to have been constructed from old packing cases and packing material. However, there is an informal wooden framework, which has been built to gain height, breadth and depth composed of heavy beams, 2×1, and 2×2 batons, as well as tree branches and recycled wooden packing crates. This informality then lends itself to an expanding metal membrane and chicken wire, which 'holds in' the mass of packing material and concrete underneath the rock formation. The entrance to this cave has to be circumvented through the landscaped foreground of the diorama and the 11 ft 6 in. African bull elephant.

To pass through this landscape into the cave entrance is to negotiate the water pools, mudbaths and the underbelly of the elephant, to then pass down under the entrance—and hence into the cave. The cave itself is a small room barely big enough for two people my impression of the cave interior is that it has a 'higgledy/piggledy' style, but an orderly construction to develop height, breadth and depth. To do this packing case materials, chicken wire, branches and various materials were utilised, both from the estate and transportation materials. The trees are real as hollowed out trunks are evidently used, they have likely come with the reeds from the surrounding estate while the palms may have originally come from the hot houses. While reeds thinly cover the wall on the left-hand side, the right hand side of the diorama conveys a different impression.

Moving from the mountain structure into the back right-hand corner reeds have again been used but they have no sense of illusion at all as half-heartedly painted tall grass has been amassed and stuck to the wall upon which is a badly painted interpretation of tall grasses. A tree has been placed beside the door frame, its dead branches jarring with the colours of a painted sky and both tree and grasses disconcert the gaze as it travels to the painted backdrop within the artifice of this scene. Above, the sky changes as the eye travels from the right hand wall to the midsection and to a horizon at sun set; this is not so well painted or in good condition, the wall is deteriorating and a large crack can be easily seen on the right. With regard to the different styles of the painted landscape it's possible that more than one person painted it, as the style on the right does appear to be different to the mid-section, and is a little more heavy-handed. This is the most dramatic diorama, and largely due to the physical stance of wildlife located in their natural habitat; these mounted exhibits demonstrate a very high degree of professional craftsmanship. There is a real apparent skill within each animal's reconstruction; many specimens have an appearance far removed from the idea of a stuffed animal or mounted exhibit because their stance remains lifelike. Very few exhibits in this diorama fail in this respect.

The museum brochure places a narrative to this diorama, the scene representing "*equatorial Africa at the end of the dry season, the animals moving down at sunset to drink at the pool*" (Quex Museum 1990). This is why the scene arrests the eye, as the illusion of movement is due to the technical decisions of the taxidermist and the location of the mounted exhibits. The diorama portrays the narrative through the descent of the wildlife exhibits from the topmost reaches of the rock formations 'watched' by the cerval cat, lion, hunting dogs, jackal and hyena.

But emerging from the tall reeds and long grasses lining the walls are dwarf buffalo and giraffe—some of which are partial specimens to increase the illusion, but then failing remarkably when observed up close. Most of the photographic documentation was taken at close view inside the diorama case, therefore the illusion is more difficult to maintain as the artifice could be clearly demonstrated. Included in this documentation is the partial illusion of a baby elephant's head, while beside it is the full specimen of the 11 ft 6 in. bull elephant. There is a further narrative given to the elephant in that Rowland Ward thinking it was such a fine specimen he refused to cut it down in size and therefore the diorama floor was removed and lowered to accommodate it.

In the front of the diorama's foreground a hippo yawns, showing its tusks and a rhino 'stands' just clear of the mud in its mudbath. Some exhibits are posed as if in anticipation—their noses scenting the air, while the hind leg of the dik dik is raised as it scratches its ear. A giraffe appears disjointed as it 'moves' without the rest of its body out of the long grass, and a baby giraffe stretches its neck and forelegs next to a gerenuk which stands on its hind legs 'grazing' on dried painted grass with its long giraffe like neck. Overhead the artificial nature of the scene is apparent where a marabou stork hangs on its chain from the ceiling and nearby a strange looking giant fruit bat hangs upside down from a tree. Then the viewers realize that during all this time some animals have been gazing unflinchingly into their eyes.

Conclusion

Karen Wonder's paper *Habitat dioramas as ecological theatre* (*1993*) drew upon the significant roles of the aesthetic, ecological, and scientific aspects of her thesis. In contrast a realistic perception of this research as photo-based inquiry is to develop an understanding of the Powell-Cotton dioramas as a negotiation of landscape—a concept considered by Mel Gooding in 'Song of the Earth' (Gooding 2002, p. 9), and one that then denotes the taxidermy object within the connotation of an illusory landscape. By stating these points optimistically it reflects a constructive proposition regarding the natural habitat diorama—and perceived constructively it then performs a working relationship of fact and fiction. However if art itself has purpose does the reality lie in the artifice and superficiality of the diorama? This superficiality edited out birth and death, the sick and the old, the need for food and shelter—it is a double fiction that was exposed in the illusory head of a baby elephant emerging from the reeds.

The destruction of natural habitats that could be alluded to was however made evident by the nature of change, and where a desire to understand change also develops as an awareness of the finite world. To re-interpret the idea of a diorama and focus on the concept of a natural habitat as an idyll is therefore to reflect upon the erosion of this ideology. Therefore it questions how the natural habitat diorama had a crucial part to play in this fiction, in the context of describing the sensuality of the natural world, in its vulnerability and its many fabrications.

This chapter discusses research that reconsiders Bal's notion of the cognitive relationship of a diorama and the concept of a discursive space. In doing so it considered how the natural habitat diorama has a relationship to *the three-dimensionality that draws on architectural space; the three dimensional representation of the landscape within the diorama itself; the two-dimensional illusion of a tromp l'œil landscape painting; and the exterior space occupied by the viewer* (Bal 2001, p. 114–115). The research compared the diorama form to its historical and contextual background through Wonders, Quinn and Altick's observations and then considered different aspects of the diorama form the innovative experiences that have been briefly demonstrated by Alticks's analysis of Daguerre's 1823 diorama following his work on the Paris stage, developed a further perspective for this research project with regard to the way Daguerre's diorama created a sensory environment of light and colour. Therein the recollection of a sense of place was conducive to considering how landscape also recollected an affective response. Consideration was then given to the wider contextual background in order to consider the Powell-Cotton dioramas and the diorama form, from a twenty-first century understanding of landscape.

Where the research context explored the cognitive presence of the diorama form as perceived in the context of Guiliano Bruno's concept of socio-cultural space and a shifting space-affect, it then considered how 'site-seeing' had created a relationship to film archaeology, film architecture, and architectural space (Bruno 2007, p. 137). On this basis the research context considered the diorama form with regard to architectural space, *site-seeing* and the mobile view. It would regard a potential aspect of the Powell-Cotton dioramas as having a shared history with theatre, film architecture, film archaeology, photography and the early moving image. In this regard the historical aspects of the museum's collections developed a relationship to the 'architectonics of embodiment' where '*the way in which the primary structure of architecture* (*architectonics*) *determines the structure of sculpture, painting, language, and eventually the structure of ideas*' (Vesely 2005, p. 41).

In moving through the large open spaces of the galleries containing these diorama landscapes, the viewer is moving through a low-lit environment designed to increase the effect of an illusion and a sense of place. As the dioramas in the Powell-Cotton Museum were not formally documented, these dioramas and their written, visual and architectural relationship to Louis Daguerre offer a contribution to knowledge.

While the Powell-Cotton dioramas had not been formally documented until now, their contribution to a sense of place would be reflected within the socio-cultural and cultural historical documentation that derived from this research. The relationships and associations that arose through the research regarding the dioramas, archives and collections within the Powell-Cotton Museum were therefore found to have had a lasting influence on the formation of the museum.

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Geraldine Howie completed a PhD in Art & Design in 2011. As the dioramas in the Powell-Cotton Museum were undocumented, these dioramas and their written, visual and architectural relationship to Louis Daguerre therefore offered a contribution to knowledge that is concurrent with the educational nature of the natural history diorama. "Each year the AHRC provides funding from the Government to support research and postgraduate study in the arts and humanities. Only applications of the highest quality are funded and the range of research supported by this investment of public funds not only provides social and cultural benefits but also contributes to the economic success of the UK. For further information on the AHRC, please go to: www.ahrc.ac.uk".

Chapter 6
James Perry Wilson: Shifting Paradigms of Natural History Diorama Background Painting

Michael Anderson

James Perry Wilson stepped into a new job as a diorama painter at the American Museum of Natural History in 1934. With a degree in architecture from Columbia University and twenty years working as a designer and renderer for the architectural offices of Bertram Goodhue, he knew much more than any of the artists at the American Museum about how to draw objects convincingly in space and how to depict light falling on irregularly shaped bodies. His overarching love, though, was painting landscapes, which he studied by painting outdoors as often as he could. A student of the physics of light and atmospheric effects in astronomy and meteorology, his practical knowledge of light and color was superb. In addition to these credentials, Wilson brought to his new job a surprising ability to remain firmly focused and not swayed by other artists, styles, or art trends. If he experimented, it was within a narrow range of realism. Although unwavering in his methods of painting, he had a humble personality and a non-combative ego. Before his employment at the American Museum, Wilson considered painting an avocation, something he fit in after work hours or on vacations. While he may not ever have considered himself to be a professional artist, he was challenged intellectually by the idea of recording what he saw before him and he spent countless hours at it. Painting large diorama backgrounds pushed him further to develop ways to create convincing depictions of the landscape inside a curved, domed enclosure.

Most of the artists Wilson worked with at the American Museum were confident, successful commercial artists or academicians with strong opinions about what they did. They derided "Sunday painters" and argued amongst themselves with much braggadocio about painting and art. Many of them had served in the armed services and most were outdoorsmen and hunters. Like Wilson, they had also studied art and techniques for painting realistically, but as fine artists, they used the landscape to design harmonious compositions with pleasing color relationships. Into this mix

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walked James Perry Wilson, a shy, retiring, intellectual with eccentric habits and odd painting methods. As much as the others tried to engage or argue with Wilson, he never insisted that his methods were better nor that another artist's work was inferior. He preferred to paint quietly by himself keeping out of the fray. Wilson's behavior and manners left the others perplexed; some denigrated his work and a few even mocked his masculinity. In general, his colleagues marginalized Wilson. He made no attempt to respond, merely put his head down, corralled himself into his dioramas, and produced some of the finest American landscapes ever painted.

The administration of the American Museum recognized the quality of his work. James L. Clark, the director of exhibits, championed Wilson from the beginning. After less than a year as an understudy with diorama artist William R. Leigh, Wilson was given sole responsibility for painting one of the choice corner dioramas in the museum's Hall of African Mammals. Using Leigh's African studies, Wilson produced a stunning, light-filled background painting of the Serengeti plains. With the success of this diorama Wilson became one of the museum's top artists. During the next five years he painted African landscapes he had never seen. He had to interpret other artists' studies and photographs. Luckily, the reference material was of high quality. Also Wilson had a talent for mimicking other artists styles and then adding some of his own elements, such as his signature light-filled blue skies.

Wilson used grids to transfer his reference studies to the diorama's background wall. These grids were key to his game-changing methods. Before this, all diorama artists used grids here and there, to work details or individual references into the background. They knew that merely approaching the background like an oversized easel painting did not work. They found that horizontal lines, especially at the sides of the diorama, would not look level from the viewing window and several sessions of repainting would ensue to try to get them to look right. Clouds and flat landscapes seemed to rise unnaturally as a result of the skewed perspective. The curve of the wall also conspired to destroy the illusion of space by making the painting appear to hug the wall. The viewer noticed the painting surface rather than having the impression that the landscape receded into the distance on either side of the diorama. Diorama artists developed methods to hide these problem areas. One was to block off the side walls with dense trees, bushes, or large boulders to direct the viewer's eye back to the rear wall where there was very little distortion from the curve of the wall. Another trick was to paint an artificial corridor or a line of animals stretching into the distance on the side walls.

No one before Wilson looked at the problem of distortion analytically. From his very first struggle to paint a tall palm tree into a curved dome in the Waterhole group, Wilson started to think systematically about the distortion inherent with a curved painting surface. He soon worked out a solution with projection geometry, a technique learned from his architecture training, in which Wilson used grids to mathematically transfer his reference studies, both photographic and painted. The method is essentially like shining a high-powered light through the references, projecting them onto the background wall. Wilson developed his grid methods in two stages. He began to use the transfer of the painted study within less than three years of his employment at the American Museum. In another nine years he would move

to transferring the panoramic photographs. The difference was that the camera located the viewer's relationship to the landscape with a mathematical angle of view that could be replicated in the diorama background. Wilson found that he could give the viewer the same viewpoint to the diorama background as he had photographing the landscape-a type of virtual reality half a century before its time.

Between September 1937 and March 1938 Wilson tried out his early gridding ideas on a large scale in the Nile River diorama in the African Hall. This diorama, in the corner of the hall had great problems with distortion. Dimensions of the group are quite asymmetric. The left wall is twelve feet from the central viewing point (an optimal viewing point slightly back and centered on the window of the diorama) and the right side twenty-six feet, or slightly more than twice as far away. Robert Kane, the background painter for this group, had heard about Wilson's ideas for gridding the background. He asked Wilson to lay out a grid in the Nile River diorama and demonstrate how it worked. The method involved two grids, one to square off Kane's painted studies and another on the curved background wall. In this first version of his method, Wilson wrapped the panoramic oil painting from top to bottom and from side to side with string at one-inch intervals. Each square on the study was transferred to a scaled up grid on the background wall.

The grid Wilson devised for this diorama makes every square, whether twelve feet away or twenty-six, look the same size when seen from the central viewing point. The grid squares on the background differ in size relative to the distance from the viewing point. In this case, the squares seen from twenty-six feet away were slightly more than twice as large as the squares at twelve feet. Wilson referred to this as a grid of "unsquare squares" that undulated over the background surface, shrinking or expanding in relation to their distance from the viewing point.

The Nile River grid surely caught the attention of all Wilson's painting colleagues. They all used grids, but none that changed size and snaked over the entire background like this one. Wilson may have tried to explain to his colleagues the concept of his grid and of projection perspective, but few seemed to understand and most dismissed it as an unnecessary complication. Training in the fine arts in the early twentieth century would typically promote reliance on the artist's eye to resolve any problems. Perspective techniques, while acknowledged as useful, were never to be relied on too heavily. Wilson, freed of the biases of that training, was quietly developing methods that would turn upside down the whole paradigm of painting natural history diorama backgrounds. Wilson then did something else profoundly different. He projected his reference painting, not as a flat plane, but as if it was bent into a semicircular curve. This innovation expanded the transferred image to include more fully the sides of the diorama, mimicking more closely the view when standing in the landscape and turning one's head from side-to-side. Using a flat plane would be like looking out a window with a more constricted view. The beneficial effect of this grid is that it contradicts the tendency for the painting to seem to wrap along the physical curve of the background. The sides of the diorama seem to travel out into the distance with the horizon, like the view on site. It meant that Wilson did not have to hide the sides of his background painting with objects from the foreground, because all the lines of the painted landscape stay in place

without distortion. This is another example of how Wilson's architectural training and his grasp of perspective and projection geometry gave him the ability to fully understand the problem and devise a much better solution than anything used before. In only his third year at the American Museum, the key components of his dual grid system were already established.

Wilson went on his first museum expedition to collect references for the Hall of North American Mammals in the summer of 1938. George Petersen, the foreground artist who accompanied Wilson to the western United States may have noticed that Wilson took more time plotting out his photographic panoramas than any of the other painters. Although he seemed to be taking photographs and painting a fully formed color panoramic study like the others, in reality, Wilson was using his camera to compose the diorama in full and to block out the painted oil study with the photographic panorama. Unlike his colleagues, Wilson would place complete reliance on these panoramic studies, transferring them, as is, when he painted the diorama back in New York.

Most of Wilson major dioramas in the North American Mammal Hall-the Grizzly Bear, Bison, Wapiti, Mule Deer, and Coyote-were gridded by his first method of wrapping string over the painted study. But there were problems with this process. Wilson knew that taking panoramic photos, swinging the camera from side-to-side on a tripod, mimicked more accurately the experience of standing in the open and turning one's head from side-to-side. Most of his photographs were black and white and Wilson used them only for details. He didn't trust them as a means to transfer to the diorama background.

When work slowed during the Second World War, from October 1944 to December 1945, Wilson, on leave of absence from the American Museum, was hired to paint the Shoreline diorama at the Peabody Museum of Natural History at Yale University. During his free time, he walked the Yale campus and undertook an extensive study of photography, testing lenses, taking careful notes on exposures, and assessing color with the more affordable Kodachrome film. Boxes of slides attest to the amount of film he was testing. It is during this time that he developed his final gridding methods, which relied more directly on photographs. In 1947 with the Beaver diorama at the American Museum, Wilson made the switch to color Kodachrome slides as his primary reference tool (Fig. 6.1).

The new method was somewhat fussy and time-consuming. The photographic grid and the background grid were linked by mathematical ratio, joining the focal length measurement of the camera lens to the depth of the diorama shell. Careful notes were also necessary when photographing in the field. Grids had to be scratched painstakingly by hand onto tiny squares of clear acetate sized to fit on a 35 mm color slide. Some of the tiny grids were for slides taken on the horizontal and some were to accommodate panoramic swings of the camera at 10, 20, 30% below or above the horizon. To make it work, Wilson had to look into a slide viewer to draw the scene on to the background wall. Wilson would view the slide, then draw, then view the slide, then draw. Wilson had a reputation as the slowest diorama painter at the American Museum and this new method would slow his process even more. Still, he was firmly convinced that this effort would produce a painting better

Fig. 6.1 James Perry Wilson drawing the Mule Deer. Courtesy of Library Services, AMNH

than anything done before. To his credit he would not compromise when it came to the quality of his work. Wilson switched from painted studies to photographic panoramic slides as his primary reference, not because photographs had gotten better, but because of his unceasing commitment to accuracy. When asked why he did not rely on photographs exclusively, Wilson answered:

> Because you can't rely on photographs-even the best color film-to record the color exactly as the eye sees it. Color film tends to increase contrast. So I use my field paintings as an overall check-[to record] the visual impression of color that I derived from the scene, but the photographs form a valuable bank or store of additional information as to detail.

It is astonishing that such little notice was given to Wilson's development of a level of realism no other diorama artist had ever accomplished or even dreamed of before. Fred Scherer was the only other artist at the American Museum to use Wilson's grid, but only for one diorama. From the earliest habitat groups in American museums, artists and taxidermists were vigilant in their efforts to guarantee the replicated foreground copied the landscape as accurately as possible. Taxidermy mounts closely imitated the anatomy and characteristics of the animals. William Hornaday, the first taxidermist to work in an American museum, began in 1882 at the United States Museum of Natural History in Washington, D.C. He created several large, popular habitat groups of bison, moose, and mule deer. These habitat groups had no background paintings, but the bar was set high: all these early groups were meant to portray life in the animal's habitat with a striking realism. In these first habitat groups Hornaday harvested foreground materials only from the exact location where the animal was collected. He later revised this approach by assembling foreground material within the general vicinity. He felt that the foreground should be as accurate as the mounts and his standard was that the mounts could be used for study by a technical zoologist. Hornaday's strict criteria for realism in the displays was later shared by successive generations of habitat preparators and those developing dioramas.

The painted background was another arena entirely. The artists chosen to create backgrounds lacked the methodological training to keep pace with the rigorous realism found in other parts of the natural history diorama. According to the early diorama builders, a diorama's purpose was twofold: to engage the viewer and to be accurate. To accomplish this, the diorama needs a strong sense of the location and the animal's place in it. The background painting therefore had to draw in the viewer like a work of art and also remain truthful to the site. Frank Chapman, the ornithologist who initiated the first wildlife groups with panoramic backgrounds at the American Museum, did not hesitate to declare in his book, *Autobiography of a Bird-Lover* (1933), that the most immediate function of the background was as an artistic expression, saying that:

> It is by the beauty of the background that makes a universal appeal. Attracted primarily by its color, its atmosphere, the scene it represents, the aimless visitor involuntarily pauses. His imagination is stirred, his interest aroused, and the way is opened for him to receive the facts the exhibit is designed to convey.

Chapman describes how dioramas might offer the same experience a viewer of fine art might have standing in front of a painting. Chapman went further, though, to add that this imaginative experience would enhance the didactic mission of the dioramas. But why did Chapman, a scientist, choose to use fine artists to paint the backgrounds when a variety of more science-based alternatives existed? A few dioramas with painted backgrounds by fine artists predate the 1902 opening of Chapman's Birds of the North America Hall. Chapman undoubtedly was familiar with "The Four Seasons," Carl Akeley's white-tailed deer groups in Chicago with painted backgrounds by Charles Abel Corwin. Chapman could walk through the North American Mammal Hall at the American Museum and critique how Carl Rungius' painting of the Canadian Rockies served as a backdrop adjacent to the Wapiti habitat group.

Chapman, an independent thinker, brought innovation to many features of dioramas that are still used today. If he thought a different type of background would work better, he would have used it. For instance, it is curious why Chapman did not insist that his artists use a camera Iucida to make their landscape studies on-site. Why didn't he work exclusively with scientific illustrators or use photographic enlargements? Chapman was well versed in photography. Why did he conclude that photographs had more limitations than did a fine artist' subjective interpretation of the landscape? John Rowley gives a clue to how the early practitioners were thinking when they chose background paintings:

> Large colored photographic enlargements on paper are used to some extent for backgrounds for groups, but they are simply a makeshift and done for cheapness. I have yet to see a colored photographic enlargement that looked like anything but what it actually was, and when completed, it is an open question as to whether any money has actually been saved by substituting an enlargement for a good oil painting. Furthermore, with a painting, greater freedom is allowed for values and composition; and the two bear about the same relation to each other as a cast and a piece of sculpture. One is art and the other is process work.

These early pioneers of modern natural history dioramas clearly expected the backgrounds to conform to the strict standards of realism used in the foreground and

taxidermy mounts. Nevertheless, they rightly believed that photographs and the other more scientific methods, despite their accuracy, would not engage the viewer as a well as a fine art painting. These were surprisingly astute observations not usually seen in those who work in the sciences. Yet the subjectivity of the artists' work still created tension. Fine artists did not like formulaic methods and were taught to rely on their sensitivities to make a painting look right. Inconsistent quality, the taking of liberties with scale, color and the composition, and the inaccuracies still stand out today as drawbacks of art-based painted backgrounds. But then, they also had never come across anyone like James Perry Wilson. A unique hybrid of artist and scientist, Wilson, came closest to reconciling the two in his work on dioramas. It was a historical fluke that the Great Depression made Wilson's work as an architect impossible and, in need of work, he just happened upon museum work. This chain of events brought to the museum world one of the few artists who could understand, articulate, and solve the problems inherent in diorama production. Only an artist with Wilson' s training could prove that a highly accurate, science-based method for documenting a site could also hold a viewer in reverie as well as, if not better than, any fine artist's creations. It's no wonder that his appearance was a threat to other artists. Francis Lee Jaques, a colleague of Wilson's at the American Museum, said dismissively of Wilson that he merely painted "giant kodachromes," a statement that goes right to the heart of the larger conflict between fine artists and a scientific painter like Wilson.

An influential book from 1934, *Carlson's Guide to Landscape Painting*, exemplifies the essence of how artists from the tradition of fine art thought about painting the dioramas (Carlson 1934). John Carlson was very suspicious of any methodical transcription of a landscape. He proclaimed that mere visual correctness, in itself, never produces a work of art. For Carlson outdoor sketches were to be used only to inform a studio composition, never as a primary work of art. And transcribed photographs were to be especially avoided. Inspiration, emotion, and creative intuition were of utmost importance. Anything that might diminish these was suspect. Wilson owned this book and, surprisingly, attended one of Carslon's landscape painting classes at the Art Student's League in New York just before he started working at the American Museum. As an indication of Wilson's mismatch with Carlson, he wrote only one note in the margins of his copy of Carlson's book, a correction of a misspelling in the chapter on aerial perspective.

The following quotes from Carlson's book are some of the concepts Wilson was setting on their head:

> "Nature is never right". I would modify this by saying that nature is seldom right. The artist must look to nature for his inspiration but must rearrange the elemental truths into an orderly sequence or progression of interests….[The artist] is manipulating the physical natural truths to his artistic "needs". Were it not for this vital truth, the man who could slavishly imitate or copy nature as he "saw her" would be the greatest artist-but he never is. p. 62
>
> Perspective, when rightly used, is an auxiliary in a worthy cause; when unartistically used it is only a mathematical equation. p. 113
>
> It is best however not to become too scientific, and after this rudimentary treatise I recommend that you rely upon your feelings rather than upon your rules. Learn [linear perspective], try it and then forget it. p. 119

> Reason never produced a work of art, but in all true works of art there is a certain amount of very sane reasoning (subconscious though it be). p. 59
> Remember that the most realistic landscape in the world can be a work of art but do not think that because a landscape is "real" that it is a work of art. A true picture is one where so-called natural elements are made to function in an idea. The idea without nature, and nature without the idea are equally nil. p. 153

Most museum artists would have aligned themselves closely with the ideas expressed by Carlson: the artist's emotions and feelings were to be relied on, visual truths were to be manipulated to the artists' needs, reason was suspect. These ideas were played out in the work of one diorama artist working at the American Museum.

Belmore Browne painted some of the American Museum's finest diorama backgrounds. His Alaskan Brown Bear may be one of the most memorable dioramas in the museum. Browne was also at the far end of the spectrum among painters who would make changes in a habitat diorama to enhance the composition. While the Alaskan Brown Bear is unquestionably iconic, Browne played loose and free with the factual details of the landscape. An August 28, 1940 letter to James L. Clark, head of exhibits at the American Museum tells the story:

> The main problem in the bear group as I figured, was the relation between the bears, stream and the distant mountains. As the bears were so dominant, I raised the mountains so that they would play a closer second to the foreground and centered the interest in the right center to make a good "going in line" from the two bears. I also moved the stream towards the right center in order to let it function from the center view. The fade out on each end of the mountains keeps the interest within bounds. I feel that there should be enough grown alders to give the bears good cover and have suggested an alder-filled draw on the left. This detail can be filled in later. The stream is an ordinary run of alder-lined stream, but can be easily made more rugged if required. In this respect, I was a bit at sea as there was the question of the authenticity of the scene to be thought of. Experience over many years has taught me, however, that you may know a mountain scene and paint it many times and then find some slight rise or change of angle will give you a completely new result.

Francis Lee Jaques, in an unpublished autobiography, offered his critical assessment of Browne's painting: "Belmore Browne did the [Alaskan Brown Bear] background, showing some greatly distorted pinnacles which I had seen and photographed. It completely lost the character of that beautiful country." (AMNH Library Services). One might go further and say that the scene, while magnificent, tends toward the aesthetics of Walt Disney and even to kitsch (Fig. 6.2).

Wilson had another agenda. While he was as interested as any other painter in the finished look of the diorama background his focus was to try to recreate the actuality that the human eye perceives. To this end, he studied the scientific disciplines that would inform his painting and worked tirelessly to minimize subjective impressions and record quantifiable, empirical observations of the landscape. He used a palette without black, because he understood that there was no black in nature. The result was a bright color range that best revealed natural light and mimicked in paint what was seen in the physical world. Wilson developed a method of painting the sky that imitated the look of a real sky. Wilson's sky would grade in two directions, both from light at the horizon to dark at the zenith and from warm to cool. In his description from a letter of August 1944-he says:

Fig. 6.2 Belmore Browne painting the Alaskan Brown Bear diorama. Courtesy of Library Services, AMNH

> The underlying principle is as follows: A typical fair-weather sky, especially at high altitudes, graduates smoothly and evenly from a deep blue (cobalt or ultramarine) overhead, to a clear and much lighter blue, usually a turquoise hue, at perhaps one quarter of the distance from the horizon to the zenith. Below this level the tone usually lightens still more, but the blue color is modified by ground haze. The hue may be somewhat greenish, in very clear weather, or purplish, on hazy days, especially at low altitude. These three tones-upper part of the sky, clear turquoise band and horizon color-may be considered as the key colors for the entire sky. If they are carefully prepared, all the intermediate tones may be obtained automatically by mixing these. This will insure a smooth, even gradation.

His treatment of atmosphere is another aspect that reveals his grounding in science and is arguably the single characteristic that defines a painting by James Perry Wilson. Regardless of conditions, season, or time of day, atmosphere gives Wilson's painting a great feeling of depth and a recognizable sense of place. Wilson wrote extensively to his student and friend, Thanos Johnson, about the techniques of atmospheric or aerial perspective, the transition of color and values with distance in the landscape. Values lighten and color temperatures cool as landmasses recede. These letters make clear that the consistent quality of Wilson's treatment of atmosphere came from a deep knowledge of how air affects light and color on the landscape, and from his skill in putting that information down in paint on canvas.

> It is one of the fundamental principles of aerial perspective that the dark tones of a landscape are the first ones affected by the interposed veil of atmosphere. A green tree in the foreground will appear dark green in the shadows; but you don't have to get very far away from it before that green disappears entirely, especially if you are looking toward the sun. In the middle distance the shadow areas in the foliage will take on a violet tone, while the sunlit parts are only a little cooler green than they are close up. At a distance of several miles (varying with the clarity of the air) this violet will become more and more blue. By this time the air will begin to affect the sunlit parts also, and the green will begin to disappear. A forest-covered mountain fifteen or twenty miles away, in clear air, will probably appear of a violet hue; but if it is fifty or sixty miles, it will be a clear pale blue.

Wilson relied completely on his painted and photographic references and took great pains with them. He spent much time, at first, looking in the field for the right

Fig. 6.3 Wapiti diorama. Courtesy of Library Services, AMNH

composition. Once found, he then made careful reference studies on-site, both with photographs and in oil paint that were intended for direct transcription to the full-scale diorama. He always deferred to the information in his studies and rarely deviated much from it. This was a primary difference of Wilson's technique. He preferred to use a single panorama from one site for his backgrounds. He was criticized for not being a "real" artist who could paint confidently without references. These same painters prided themselves in their ability to paint landscapes realistically without over-reliance on references. Yet Wilson remained unshakably confident in his method and ultimately; the results he was achieving were powerful as well as discernably accurate. He sought to remove the artist's subjective, emotional interpretation and to understand what he saw in front of him with the aid of meticulous references, using those documents to transfer visual data to the background wall. He transformed the subjective methodology of oil painting into a more objective practice and, in this sense, he came closest to aligning background painting with the objective standards set for the dioramas. With characteristic humility, he sought to mask all evidence of his art so that no aspect of his painting detracted from the illusion of actuality. And yet he was completely confident that what he painted was accurate. His colleague, Ray deLucia recalled "the look on his face when someone questioned an effect he had included in a background painting. It was not a look of anger but more of disbelief that his conclusion should be doubted." Wilson's time-consuming methods came as close as that of any painter ever had ever come to matching the rigors of the science that provided the foundation for the dioramas (Fig. 6.3).

Wilson's thoroughness and self-assurance is evident in a November 20, 1945 to Johnson about the painting of the sunset in the Wapiti Group:

> The sunset light on Himes Peak in the [Wapiti] background was not an "improvisation." As you may remember, the group was originally planned for about 4:00 p.m., and the field study and photographs showed the lighting at that hour. When it was decided to change the time to sunset, I worked out the new lighting as carefully as I could, on the basis of the photographs taken about an hour and a half earlier. If you could get a look at the group, you would find that the sunlight on Himes Peak is not from the front, as you seem to think, but

> from the side. It was done with considerable care. The only question on which I had to do considerable guessing was where the edge of the shadows from the peaks on the right side of the valley would fall on the opposite side, over by the Chinese Wall. The item which received the most intensive study, and about which I am entirely confident in regard to its accuracy, is the position, phase, angle, etc., of the rising moon. That I could guarantee without hesitation.

Until Wilson, the best diorama painters were excellent artists who succeeded at engaging the viewers quite well. The strength of these paintings trumped concerns about accuracy. Accuracy was a more-or-less proposition. Unfortunately, over time, the paintings do not hold up well. The extras Belmore Browne painted in his backgrounds to enhance the composition come on too strong for twenty-first century sensibilities. Francis Lee Jaques's simplified graphic forms seem too personalized as a style, even though they draw us to them. William R. Leigh's surreal color harmonies weaken his muscular paintings. And these are the best painters. The worst artists succeed at neither accuracy nor engagement.

Wilson, using scientific, photographic, and mathematical references, created significantly different diorama backgrounds. For one thing, the illusion is more complete. Beyond this, Wilson's objectively inspired methods quietly challenged the prevailing ethos that artistic creativity, stylistic interpretation, and intuitive composition of the painted landscape were of special importance. Interpretive qualities suitable for easel painting, when applied in natural history dioramas, were called into question by Wilson's work. Critics alleged that Wilson's backgrounds lacked creative inspiration. Wilson responded by consistently painting stunning backgrounds, demonstrating that highly researched and documented background paintings were quite capable of transmitting all the nuances and moods of the best landscape paintings.

But accuracy alone could never bring about the rapture that Chapman described. Neither was high quality painting enough. Wilson proves that the artist' subjectivity is not helpful to the success of the diorama. For a viewer distracted by the signature of the artist, either written or stylistically, the illusion is less effective. Wilson's dictum for art to conceal art was not just an egoless statement. He had analyzed the look of all of the diorama production and had deemed that the subjectivity of the artist detracted from the effectiveness of the display. For the viewer to be held entranced, to stand still and to stare at the scene, to connect with it emotionally, the diorama will then deeply impart the messages it holds in such a way that it stays forever imprinted on the lucky viewer. Yet the experience is tenuous, the slightest distraction snaps the viewer back to reality, and the curtain closes. To this end, Wilson critiqued all aspects of the painted diorama background. His skies were painted by method, the grid was mathematical, atmosphere was linked to a precise modulation of values, and lastly, painting was meant to disappear. Brush marks were feathered away, the surface was carefully controlled to be non-reflective. An early experiment with painted texture at the junction of the foreground and background painting was abandoned as ineffective. Finally, Wilson painted only what the eye could see. He deferred to his painted studies for color and mood, but he also modulated the details of his photographs using the painted studies. There is an anecdote from Ralph

Morrill, the foreground artist at the Yale Peabody Museum, who asked Wilson when he was working on the Shoreline diorama why he did not paint legs on the cows on the hill in the distance. Wilson matter-of-factly answered that legs on cows cannot be seenat that distance. It was not that he was too lazy to paint them, but that painting them detracted from the experience he was aiming for. It took a highly focused and skilled painter like James Perry Wilson to produce this new form of background painting that more closely adhered to the realism called for by the early diorama innovators. Here was a perfect union of art and science.

Wilson's time-intensive methods came as close as any painter ever had ever come to matching the scientific rigors, which provided the foundation for the dioramas. But Wilson also quietly insisted and proved that it was possible within this controlled system of painting to evoke an equivalent mood; one that comes naturally from objective creation of a portrait of a place.

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Wilson's Correspondence Taken from

James P. W. Unpublished interview with Rudolph Freund and Rudolph Zallanger at the Peabody Museum, circa 1959 (AMNH Library Services).
Letters to Thanos Johnson, property of Michael Anderson.

Michael Anderson (Yale, US) is a natural history museum preparator with twenty-five years of service at the Peabody Museum of Natural History in New Haven, CT. M. Anderson started his museum career at the American Museum of Natural History in New York City, leaving in 1985 to attend graduate school in Medical Illustration/Modelmaking. He apprenticed with Ralph Morrill, the foreground preparator and taxidermist who worked with James Perry Wilson and Francis Lee Jaques to create the Peabody Museum's habitat dioramas. Anderson negotiated the permanent transfer of James Perry Wilson's Point Pelee diorama shell from the Canadian Museum of Nature and then built the foreground habitat for it. He currently has full responsibility for the upkeep of all of the Peabody dioramas. In 1994, M. Anderson curated an exhibit on James Perry Wilson's paintings and diorama techniques at the Peabody Museum. He compiled interviews and conducted research for a biography of Wilson, which is currently posted on the Peabody Museum website.

Part II
Resurrection and Modern Dioramas

Dioramas are regarded differently in countries and areas of the world. There is the introduction of new ones, amongst older ones, as in the Los Angeles County Museum or at the Peabody Natural History in Newhaven, USA, and the Museum Koenig in Bonn, Germany. Some museums have introduced natural history dioramas for the first time, like in Malta and China, even though museums in other countries, such as many in England, have dismantled their dioramas, evidently considering them as old fashioned and focused on exhibits with more technologically involved aspects and physical hands-on. Yet other places are incorporating new technologies in older dioramas, such as a diorama depicting African savannah in the recently renovated African Hall at the Californian Academy of Science.

This section of the book provides discussion and exemplars of these different trends in exhibit design and implementation. Borg discuses the new dioramas in the Museum of Natural History in Malta which are conceptual dioramas, depicting aspect of the various local ecosystem and incorporating recognizable human constructions such as the characteristic traditional Maltese boat used by fisherman, and the courtyard, as well as the walls or bastions. Kang from Zhejiang, China, discusses the new construction of dioramas based on actual field locations to illustrate aspects of the natural history of their country. Loveland and his colleagues discuss the use of new technologies such as virtual reality in museum exhibitions whilst Munch and colleagues take us through the conservation, restoration and reconstruction of existing historical dioramas.

Chapter 7
Dioramas in Natural History Museum—Tools for Nature Conservation

John J. Borg

1 Introduction

The art of "reproducing" nature has for long been a substantial part of museum displays. These settings, or as they are more popularly known as dioramas may depict actual locations or fictitious scenes and can vary in size from small showcases to large and impressive setups. The topic varies according to the themes represented. In our case the setting is a natural one. This form of displaying nature found in many natural history museums, has always attracted the attention of the lay person as well as students. In 2004 the National Museum of Natural History, housed in an eighteenth Century Magisterial Palace in the old walled city of Mdina, embarked on an educational program by building and presenting a set of dioramas highlighting local ecosystems. Devoid of large tracts of woodland or open bodies of water, Maltese people are under the impression that Malta is devoid of wildlife. Although bombarded with natural history documentaries aired on foreign television stations, showing wild and exotic animals, there is an acute lack of local productions and this highlights the misconception that Malta is devoid of wildlife. The Natural History museum through its education program is tackling this issue. First and foremost through interactive programs and secondly though the diorama setup.

2 Presentation

Six local themes were chosen including a cliff habitat, rural courtyard, agriculture, steep valley, beach habitat, and night time near the fortifications. Added to these are three smaller displays, one highlighting a seabird colony in the North Atlantic, a North African desert scene and the last showing an array of oriental passerine species. The latter three displays measure $1 \times 1 \times 2$ m while the former ones measure approximately $2 \times 3 \times 2$ m.

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2.1 Maltese Habitats

1. **Coastal Cliffs** The coastal cliffs are the least disturbed habitat in the Maltese Islands and so provide a unique and ideal habitat for a diversity of species. Cliffs are one of the most important ecosystems in the Maltese Islands and in respective of this, most cliff areas in the Maltese Archipelago have been afforded legal protection and form part of the European Union's Natura 2000 network of protected sites. In this diorama highlights the importance of cliffs for breeding seabirds mainly though the flag species; Scopoli's Shearwater *Calonectris diomedea*. Several migrant bird species such as the Glossy Ibis *Plegadis falcinellus*, Squacco Herons *Ardeola ralloides* and Little Egret *Egretta garzetta* watch out for any small fish swimming on the surface of the water while wading birds such as the Turnstone *Arenaria interpres* and Common Sandpiper *Actitis hypoleucos* search for minute invertebrates that cling to the rocks. A watchful Kingfisher *Alcedo atthis* present in the Maltese islands from July to April patiently waits on a rock for any passing fish. Beneath the ripples of the water one can see a small variety of marine organisms.

2. **Rural Back Yard** Nature is found even in our back garden. The Spanish Sparrow Passer *hispaniolensis* is the most common bird species and a pair of Sparrow built a nest in the ventilator above the door (Fig. 7.1). White Wagtails *Motacilla alba*, Common Chiffchaffs *Phylloscopus collybita* and Black Redstarts *Phoenicurus ochrurus* are some of the winter bird species. The cultivated everlasting has attracted a number of Large White Butterflies *Pieris brassicae* while grasshoppers are actively mating on the wall of the yard. One of the world's smallest mammals the Etruscan Shrew *Suncus etruscus* chases a tiny beetle across the path while the Moorish Gecko *Tarentola mauretanica* is on the lookout for any unwary insect.

3. **Fields and Rubble Walls** *Fields and rubble walls* provide an ideal habitat for a wide variety of floral and faunal species. The Almond tree offers shelter for a number of birds like the European Bee-eater *Merops apiaster*, Golden Oriole *Oriolus oriolus* and Cuckoo *Cuculus canorus* (Fig. 7.2). The introduced *Chameleon* Chamaleo chameleon is firmly clinging to the branches. A large Algerian Hedgehog *Atelerix algirus* sniffs for some snails while a small flock of Yellow Wagtails *Motacilla flava* is feeding in the field. The cryptic feathering of the Woodcock *Scolopax rusticola* provides the bird with ideal camouflage capabilities. The Wild Rabbit *Oryctolagus cuniculus* is the largest wild mammal in the Maltese Islands and it is not infrequent to see this animal grazing in fields early in the morning or late evening. Watch out for the Ocellated Skink *Calchides ocellatus* sunbathing on the rocks.

4. **Valleys** Deep valleys especially those containing water throughout much of the year are real wildlife sanctuaries. Painted Frogs *Discoglossus pictus* and some water birds such as the Jack Snipe *Lymnocryptes minimus* can be found in the lower parts of the valley near water (Fig. 7.3). Along the valley walls one finds a variety of landsnails and other wildlife. The Blue Rock Thrush

Fig. 7.1 Maltese courtyard diorama

Fig. 7.2 Maltese fields diorama (stone wall)

Monticola solitarius, our National Bird, is a resident species and frequents such valleys as well as seacliffs. Migrating birds such as Alpine Swifts *Apus melba* and Common Kestrel *Falco tinnunculus* may also be observed here. A Brown Rat *Rattus norvegicus* is attacking a nesting Rock Dove *Columba livia* while

Fig. 7.3 Maltese valley diorama

various species of land snails are fixed to the valley walls. One Edible Snail *Cantareus aspersus* has also managed to climb on the glass viewing pane.

5. **Beaches** To us humans beaches are a place of relaxation during the hot summer months. But beaches are more than that. They offer food and shelter to large numbers of animal lifeforms, including migratory birds such as gulls and wading birds. A pair of Kentish Plovers *Charadrius alexandrinus* are combing the beach for any invertebrates as is a Greeshank *Tringa nebularia* perched on a small rock. On the beach one can also find dead or remains of sea creatures that have been washed ashore by the rushing waves. A wrecked fishing boat provides a perch to an adult Yellow-legged Gull *Larus michahellis* and a Teal *Anas crecca* flies overhead.

6. **Nocturnal Wildlife (Mdina Bastions)** Our bastions and fortifications are not only cultural icons but provide a refuge to our wildlife. The very rare Barn Owl *Tyto alba* has built a nest in a crevice in the walls and our largest bat species the Maghrebian Bat *Myotis punicus* is flying about in the shelter of the bastions while a lone Grey Long-eared Bat *Plecotus austriacus* is being watched by an adult Night Heron *Nycticorax nycticorax*. Nightjars *Caprimulgus europeaus* are active during the night as are most of our mammals and male Weasel *Mus-*

tela nivalis is chasing a Brown Rat over a small mound of rubble. Most insects are also nocturnal and some of the most interesting are the large Hawk Moths *Hyles sammuti*, two are clinging onto the bastion walls.

2.2 Smaller Displays

Seabirds of the Northern Hemisphere This diorama displays coastal cliffs in the north Atlantic. Here one can see the variety of seabird species that nest colonially on the ledges and inside burrows of these sheer cliffs. The most dominant species is the Northern Gannet *Morus bassanus*. The white and black plumaged adult male keeps watch over its nesting site. On the ledges below one finds different species from the auk family, such as the Common Guillemot *Uria aalge*, Brunnich's Guillemot *Uria lomvia*, Black Guillemot *Cepphus grylle*, Razorbill *Alca torda* and Atlantic Puffin *Fratercula arctica*, the latter species nesting inside small burrows.

Birds of the North African Desert North Africa is very rich in wildlife and birds are plentiful. The Lanner Falcon is one of the top predators in the avian world and a juvenile male forms the centerpiece of this small display. In the bushes and on the sand one finds diverse and unique species such as the North African endemic Moussier's Redstart *Phoenicurus moussieri*. The Dupont's Lark *Chersophilus duponti*, Rufous-tailed Scrub Robin *Cercotrichas galactotes* and Southern Grey Shrike *Lanius meridionalis* complete this display.

Tropical Bird Species Tropical birds are amongst the most colourful and spectacular animals. Parrots, lorikeets and leafbirds have colour combinations that dazzle the eyes. This small display highlights some of these species. Lorikeets, Rosella's, Green Magpies, and Oriental White-eyes are displayed.

Why no labels? The majority of the Maltese people are unaware of the natural richness that these islands host. Nature for many is something to exploit and even today it is not infrequent to find children collecting frogs and tadpoles, cutting wild plants and catching butterflies, chameleons and hedgehogs. The catching and killing of wild birds is still common occurrence as is the total disregard to nature and everything natural. Therefore the main aim of these displays was to introduce nature to children and adults as well as to entice them to observe the natural world and all its wonders. So, these dioramas serve as an educational tool in nature conservation and appreciation. The setup of each display highlights a local ecosystem and familiar localities were chosen so visitors could easily identify each locality depicted. One fundamental issue in this area is that the dioramas are devoid of any labels or information panels. During organized visits, participants are invited to list the animals and plants they observe in the displays and then, with the help of museum staff they go through each display and see which species have been missed. From such an exercise we could also identify the difference between visitors coming from urban areas with those originating from rural areas. Museum staff also helps visitors to place in perspective to their natural surroundings the various animals present in the display.

Another environmental issue addressed by these dioramas is the need to maintain a clean and therefore healthy environment. Much to our dismay and in spite of the numerous educational campaigns, one still finds rubbish being dumped in the countryside. In one of the dioramas (Bastions at Night) an empty food tin was placed and the boulder screes and interestingly enough it immediately create a reaction from the local visitors. Here we take the opportunity to elucidate the need for a garbage free environment.

With such an interest in dioramas and their value as educational tools, in the coming months the museum will be enhancing its displays with a number of micro-dioramas highlighting life in the undergrowth.

John J. Borg joined the ranks of the Museums Department in 1992 where he spent most of the time assisting the curator of Geology and Palaeontology at Ghar Dalam Cave and museum. In 2001 he moved from Ghar Dalam to the National Museum of Natural History taking charge of the biological collections. An ecologist by training John focuses his research on seabird biology and the ecology of micro mammals, particularly bats. Results from his research have been published in local and foreign peer reviewed journals. Apart from the natural history aspect he is also interested in the history of the subject, especially Maltese naturalists of the nineteenth and early twentieth Century. John is the Senior Curator of the Natural History Section of Heritage Malta responsible for the National Museum of Natural History, Ghar Dalam and the Gozo Nature Museum.

Chapter 8
Using Technology to Deepen and Extend Visitors' Interactions with Dioramas

Mark Loveland, Barbara C. Buckley and Edys S. Quellmalz

1 Introduction

Museums invest significant human and financial resources into designing learning experiences in compelling, scientifically accurate exhibition spaces with exhibits that aim to enlighten visitors about nature, history, art, and science. However, with the many permanent exhibits, floor demonstrations, and exhibitions, museums—especially natural history museums and halls of science—are often compared to an all-you-can-eat buffet, with too many choices for the typical museum visitor to sample. Most visitors, particularly children and school groups, experience only a small subset of the exhibits on display at a typical exhibit museum. Typically, younger children pull adults away from one exhibit toward another exhibit before they have a chance to digest the science behind the first exhibit. Museum researchers have documented the typical dwell time at exhibits as approximately 30 s (Beer 1987; Cone and Kendall 1978). Rushing from exhibit to exhibit, visitors are unlikely to be able to fully explore the concepts, phenomena, history, or scientific relevance behind each exhibit in a single visit.

The Holy Grail of learning in museums is to identify ways to deepen a visitor's experience, even extending it beyond a single visit. Leveraging innovative and interactive technologies, such as Web-based activities, RFID, augmented reality, and simulations, represents a way to learn about science beyond the museum setting and address the hurried visitor problem.

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2 Visitor Engagement and Learning

Until recently, the effectiveness of museum exhibits was largely assessed by measurements developed using the behavioral sciences. These measurements highlight the importance of visitors' dwell-time at and their learning from exhibits (Screven 1976; Shettel 2001). With the cognitive turn of the social sciences in the 1970s and 1980s, visitor studies increasingly shifted their interest towards visitors' learning from exhibits. This shift in focus inspired new studies that attempted to demonstrate that visitors do learn from museum exhibitions. They also provided information for museum managers and exhibit designers, which they used in the development of more effective exhibitions. In particular, this led to changes in the layout of exhibitions and the design of exhibit features, labels, and other information resources to increase the visitors' dwell-time in exhibitions and with exhibits (Falk 1983, 1993; Serrell 1993). Such studies also discuss ways in which cognitive factors such as "interest," "motivation," or "attitude" could be addressed in order to improve visitors' experience of exhibitions (Csikszentmihalyi and Hermanson 1995; Perry 1993).

More recently, visitor studies have been influenced by a shift in the cognitive sciences towards an interest in the way in which social interaction and talk impact people's learning and understanding (Lave and Wenger 1991; Wenger 1999; Wertsch 1991). Likewise, within the field of science education, there has been an increasing emphasis on the role and significance of language in the learning of science (Lemke 1990; Sutton 1995; Wellington and Osborne 2001). The importance of social influences for visitors' experience of exhibits has been noticed by behavioral researchers (Bitgood 1993), sociolinguists, and others (Blud 1990; McManus 1988, 1994). However, only the emergence of sociocultural theory resulted in a large-scale turn in visitor studies towards studies of social interaction in museums. A growing body of research now reveals how objects, tools, and artifacts feature in and mediate learning in visitor groups. These investigations increasingly argue that the museum experience is fundamentally influenced and shaped by social interaction and talk among visitors (Crowley 2000; Leinhardt et al. 2002; Paris 2002; vom Lehn et al. 2001).

3 The Use of Digital Technology in Museums

Various studies in settings other than museums have shown that using technology is extremely appealing to people, particularly children, and that it can facilitate social interaction (Scrimshaw and Wegerif 1997). Considerable debate has focused on the suitability of using technology in museums. While technology-enhanced exhibits lead to a relatively long dwell-time (Schulze 2001; Serrell and Raphling 1992; Wohlfromm 2002), the screen and the interfaces (trackball, keyboard, touch-screen) are often too small and clumsy to encourage social interaction (Flagg 1994). Nevertheless, computer-based exhibits are increasingly viewed as a means to enhance the effectiveness of museums in communicating information to the public in different

and novel ways and in facilitating new forms of participation and interactivity. They are also seen as a way to support and engender social interaction and discussion among visitors (Bradburne 2000; Thomas and Mintz 1998).

Research on the use of digital technology in museums has focused almost entirely on casual visitors' use of computer kiosks on the museum floor, either as stand-alone exhibits or to complement physical exhibits in order to increase interactivity and learning. For example, one study (McIntyre 2003) investigated claims that new computer-enhanced exhibits installed alongside ancient artifacts at a British museum were thought to be distracting, intrusive and patronizing. Results showed that these concerns were unfounded. Instead, the computer-enhanced exhibits deepened visitors' engagement with the real objects. A subsequent study of computer-enhanced exhibits at science centers in the UK (Heath et al. 2005) found that in many cases the computers inadvertently reduced social interaction and cooperation since only one person could operate the computer at a time. Following the same line of investigation, a study of visitor interaction mediated by computers at the Science Museum of London (Meisner et al. 2007) found that although one individual often does dominate the operation of the computer, other visitors often become quite involved as spectators.

In recent years, studies of computer-enhanced exhibits have focused on the use of handheld guides, such as tape recorders, personal data assistants (PDAs), and cell phones, including applications in which visitors take an active role in collecting data and directing their own exploration of the museum exhibits (Tallon and Walker 2008). Emphasis on the use of computers to mediate social interaction at museums is not surprising since the social role of learning has been known to be important since the work of Vygotsky (1934) was rediscovered over 50 years ago, and recently reaffirmed in school settings (Duschl et al. 2007) and informal learning environments (Bell et al. 2009).

Much of the earlier efforts to incorporate technology in museums dealt primarily with simple computer software aimed at providing information, posing questions, or engaging casual visitors in very brief interactions. Recent efforts, however, have introduced sophisticated simulations in the museum setting, or the use of technology-enhanced tools to promote learning and engagement with museum exhibitions. Important twenty-first century skills that can be promoted through the use of technology include argumentation (Squire and Jan 2007), collaboration (Lim 2005; Hausmann et al. 2008), design and model-based thinking, and innovation (Gee 2009). Handhelds have been used in formal education to measure student learning in jigsaw cooperative learning environments (Lai and Wu 2006), inquiry-based science classrooms (Vonderwell et al. 2005), outdoor learning spaces (Liu et al 2009), urban city centers (Morrison et al. 2009), class field trips (Weller et al. 2008), and historic and environmental sites (Klopfer and Squire, 2008). In addition to expanding temporal and geographic flexibility in promoting learning, handheld technologies also facilitate the collection of data and recording of visitor responses in museum environments (Patten et al. 2005). Additionally, more and more museums are developing electronic guide systems that deliver content and facilitate a museum visit, while also recording visitor responses in order to determine

what they are learning during their visit (Bruce 2010). These systems not only help museums better understand how people learn from exhibits, but they also help visitors connect to the museum space (Duff et al. 2009) and stimulate complex thinking about exhibit topics (Schmitt et al. 2010). Digital tools also enable education researchers to measure what people know about important topics that are not yet a part of established formal education curricula, such as nanotechnology (Crone 2006) and climate change (Schultz and Shugart 2007).

In order to get a better sense of how technology can be utilized in a museum exhibition, it is informative to look at how two very different museums focus on ecosystems. Since its inception in 1869, the guiding motto of the American Museum of Natural History in New York City has been, "For the people, for education, for science." The museum has long been an invaluable educational resource and takes its role as a partner to teachers, schools, and the local community very seriously. Among the most popular exhibits at the museum are the Mammal Halls, which display precise depictions of geographical locations and careful, anatomically correct mountings of the specimens. The Hall of North American Mammals offers a snapshot of North America's rich environmental heritage, with 43 dioramas focusing on 46 mammal species and their habitats. The dioramas are considered among the finest in the world and offer a visitor an experience that is akin to traveling in space and time. Dedicated naturalists, artists, photographers, taxidermists painstakingly replicated specific animals in specific geographic locations at a specific time, using specimens collected from the actual locations depicted. Ironically, when the hall was dedicated in 1954, curators limited the intrusion of text on the walls surrounding the dioramas because they did not want anything, including distracting labels, to interfere with the intended illusion of a wilderness experience (Quinn 2006). Things, however, have changed in the last half-century. While the dioramas look much as they did when the hall first opened, thanks to on-going preservation efforts and recent extensive renovation, the visitor experience has changed quite a bit. Prior to coming to the museum, visitors can explore a virtual map of the museum, watch YouTube videos of the restoration process, download educational resources for the exhibit, and view an online photo gallery of the dioramas while learning about the animals and habitats. Once at the museum, visitors can use a smartphone app (Fig. 8.1) to view images of the hall's dioramas, behind-the-scenes videos, archival photos, and current-science commentary from the curator while exploring the dioramas.

A stark contrast to the 32 million specimens and 500,000 ft^2 of the American Museum of Natural History is provided by the Marian Koshland Science Museum of the National Academy of Sciences in Washington, DC. With only a handful of physical artifacts and 6000 ft^2 of floor space, the Koshland utilizes state-of-the-art exhibits, public events, and educational programs to provide information that stimulates discussion and provides insight into how science supports informed decision-making. Opening in 2004, the Koshland represents a new sort of museum that is based on information and interactivity, not artifacts. It has received national and international attention for its innovative and content-rich multimedia exhibits and interactive displays. Koshland exhibits are developed with the assistance of science experts, using the wealth of information provided in reports by the National

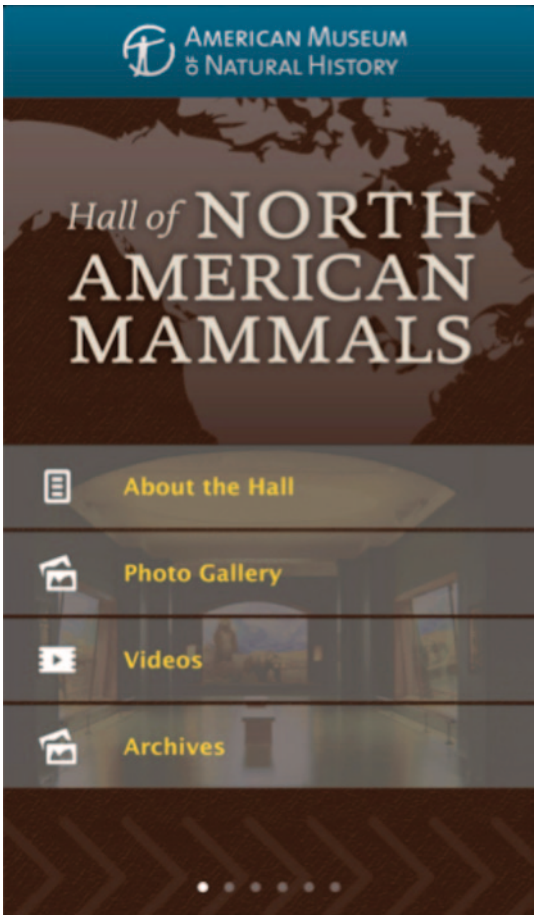

Fig. 8.1 Screen capture of the AMNH Hall of North American Mammals smartphone app.

Research Council (NRC) and Institute of Medicine, incorporating cutting edge multimedia, video, and computer interactive technology.

A signature exhibit at the Koshland is the Earth Lab, which focuses on the causes of global warming and impacts of climate change. While the Mammal Halls at the American Museum of Natural History provide a precise recreation of ecosystems and habitats from the past, the Earth Lab exhibit uses up-to-date data, simulations, and multimedia visualizations to present how ecosystems across the globe are impacted by drought, heat waves, rising sea levels, receding glaciers, and increasing ocean salinity. Some of the impacts presented include displaced forest cover, loss of wetlands, permafrost warming, shifts in animal habitats, and an increased risk of extinction of species in the Arctic and Southern Ocean, including polar bears. Using projected, interactive displays, sophisticated computer models, and simulation-based decision-making tools, the Earth Lab exhibit promotes social interaction and talk as visitors are able to explore how their own personal choices could contribute to human activities that impact climate change and compare them in real time to choices made by other visitors in the exhibit.

4 Theoretical Framework

The NRC reports, Taking Science to School: Learning and Teaching Science in Grades K–8 (Duschl et al. 2007) and Ready, Set, Science!: Putting Research to Work in the K-8 Science Classroom (Michaels et al. 2008) proposed four "strands" of science learning which, rather than focusing solely on science content, encompass the knowledge, reasoning, and inquiry skills that students must acquire to be considered proficient in science. These four strands were expanded to six in Learning Science in Informal Environments: People, Places, and Pursuits (Bell et al. 2009) and Surrounded by Science (Fenichel and Schweingruber 2010) in order to extend science learning beyond the formal classroom. These six strands for promoting science learning include:

Strand 1: Experience excitement, interest, and motivation to learn about phenomena in the natural and physical world. (Motivation)
Strand 2: Come to generate, understand, remember, and use concepts, explanations, arguments, models, and facts related to science. (Conceptual Understanding)
Strand 3: Manipulate, test, explore, predict, question, observe, and make sense of the natural and physical world. (Active Inquiry)
Strand 4: Reflect on science as a way of knowing; on processes, concepts, and institutions of science; and on students' own process of learning about phenomena. (Metacognition)
Strand 5: Participate in scientific activities and learning practices with others, using scientific language and tools. (Collaboration and Communication)
Strand 6: Think about themselves as science learners and develop an identity as someone who knows about, uses, and sometimes contributes to science. (Identity)

Strands 1 and 6 represent the interest and engagement in science that are often emphasized in informal environments. Our focus is on leveraging the interest and engagement engendered by compelling dioramas to support the learning described in Strands 2–5—conceptual understanding, scientific practices, and metacognition, as well as collaboration, communication, scientific argumentation and discourse. All six strands, however, should be addressed in any effort to promote STEM learning.

5 Learning Theory in Informal Settings

One of the most frequently cited resources in the world of informal science education research is *Learning From Museums: Visitor Experiences and the Making of Meaning* (Falk and Dierking 2000). In addition to its value as a review of some 400 research studies, the book offers a number of coherent theories, supported by research, that have been invaluable in the process of designing new museum exhibits and programs as well as focusing the targets of future research in museum settings. Among the theoretical perspectives they describe, the following are relevant to our work:

- Learning in museums is a socio-cultural experience that involves interactions between the visitor and creator of the museum artifacts, exhibits and programs, and among the visitors themselves as they share perceptions, questions, insights, and emotions during the visit.
- The authentic physical setting provides significant support to learning and recall. Examples are provided of visits to zoos and natural history museums that prompted visitors to later recall vivid memories and associated learning.
- A key element of constructivist theory is that learning in the museum is mediated by the knowledge that visitors bring to the museum, such that some knowledge and interest relevant to a given topic will enhance learning at an exhibit on the same or similar topic.

6 Model-Based Learning (Buckley 2012)

Our theoretical perspective is a special case of constructivist theory in that we focus on the mental models that learners construct from their prior knowledge and the situation at hand. As learners experience new situations and task demands, they use and evaluate their existing mental models, and as a result of that evaluation, may reinforce or reject their existing model or they may revise or elaborate their mental model by adding elements. In addition to providing realistic contexts that bring science to life, museum experiences can help visitors form mental models of the science systems represented. Systems and system models are important cross-cutting concepts in the Next Generation Science Standards. Museum exhibits provide richly detailed contexts in which visitors can use and revise their mental models of the components, interactions and phenomena of the science system on exhibit. We find model-based learning especially helpful in science learning because the cognitive processes required parallel those of scientists as they posit, test, and refine theories. We characterize the mental models of learners as internal representations of natural (or man-made) systems—their components, the interactions of those components, and the phenomena that emerge from those interactions.

7 A Richer Understanding of Ecosystems

Since understanding requires the development and revision of mental models (Johnson-Laird 1983), a richer understanding of ecosystems must include mental models that represent the system by integrating knowledge about the organisms that inhabit the ecosystem, their roles in the cycling of matter and energy, and how they interact in feeding relationships to produce population changes. This systems view develops from understanding that population dynamics emerge from the interactions of organisms and abiotic factors and becomes a model of the system that is transferrable to other ecosystems and extensible to the population changes brought about by evolution as well as human activity.

The development of mental models of ecosystems might begin with observations of organisms that comprise the producers, consumers and decomposers that drive the flow of matter and energy within the ecosystems. They interact with each other and the abiotic factors of the environment and result in variations in the populations of organisms over a wide range of time scales.

Dioramas are external representations of the consensus models of scientists and the mental models of their designers (Norman 1982). Since dioramas typically portray organisms in a particular ecosystem, visiting a diorama can inform a visitor's model of that ecosystem. In order to examine how dioramas might inform the mental models of visitors, we consider what aspects of the ecosystem are represented. Buckley and Boulter (2000) developed a framework for investigating the role of representations in developing mental models, which we will use to characterize dioramas. In analyzing representations, Buckley and Boulter examined what we now refer to as the components, how they interacted, and how those interactions explained the phenomenon represented. This framework for conceptualizing a system model maps directly onto the organisms, interactions, and population dynamics we use to define the desired richer understanding of ecosystems.

To illustrate, we begin at the Hong Kong Museum of History with a diorama that depicts the flora and fauna of the area 6000 years ago (Fig. 8.2). What is compelling about this diorama is the immersion of the visitor in the environment. Because of the configuration of the diorama, visitors can walk around three sides of the diorama and view the trees, birds, reptiles and mammals from different perspectives, spotting different fauna from different viewpoints. In addition, the towering trees immediately convey scale while the "sound track of birds chirping and twittering, and animals roaring and grunting" adds yet another sensory input (Hong Kong Museum of History 2004). In addition, there are traditional static legends posted at various points on the perimeter as well as computer kiosks that provide access to additional information, primarily in the form of text and images.

What aspects of this ecosystem are being represented? At the organism level visitors see a sampling of the visible producers and consumers in the ecosystem, but probably no visible decomposers. Visitors cannot learn about the feeding relationships from the diorama itself, but they might bring to the experience prior knowledge about how the characteristics of organisms enable different feeding behaviors, understandings about predator-prey relationships in general, and might therefore be able to draw some inferences based on their existing knowledge. This might be facilitated by conversations with parents, docents, or other visitors. The diorama itself represents a snapshot of the system at a given time, but does not represent the interactions among organisms or interactions with the environment that produced the population represented in the diorama. Moreover, the population numbers in relation to each other may not be able to be portrayed in the limited exhibit space. However, these organism interactions and population numbers and fluctuations could be represented in videos of organisms eating, games that involve building a viable ecosystem of organisms, or simulated investigations.

Fig. 8.2 Historical diorama at the Hong Kong Museum of History

8 Affordances of Dioramas and Technology for Supporting Model-based Learning

Throughout the following examples we will examine which aspects of an ecosystems model—components, interactions, and emergent population dynamics—are portrayed and how technology is or may be used to support the development of visitors' mental models of the particular ecosystem or ecosystems in general.

9 Oakland Museum of California (museumca.org)

The Gallery of Natural Sciences at the Oakland has been a leader in natural science presentation techniques since it opened in 1969. Reopening in Spring 2013, the new gallery will include a comprehensive re-thinking of previous exhibit and interpretive components, as well as a major expansion into previously under-utilized areas. Along with new exhibits, existing dioramas will be enhanced with new technologies

for audio and visual data display and links to websites and social media forums. With a working title of "Bringing Nature to Life through Community Voices," curators are working with residents of seven distinct California ecosystems and collaborating with research scientists and conservation groups such as the Nature Conservancy, the Golden Gate Audubon Society, and the East Bay Regional Park District to develop programs and displays.

The renovated gallery will feature an orientation area plus diorama-based exhibits dedicated to specific California ecosystems. While many of the existing cases and dioramas will be retained, they will be dramatically enhanced with new content and messages. Integration of audio, video, online media, and scientific visualization technologies into the diorama displays will provide visitors with direct access to the places and the people who live and work in California's ecosystems. The museum has gone throughout California to identify areas of spectacular biodiversity in terms of plant and animal life. They are working with local groups in order to get local communities to contribute to and engage with the exhibits depicting their local ecosystems. A goal is to have visitors engage in issues specific to each of the ecosystems and not just listen to scientists describing what kind of rock is in the exhibit. As current scientific discoveries are made, the museum will have various venues in the gallery where they can be shared and discussed.

The focus of the new gallery is on California's unique status as a region of extreme biological and geological diversity, which harbors the nation's highest species' richness, as well as some of the most imperiled habitats on the planet. In addition to its rich diversity, part of what makes California a biological "hotspot" is the human population pressures that have rendered it one of the most ecologically degraded states in the country. The Oakland Museum seeks to protect the natural environment by encouraging people to see themselves and their communities within the natural world. Therefore, the goal for the new gallery is to encourage a compelling connection to place, an understanding of the issues facing the natural environment, and a sense of urgency for sustainability.

For example, Mount Shasta, an iconic California landmark and the setting for one diorama exhibit, plays a defining role in the region's ecosystems. Visitors learn about the habitats that surround the volcano and how the water from it feeds major rivers and tributaries and sustains local wildlife in a myriad of habitats. Ecologists from the region talk about improving habitats for native fishes by focusing on enhancing food webs and their productivity. Aquatic food webs are inherently complicated, starting with primary producers (e.g. plants and phytoplankton) that feed primary consumers (invertebrates), which ultimately feed fish, such as juvenile salmon—a common target of restoration efforts. On Big Springs Creek, a tributary to the Shasta River, geologically derived nutrients fuel an unusually productive food web. These nutrients are incorporated in groundwater as it passes through the volcanic rocks of Mount Shasta and marine sedimentary rocks that underlie the mountain. As the groundwater emerges as springs, nutrients create rapid and abundant aquatic plant growth. These plants, in turn, support exceptionally high numbers of aquatic invertebrates. In this way, the nutrient rich groundwater is churning out voluminous, high-quality fish food. As invertebrates drift downstream in the water

column, they are eaten by juvenile coho salmon. Because the spring water temperature is constant, it provides high quality growing conditions throughout the year for all components of the food web. These ideal growing conditions (constant temperature, unlimited food resources, and high quality habitat) allow the juvenile coho to grow much faster than in adjacent watersheds where these conditions are not present. These coho are roughly twice the size of similarly aged fish only 40 miles away. By understanding how Mount Shasta contributes to a healthy local ecosystem, ecologists can target the same factors in other struggling aquatic ecosystems to try and improve their health and productivity. Thus, the Gallery of Natural Sciences portray both the organisms and abiotic factors (minerals and constant temperature) of the Mt Shasta ecosystem and how they interact to produce healthy populations of organisms. In addition the use of technology to inform the social impacts will likely deepen the visitor's engagement.

10 Monterey Bay Aquarium (www.montereybayaquarium.org)

At the Monterey Bay Aquarium several ecosystems are represented. There are tide pools and an otter habitat, but the most dramatic is the Kelp Forest. "At 28 ft, the Kelp Forest is one of the tallest aquarium exhibits in the world. You'll get a diver's-eye view of sardines, leopard sharks, wolf-eels and a host of other fishes as they weave through swaying fronds of kelp, just like they do in the wild (http://www.montereybayaquarium.org/efc/kelp.aspx)." Traditional legends help visitors identify the denizens of the Kelp Forest. While visitors are presented with a mesmerizing and captivating view of sea life, information about feeding relationships in the wild is absent. Instead visitors observe divers feeding the inhabitants. The visitor can gain some insights about the difficulty of spotting some of the creatures and hence their ability to evade predators.

Elsewhere in the aquarium are technology-enhanced exhibits that provide additional information about the kelp forest ecosystem. One display focuses on the concept of avoiding predators with an interactive multi-user simulation. Up to three users set the color, size, and texture of their seahorses. If the user has successfully matched the color of the surrounding kelp, made the seahorse small, and blended the texture to match the kelp, the predatory fish does not eat the seahorse. This makes the concept of adaptation and camouflage both meaningful and memorable. The activity also provides opportunities for discourse and peer-teaching as the users who have figured it out teach newcomers. In another exhibit, visitors can manipulate an underwater camera in order to observe a hermit crab foraging in a shallow tide pool tank. An interactive game kiosk engages visitors in solving the mystery of the disappearing abalone by investigating biotic and abiotic factors.

The population dynamics of ecosystems are challenging to understand and investigate within the context of a museum or aquarium visit, yet are an important component of a deeper understanding of ecosystems. Unlike static dioramas that include typically one or at most a few of each organism, the Kelp Forest contains

populations of organisms, although sustained artificially. It is, however, impossible to develop more than a vague sense of the numbers of each and how they change overtime. The Seafood Watch program at the aquarium focuses on the population dynamics of the ocean and how they are affected by our choices when consuming seafood. Focusing on the ecological sustainability of wild-caught and farmed seafood commonly found in the United States marketplace, the program's goals are "to raise awareness of important ocean conservation issues and empower seafood consumers and businesses to make choices for healthy oceans." Wouldn't it be engaging to see what the impact of seafood choices made by all the visitors to the Aquarium might be on simulated populations? Visitors might also explore the impact of other factors such as pollution, fishing quotas, etc. on these populations.

The Monterey Bay Aquarium employs a variety of technology-enabled interactions in other exhibits that might be useful in extending the visitors interaction with the Kelp Forest. In one exhibit, a large touch-sensitive screen displays invertebrates in motion. If such touch-sensitive screens were used in place of static legends, the visitor might be able to view feeding relationships or population numbers in the kelp forests in Monterey Bay. One teacher has created a learning activity that involves students in researching and enumerating the ways in which the Kelp Forest exhibit differs from kelp forests in the wild. This represents not only an opportunity for students to investigate kelp forest ecosystems, but is also excellent fodder for discussion of the nature and limitations of models.

11 California Academy of Sciences (www.calacademy.org)

The exhibits of the Kimball Natural History Museum at the California Academy of Sciences draw heavily from the Academy's 150-plus years of research, its 20 million specimens, and the expertise of its many world-class scientists and affiliates. The Tusher African Hall is the only hall from the original California Academy of Sciences that has been recreated in the recently renovated Academy building. Twenty-one dioramas showcase a variety of African animals, handcrafted rocks and plants, and meticulously painted backdrops, giving visitors an in-depth look into Africa's diverse ecosystems. The original African Hall opened in 1934 with 24 dioramas and, much like the exhibits at the Museum of Natural History in New York, it quickly became a San Francisco icon. A 1930 expedition created a record of Africa's vanishing wildlife by documenting actual localities where the specimens were collected to ensure that each diorama would be true to life.

Although much of the African Hall looks identical to the original, the visitor experience has been enhanced with innovative new elements. Five of the dioramas contain live animals. Human evolution is also addressed in the hall, sharing the message that "We are all Africans." Redesigned interpretative panels and plasma touch-screens allow visitors to dive deeper into the animals' habitats and their adaptations through interactive games and videos of researchers discussing their work.

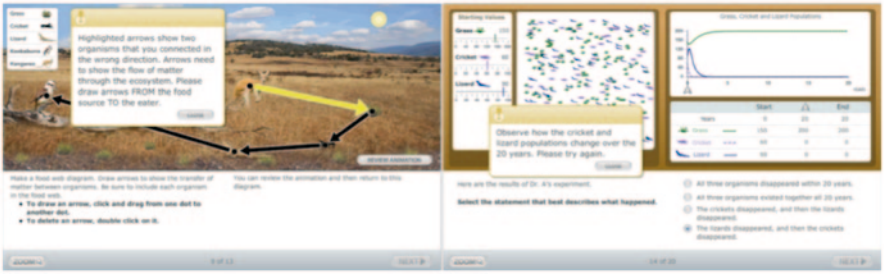

Fig. 8.3 Simulation-based activities from WestEd's SimScientist program depicting an investigation of grassland ecosystem

One of the most striking exhibits—the Somali arid zone—features a double-wide diorama with no glass barrier, containing a rich habitat and animal species, including Grevy's zebras, antelopes, a leopard, and virtual elephants walking in the background. Part of what is so striking about this diorama is the fact that all three levels of an ecosystem model are present in a physically immersive environment. Visitors stand underneath the leopard (a secondary consumer) as it stalks the zebras and antelopes from an overhanging tree branch. The zebras and antelopes (primary consumers) are warily eating the various grasses (producers for the ecosystem). This diorama is a prime target for technological enhancement, potentially utilizing simulation-based technologies like those developed for assessing classroom students' understanding of complex science systems (Fig. 8.3).

Imagine if you will a smartphone app that poses real-life problems for visitors as they explore the dioramas in the African Hall as part of a "virtual safari". For example, as visitors encounter the Somali arid zone diorama, they would use their smartphone to activate a simulation-based activity on the touch screen by scanning a Quick Response (QR) code or triggered automatically by an RFID tag. A visitor standing in front of the zebra might explore a dynamic food web, observing the feeding habits of each species and drawing arrows in a food web to see how matter and energy pass through the ecosystem. Standing under the leopard might activate an investigation for visitors in which they view impacts on the leopard due to habitat loss. The smartphone app could record responses and engage visitors in social media discussions.

12 Discussion

While dioramas offer opportunities to engage and interest visitors and for visitors to pose questions about the ecosystems portrayed and about their denizens, they do not present sufficient information by themselves to enable visitors to construct deeper understandings of ecosystems by building mental models of these dynamic systems. Dioramas can portray the biotic and abiotic components of the ecosystem,

but are less likely to show the feeding relationships that move matter and energy through the ecosystem. Rarely do dioramas adequately portray the dynamic population changes that emerge from those interactions.

In our examples, we have glimpsed uses of technology that help the visitor prepare for the museum visit, delve into some aspects of ecosystems, and engage visitors both during and after their visit. None systematically support the casual visitor in integrating all aspects needed to construct the mental models by which we defined a deeper understanding of ecosystems. Like the teacher who asked students to compare and contrast the Kelp Forest exhibit to kelp forests in the wild, teachers and museum staff can support such integration in diverse ways for classes that visit the museum or aquarium. In the next section we offer some principles for using technology during and after the visit to better inform and support development of the casual visitor's understanding of ecosystems.

13 Principles for Extending the Diorama Experience with Technology

A typical diorama exhibit can offer a realistic, rich depiction of an ecosystem, yet the diorama remains limited to static portrayal at a point in time of a limited number of organisms in a habitat. Technology can help the visitor build a more complete, dynamic model of the system interactions and changing population levels across time and changes in environmental conditions. We offer the following design principles as a starting point.

1. Visitors need all the pieces to make a system model of ecosystems—component organisms, their feeding relationships (food web), and the resulting population changes.
2. These pieces need to be linked via contiguity (Mayer 2005) or explicit scaffolding such as that afforded by driving questions of Who eats whom? and What are the impacts on populations both local and global of human choices, climate change, disease, or invasive species?
3. Use the static displays or artifacts to stimulate questions or pose mysteries. Use technology to enable the visitor to answer those questions or investigate those mysteries. Make the displays large enough for small groups to participate either directly or vicariously.

For example,

- Static legends could become interactive displays that bring up videos or animations of feeding behaviors either on a large screen or the visitor's mobile device.
- Electronic 'trails' might lead visitors to other exhibits so they can answer the driving question of who eats whom.
- Large GIS displays could present the output of simulations that enable visitors to investigate the impact of human choices, climate change, disease, or inva-

sive species on global ecosystems. Visitors could continue these investigations at home through the museum's website.

In this chapter, we have advocated using a model-based approach to support visitors' understanding of ecosystems. The goal of using a system model framework to focus and shape visitor experiences would be to help the visitor become aware of the habitat as a system and to build a more robust mental model of system components, interactions and emergent behaviors across all ecosystems. Technologies help to build such models of ecosystems by both portraying the unobservable causal, temporal, and spatial relationships in a dynamic ecosystem and immersing visitors in the interactions and population changes of the habitat displayed. The integration of technologies with dioramas promises to enhance and invigorate both the immediate museum experience and create strong models for visitors to organize their understanding and investigations of ecosystems.

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Chapter 9
Displaying Eco-Scenes with Techniques of Diorama Representation

Ximin Kang

1 Significance of Displaying Eco-scenes with Techniques of Diorama Representation

Museums, a product of social advancement, interact and inter-grow with the society in which they are situated as well as with the economic, social development and environment changes. There is the view that museums shoulder the responsibilities and obligations of publicising the cultural diversity and bio-diversity of the human heritage and promote eco-civilization. Thus, the theme of 22nd International Museum Association Conference, held in Shanghai in November 2010, was "Museums for social harmony". As far as natural history museums were concerned, the theme was "for the harmony between human beings and nature", i.e. the bio-diversity and the interdependence of human beings and nature as well as knowledge, essence and approaches that are presented to the public through the exhibitions of natural resources, phenomena, principles, rules and scientific achievements.

Bio-diversity sustains human survival and development, and constitutes a major theme in natural history museums. Bio-diversity generally includes three components:

1. genetic diversity—the inherent form of bio-diversity;
2. species diversity—the basic unit of eco-diversity;
3. eco-diversity—the diversity of the eco-system compositions and functions and the diversity of eco-processes, i.e. the diversity of eco-environment, biocenosis and eco-processes. It appears that diorama representations on eco-diversity are favoured by most visitors.

The techniques inherent in the methods used by exhibition holders are aimed at conveying the intended message. Diorama representation, a method applied in modern museums and becoming increasingly used in China, highlights the theme and

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exhibits preserved plants and animals as well as geology and general habitat characteristics. Traditional dioramas with a frame and glass often suffer a number of problems such as focusing too much on artistic creations while neglecting the scientific essence of the theme, incongruity of physical images with backgrounds, lack of scientific, artistic qualities and display effects of eco-scenes. As a consequence, visitors may not be attracted and cannot interpret correctly the biodiversity, the relationships between organisms and environment, and between organisms and human beings. In the last decades, however, progress has been made in the analysing, interpreting and exhibiting themes, the application of designs and techniques and interactive projects with the development and application of technologies.

Bio-Diorama representations strive to create bio-scenes full of artistic conceptions in a limited space with the prototype of model areas, through the scientific refinement of original materials, vivid representation, artistic generalization and creation of a story line. They also take advantage of design elements of space, colour and shape as well as high-simulation techniques. The significance of creating a diorama lies in making the bio-scenes more real, vivid and appealing, thus more appealing to the audience whom we anticipate will make senses of it. It can facilitate their active involvement and brings them the pleasure of "thinking and discovery", and lead them to concur with the intended message. Museums should seek to inspire the visitors, broaden their vision and lead them to in-depth thinking. Thus, an excellent exhibition may positively influence the thinking patterns and even life attitudes of the visitors. Diorama representation can help visitors to understand the exhibition and obtain, possibly, a relatively complete understanding of eco-system diversity. Moreover, with obvious visual effects and refined parts, the visitors are more likely to be receptive and receive the intended information, to become actively involved, to appreciate the beauty, aspirations and ideals, to think more about bio-diversity and the importance of human and natural harmony in their vicinity as well as the whole world. In a sense, an aspiration of exhibit designers is that the visitors are inspired to love nature, cherish life and the natural environment in which they live.

Zhejiang Museum of Natural History, China, was officially open to the public in July 2009. The new exhibition, designed and overseen by the author, consisting of eco-scenes displayed by Diorama representation, with good quality and effects, has won applauses from the public, other museums and the government. The number of visitors increased from 100,000 person-times annually before to 1 million person-times annually after.

2 An Introduction to the Cases of Displaying Eco-scenes with Diorama Representation

Zhejiang Museum of Natural History, with the predecessor of West Lake Museum born out of the first West Lake Exposition in 1929, enjoys a history of over 80 years. The new Museum, situated in Hangzhou West Lake Culture Plaza, China, which covers an area of 26,000 m^2, was officially open to the public in July 2009. As a

museum of natural history integrating scientific education, collection research, foreign exchanges and enjoyable, informing leisure visits, the Museum, with the theme of "Nature, Life and Human Being", houses three permanent exhibitions: "The Life Story of the Earth", "A Rich and Fantastic Bio-world" and "Green Zhejiang", which connect the past and the present, nature and human beings, distant places and our immediate vicinity. They reflect the modern concept of harmonious interdependence between human beings and nature and the regional flavour of Zhejiang.

At the entrance of the exhibition, a **Presentation Wall** features specimens like *Traumatocrinus* sp., 1000-year-old buried wood, *Eschrichtius robustus, Rhincodontypus* and some representational animal specimens recounting silently the mysteries and magnificence of the scene and reminding the visitors of a journey into the natural world.

2.1 The Life Story of the Earth

This exhibition describes the Earth of 4.6 billion years long, it reproduces the birth of the Earth, origin of life, ascent of life, age of dinosaurs, age of mammals and the appearance of human beings, and displays the persistent and steadfast evolution of the life in extinctions and explosions, which may encourage the development of the people's regard an awe for life.

2.2 A Rich and Fantastic Bio-world

This exhibition amalgamates the representative species of different biological categories (from the lower to the higher) on the Earth. Dioramas are used to reproduce typical eco-system scenes of Polar Regions, deserts and semi-deserts, tropical rain forests, mangrove forests and ocean coral reefs. They interpret the relationship between organisms and environment, organisms and human beings, and are anticipated to trigger people's understanding of the harmony between human beings and nature.

Eco-scenes of Polar Regions (covering an area of 60 m^2 and a height of 5.2 m)

Location of place which is modelled: The South Pole.

The South Pole is the only continent uninhabited by the aboriginals. It has a harsh natural environment. However, it is far from being a lifeless desert. There are lots of robust creatures, e.g. krills, Antarctic cods, emperor penguins and leopard seals still survive and multiply.

Eco-scenes of Deserts and Semi-deserts (covering an area of 50 m^2 and a height of 5.2 m)

Location of place which is modelled: Depopulated Zone in northern Tibet, China.

Deserts and semi-deserts are the most arid places on the Earth and the uninhabited area of northern Tibet is famous in China. With an average altitude of over 5000 m, it is called "The lifeless desert" since this uninhabited area has a wide area

Fig. 9.1 Bioscenes of Tropical rainforests

and acrid living environment, however, the rarest wild animal communities and unique animal categories are preserved here.

Bio-scenes of Tropical Rainforests (covering an area of 70 m^2 and a height of 5.2 m)

Location of place which is modelled: Xishuangbanna in Yunnan Province (Fig. 9.1).

Tropical rainforests, the biggest forest ecosystem with the greatest area and the richest species on Earth, boast complex community structures. In addition, they are renowned as "kingdoms of flora and fauna" since some unique sights can be seen in tropical rainforests: one tree making a forest, cauliflory, hanging gardens, tabular roots and strangulation and a wide variety of animal and plant resources exist there.

Bio-scenes of Mangrove Wetland Ecosystems (covering an area of 40 m^2 and a height of 5.2 m)

Location of place which is modelled: Dongzhai Port, Hainan, China.

Mangroves, a special transitional ecosystem from the sea to the land, are grown on the mudflats where the land meets the sea. They are renowned as "a natural marine land" and "a paradise for birds" since they are not only endowed with luxuriant foliage, dynamic root development and plentiful resources of aquatic organisms, but an important habitat for aquatic birds.

Bio-scenes of Sea Coral Reefs (covering an area of 36 m^2 and a height of 5.2 m)

Location of place which is modelled: The South China Sea.

The ocean, covering 70 % of the earth's surface, is the cradle of life and treasure-house of resources. Over 200,000 kinds of living beings in the ocean constitute a unique marine ecosystem, among which, the coral reef, commonly referred to as the "tropical rainforest" in the ocean, is an ecosystem with the most diversified species.

Fig. 9.2 Bio-scenes of Inland Wetlands in Zhejiang

2.3 Green Zhejiang

These exhibits illustrate the essence of Zhejiang land. The gallery illustrates the survey of Zhejiang nature, displays the eco-scenes of coastal islands, inland wetlands and mountains, plentiful natural resources with Zhejiang characteristics and the achievements in making Zhejiang an environment-friendly province. In this part of the museum, the beauty, richness, harmony of Zhejiang in a well-to-do society is exhibited.

In "Green Zhejiang", three eco-scenes of islands, wetlands and mountains are exhibited.

Bio-scenes of Hills and Mountains in Zhejiang (covering an area of 400 m^2 and a height of 13 m)

Location of place which is modelled: Fengyang Mountain, Zhejiang.

Hills and mountains occupy a large area in Zhejiang Province. Zhejiang Province ranks second in China with 70.4 % coverage of hills and mountains and 60.5 % coverage of forests in the total land area. Typical evergreen broadleaved forests of middle subtropical regions are the zonal vegetation of Zhejiang and the forests, with rational structures, distinct layers and diversified species, are the key habitats for rare animals.

Bio-scenes of Inland Wetlands in Zhejiang (covering an area of 180 m^2 and a height of 5.2 m)

Location of place which is modelled: Xiazhuhu Wetland (Fig. 9.2).

Zhejiang boasts plentiful wetland resources and a wide variety. Besides, natural wetlands of over 8 hectares cover an area of over 129 ha. Inland wetlands are called

"hometown of fish and rice" since they provide key resources for human survival and are equipped with key eco-functions. In addition, they are major areas for organism diversity.

Bio-scenes of Islands in Zhejiang (covering an area of 180 m^2 and a height of 5.2 m)

Location of place which is modelled: Zhoushan Islands, Zhejiang.

Zhejiang Province, the province with the largest number of islands in China, equivalent to over 40 % of the total number of islands, owns 3061 islands of over 500 m^2. A great majority of the islands are uninhabited and they became lively breeding paradises for sea birds in spring and summer.

3 Illustration: Displaying an Island Eco-systems in Zhejiang with Diorama Representation in Four Steps:

1. The basic set-ups Location: Nature Reserve of Wuzhi Mountain Archipelago situated in an uninhabited island in the offshore area
Season: Summer
Time: Daytime
Animals: Blacknaped terns, Blacktailed gulls, *Egretta eulophotes*, oystercatchers, Blue rockthrush and Balanus, etc.
Plants: *Penang muricata, Ficus formosana, coastal pearl leaves, Euonymus japonicus, Peucedanum praeruptorum, Miscanthus floridulus, Artemisia capillaries, Crossostephium chinense*, etc.

2. Scene Design The exhibit features the eco-environment of habitat islands for sea birds, the eco-relationship between organisms and environment. It reproduces the "breeding paradise" for the sea birds' living, nest-building and feeding their offspring and vigorous seas as well as islands. Three-dimensional patterns and two-dimensional paintings are combined to produce a backdrop of the depth of the expansive space. Additionally, a vertically rear-positioned visiting platform has been coupled with the front-positioned part, displaying the eco-environment of uninhabited islands in daytime in summer that reproduces optimal breeding conditions for sea birds, together with the singing of birds and sea lighting effects. In the vertically rear-positioned open scenes, visitors can ascend the spiral rock passageways to enjoy the ever-changing eco-scenes. The continuing audio and visual inputs of the display attract the visitors' attention, arouse their curiosity, and are supposed to inspire their creative thinking. This allows the visitors to acquire knowledge while enjoying the natural beauty.

3. The Display Design Designs and the interaction between visitors and scenes are conducted according to the story-based inventions, the story line, and ideas, refined image elements from original materials, physiology and psychology of visitors as well as the design elements of space, animation and visual effects.

The basic effects of lighting and modelling of organism and artefacts are crucial to the success of the exhibit. In this exhibit lighting is strong sunshine and the sound effects creating a soundscape are the sounds of waves and of birds singing.

4. Display Making First of all, study models with 1:20 proportion were made. Secondly the display contents and effects are shown from different perspectives to convey the display intentions. Thirdly, the study models are studied further to address the technical and artistic difficulties and skills needed to achieve the best effects. The following techniques were discussed and then used:

1. Fabrication of rock: The fabricating area of scene rock is around 350 m^2. According to the rock shape determined in the model venue and specific duplication venue, 20–30 rocks with features of islands were selected to roll over with silica gel and take samples on site; duplicates and models with uniting technology; and then hang and splice on site.
2. Fabrication of sea surface: After on-site sampling for the sea surface, the picture photographed was recreated in a model with quick-setting cement with lime and hemp thread. Then it was covered, polished and coloured with a fabricating method of glass fibre reinforced plastics. The 3D sea surface and the sea surface on the background picture were joined. Attention was paid to the waves at the bank and the dynamic details of wave and change in the nature of the water borderline in deep and shallow.
3. Fabrication of plants: Three kinds of herbaceous plants growing in summer and 10 leaves in the location were selected for simulation modelling. Again pictures and samples were taken. The patterns of growth, morphological characteristics and tissue features of the leaves were recorded. Fabric with appropriate texture and thickness were identified for the models and properly laminated. They were fabricated with knife steel die, molding-die and moulage. The trunks, collected as required from the roots under the ground, were to show the growing position and characteristics of a tree; after stifling, liquid medicine anticorrosion and degrease and dry, assemble and manufacture it. Finely fabricated trunks, leaves and fruits and flowers were positioned in the exhibit within 5 m of the audience. If it needs to be further distance away they may be embellished by adjusting fabricating.
4. Fabrication of background painting: Based on the image photos and relevant materials and constitution factors in the real location, the background painting was scientifically refined and an artistic creation was executed: First of all, a 1:20 colourful painting ground pattern was pasted on the background of the proposed diorama. After determining composition and colour, which was planned and set out on site, and sketching a draft outline of the background painting, it was painted as per the plan for creating the overall perspective and the complete diorama. The back veneer of the background painting is a double-layer 12 mm plywood which is fixed on a framework welded by steel structure; the backing material of the back veneer is sealed up with putty and boiled oil. The facing canvas is fabricated by propylene painting background (Fig. 9.3).

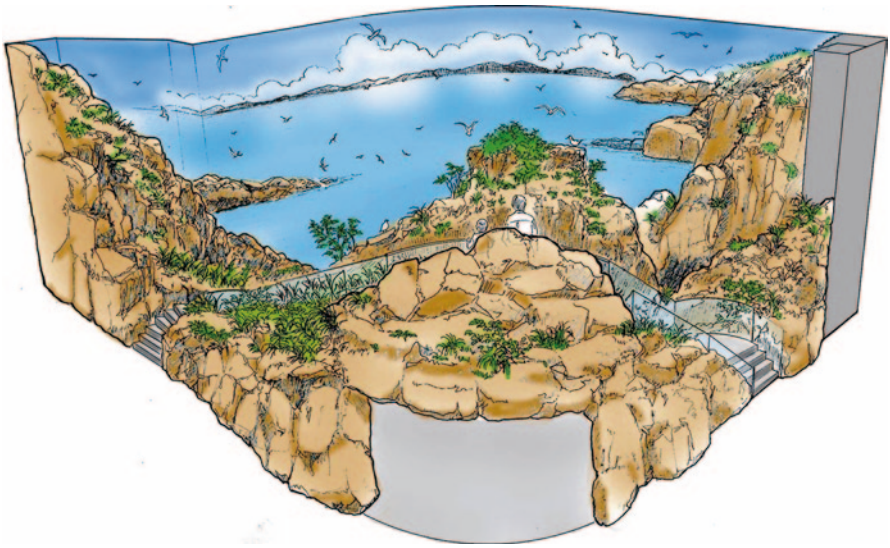

Fig. 9.3 Design Sketches of island eco-scenes in Zhejiang

5. On-site installation: The bird specimens were installed in compliance with the planned story scene and the ecological modelling of birds. In the installation of plants, they were positioned according to the design for the finished product. The embedding and direction of tree roots conformed to the actual ecological environment as they were found in situ. The trunks underwent crack processing and epidermis protection treatment. The simulated plants were decorated and embellished by splicing and pasting. After completing the installation, the background painting was appropriately adjusted and the whole image checked according to the scientific and artistic requirements and the overall show effect of the ecological scene desired. In addition, such techniques should strengthen the cleaning and maintenance in fabrication and installation to avoid any dust produced during on-site construction on the scene. This particularly affects the trunks, leaves, herbaceous plants and specimen. In this way the quality and effect of ecological scene created is ensured.

4 Some Suggestions on the Eco-scene Display with Diorama Representation

Due to the great variety of eco-systems and the wide space required for eco-scene displays, four aspects should be taken into consideration when designing such complex exhibits which are representations of the natural world.

a. Feasibility
   In drafting and preparing for display plans, a rational analysis and comprehensive consideration should be given to the facilities of display areas such as galleries, academic support and exhibits. Furthermore, the investment budget and follow-up operational costs must be considered. In the implementation, attention should be given consistently to the key points, technical feasibility and financial rationality. If mistakes occur in any stage, display plans, designs, making and assembling, professionals, planners, designers and effect, supervisors should address the problems collectively.
b. Scientific Aspect
   An Eco-system is a natural composite of different organisms and environments. In order to ensure the scientific value and display effects, the information about the relevant eco-scenes, including the particular environment of individuals, population and communities and other ecological factors, should be gathered from first hand, in situ studies in the chosen location. Different landscape factors and diversified landscapes made up of eco-systems to be represented in spatial structures should be carefully weighed. It is better to conduct an investigation of locations in the field to collect original materials, select information, create story scenes, conduct simulation design and make models rather than conceptualising an exhibit theoretically
c. Visitor Experience
   Experience is an objective psychological need and an advanced psychological activity. Seen from a sociological and psychological perspective, experience is a subjective cognitive process. Therefore, in displaying eco-scenes, the potential participation and experience of visitors should be taken into account. If visitors are stimulated in their thinking, senses, sensations and behaviours, they may be more attracted to museums.
d. High-technology
   High technology should be used appropriately. In a world with fast developing technology, a comprehensive analysis should be given to the display targets and potential visitors experience key points and knowledge interpretation based on the principle of "rational thinking and appropriate setting". Therefore, mature technical means and appropriate methods should be integrated to avoid the over use of modern technology which can overshadow the display themes and concepts.

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Chapter 10
Conservative Restoration and Reconstruction of Historical Natural History Dioramas

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1 Introduction

When the building for the Darmstadt museum was first designed in 1892, its architect, Alfred Messel, and the curator of zoology at the time, Gottlieb von Koch, already placed major emphasis on an architectural layout that would create a shell around the displays and as a result maximize the effect of the planned dioramas. G. von Koch had criticized in a publication that the display of large animals in cabinets, which had been common practice until then, was entirely inadequate, stating, "*Schon die für den Besucher außerordentlich störende Zerschneidung jedes größeren Tieres und jeder Gruppe durch die zwischen den Glasscheiben nötigen Sprosse, mögen diese auch noch so dünn sein, bildet einen großen Übelstand*." (von Koch 1892), meaning in translation, "The inevitable cross bars between the panes of glass, no matter how thin they might be, are annoying to the visitor to the extreme in that they segment every larger animal and every group display and are therefore a major nuisance." Von Koch's ideas for setting up large group displays (von Koch 1899) were then realized in a terraced addition to the northern side of the building when the museum was built under the supervision of Alfred Messel from 1897 through 1904 (Krause 1972).

Comprising nearly 1000 animal specimens, the ten dioramas of the Hessisches Landesmuseum Darmstadt ranked amongst the first displays that ever focused on zoogeography and systematic zoology. Displaying animal specimens in an abstracted environment that merely provided an idea of the natural habitat and never aimed at reproducing it true to every detail was very modern indeed then and could rightfully be termed revolutionary from a historical perspective. In fact, there is no other

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museum in the world where a comparative concept has been realized, rendering in particular the dioramas “Africa”, “Asia” and “Australia” exceptionally important historical documents on an international scale as they still exist in their original conditions.

The dioramas of the Darmstadt museum are amongst those in Europe whose basic components are still, aside from repairs necessary to eliminate damages suffered during World War II, in the same condition as when they were originally set up in the early years of the twentieth century. Right from the beginning, they were what drew people to come and visit and they have since remained one of the most distinctive trademarks of the Hessisches Landesmuseum Darmstadt. If these dioramas were to be preserved long-term, comprehensive restoration measures were now required, however. Neglecting these measures would inexorably lead to further expansion of the existing damages and the continual overall deterioration of the exhibits. Such a restoration, or reconstruction as the case may be, needed to be effected with great care in order to preserve as much of the original substance of the dioramas as well as of the original conceptional and creative ideas as possible. At the same time, the need for long-term preservation, which entails the necessity of effecting continued maintenance measures without causing new damages, had to be taken into consideration.

In the following, we elucidate the history of the Darmstadt dioramas, discuss the problems posed by existing damages, and describe the conservative measures of restoration taken.

2 History

2.1 Construction of the Dioramas

Construction of the dioramas of the Hessisches Landesmuseum Darmstadt actually began long before the inauguration of the museum building in 1906. Already around the turn of the century, the taxidermist Karl Küsthardt and his assistants were busy planning and assembling the “zoogeographic groups”, which was a term coined by Gottlieb von Koch for the individual units (von Koch 1910). The unit that saw completion first displayed animals of continental Australia and New Zealand and was set up in the West Wing as early as in 1904. However, this “Australia” diorama then suffered substantial damages from subsequent construction works on the building and these proved so severe that it had to be taken down and redone. It eventually took until 1908—two years after the opening of the museum—before it could be presented to the public once more, together with the other displays in the West Wing (i.e., South America, Africa and Asia). At this time, the dioramas for the East Wing were already at their planning stages, but bringing them into being first required further funding and time. In November of 1908, G. von Koch wrote in an article in the *Darmstädter Tagblatt* (Darmstadt Daily News): “*Die Faunengebiete Europas sollen sich später in etwas eingehenderer Ausführung anschließen*.” (“The zoogeographic regions of Europe are to follow in more detailed execution later.”)

The following years then indeed saw the successive completion of the European dioramas "Northeastern Europe" (1913), "German Forest" (1915), "Alpine" (1918), and later, extending far into the period of World War I, of the remaining displays "River Bank", "North Sea Coast" and "Arctic". This did not mean that the work on the dioramas was finalized, though. As is documented in a report published in the Darmstädter Tagblatt of 14 December 1926, the unit "Northeastern Europe" became temporarily unavailable to the public after it had actually been completed because it was subjected to a complete overhaul. This work included, amongst others, the incorporation of stuffed European bison specimens. It is quite safe to suppose that the other dioramas likewise experienced repeated additions, alterations and smaller repairs after they were first presented to the public.

The substructures of the landscape components of all dioramas were made from wood upon which a simple lattice structure was mounted that was reinforced with steel bars where it was to carry the weight of trees and boulders. These constructions were then overlain with wire mesh and eventually coated with wet sacking (called "Hessian" at the time) or jute soaked in a mix of dextrin and plaster. After the landscape had been sculptured thus, it was coated with a viscous paste made from dextrin and plaster. The latter constituent made it possible to sculpt the required fine structures of the surface and finally paint it with casein paint.

Supervision of the painting of the "Alpine" display was entrusted to Prof. Kurt Kempin in 1918. Trees and branches were sculpted from iron T-bars, round bars and wire. These were then mantled with jute cloth and hemp and once more coated with plaster. As models for trees in the European displays, impressions were usually taken from trees growing in the *Herrengarten* so as to have negative moulds that could be filled with plaster, cloth soaked in bone glue, or papier-mâché and so produce casts of all the parts that could later be assembled to form a complete tree in the diorama. The required bright illumination of the dioramas was taken care of by generously large skylights, while visitors would look at them from the shadows of a dim aisle. This eliminated all forms of reflection in the "windows". Von Koch had adopted this illumination concept from the skylit rotunda of the Stockholm Museum.

2.2 Concepts and Displays

Various aspects played central roles in the planning and conceptional design of the dioramas. First of all, specimens of the animal species to be displayed had to be available. Then, it had to be technically possible to realize the desired design. In order to obtain an impression of how visitors would perceive a display, sketches were made first. These were then turned into models at a scale of 1:10 (Fig. 10.1). Such a model diorama would consist of an open wooden crate into which the landscape was sculpted using wooden blocks and plasticine. These models were built paying close attention to every minute detail. The animals were likewise modelled from plasticine, initially limited to species already available, but later also including those desired and yet to be found.

A major difference existed between the West and the East Wing of the museum in the manner in which the various zoogeographical units were displayed. While

Fig. 10.1 Diorama "South America". **a** Plastinin model, scale 1:10. Exact date unknown, but prior to initial construction in 1906. **b** Tentative placement of mounted specimens with incomplete landscape construction. Exact date unknown, but possibly showing a second construction between WW I and WW II. **c** Oldest known picture of finished diorama. Exact date unknown, but probably taken around 1908. **d** Diorama after partial re-construction and repair of damages caused by bombing in WW II. Exact date unknown, but photo probably taken in the 1980's

the younger European groups were presented in a near-naturalistic imitation habitat (in which, for example, even the surface structure of the bark on the trees is modelled), the dioramas of the other continents are greatly abstracted. The colour given to the landscape was quite unobtrusive, and attaching foliage, flowers or fruit was done almost completely without, "*so dass die Phantasie nicht gehindert wird, sich die Tiere in einer entsprechenden Landschaft vorzustellen*" ("so as to not obstruct the fantasy in envisaging the animals in a corresponding environment") (von Koch 1910). The modelled landscapes of these older dioramas were therefore not to be taken as naturalistic recreations of a certain natural habitat, but rather suggested in an undifferentiated manner the diversity of potential habitats of an entire continent. The concept of display always used all representatives of the fauna of a certain continent present in the museum's holdings, irrespective of whether they would be present in the same natural habitats in reality. For example, the "South America" diorama comprises the High Andes next to the marshes of the Amazon lowlands, but

care was taken to populate the respective areas with animals that would really occur there. In this manner, von Koch managed to exhibit 169 species in 200 specimens on a surface area of just 25 m^2 in the "South America" diorama, and 107 species in 160 specimens in the "Africa" unit.

Information on the individual animals on display was provided in the shape of simple display plates that were limited to the respective German and scientific names and mounted below the windows. More information of general interest was to be found in the form of captions mounted in recesses in the opposite wall. For a time, these would also house lectern-type glass display cases with exhibits of mainly invertebrates that were arranged according to geographical and biological perspectives.

2.3 Subsequent Modifications

The dioramas of the Hessisches Landesmuseum Darmstadt sustained dramatic damage during the course of World War II, in particular during the night bombing raid of 11/12 September 1944 when the museum as a whole was badly damaged. The roof was destroyed in almost all parts of the building, and serious fire damage was experienced in wide sections. The impact almost completely destroyed the units "Artic" in the East Wing and "South America" in its western counterpart. The unit "Australia" suffered damages too, but to a lesser extent.

While the "South America" diorama was subsequently reconstructed quite to the detail from the original plans and presented to the public in 1959, the unit representing the "Arctic" was substantially modified and returned to the public display only in 1968. The latter was not reconstructed according to the original concept, but rather in a greatly abstracted form, with boulders and sheets of ice being reduced to simple geometrical dais (Feustel 1968). This modification probably had to do with a lack of material and funding just as much as with the zeitgeist of the time, which tended to present everything as abstractedly as possible. Furthermore, this exhibit was also meant to come close to the concept applied to the dioramas of the West Wing.

3 Condition Prior to Restoration

3.1 Damage from UV Radiation

The original concept of illuminating the north-facing dioramas exclusively with daylight resulted in very balanced lighting that resembled the situation commonly found in an artist's studio. More than a century of constant exposure to daylight made the animal specimens and model landscapes suffer massively from UV-induced damages, however. Deterioration, and fading from exposure to UV radiation in particular, of museum specimens is a long-known and rampant problem, as the lack of alternative means of illumination in the past enforced the use of natural daylight.

The result was a partial loss of the original pigmentation in the animal skins and painted landscapes. Their appearance today did therefore not correspond any longer to the original situation, making the visitor experience the dioramas in colours that were decidedly deficient in contrast. In some instances, certain animal species with a particularly characteristic, species-indicative colour pattern had in fact become difficult to identify as such.

3.2 Damage from Climatic Fluctuation

The objects within the dioramas were exposed to substantial climatic fluctuations for an extended period of time. The respective part of the building never benefited from air conditioning, and temperatures could be controlled exclusively by heating the aisles for the public and never in the dioramas themselves. The influences of the unfavourable climate were over time amplified by the appearance of leaks in the skylights. The relatively large proportion of outside walls in the sections of the building that housed the dioramas furthermore resulted in climatic fluctuations that were relatively wider than in other parts. Major fluctuations in temperatures and relative humidity negatively impact on zoological specimens in so far as, in conjunction with exposure to UV radiation in particular, they may render feathers and skins brittle. Moreover, the materials used for preserving a specimen expand and contract to different extents from moisture and heat. As the elasticity of certain components may be strictly limited, this results in cracks and tears appearing in the original animal skins over time. An important aspect to consider here is the manner in which these skins used to be tanned and worked by means of tawing with alum salts. This tanning method in conjunction with fatty remnants in the skin favours the formation of acid and as a consequence leads to decomposition effects. These tanning methods of old respond very badly to climatic fluctuations. The method of chrome-tanning, which would not be fraught with these problems, was developed only later. The damages incurred can be so massive that they eventually lead to the total destruction of an object if they are not halted in time. Further damage resulted from iron nails that had not been removed after the objects had dried or before they were set up in their dioramas in that they caused unsightly rust stains in the face, on the feet or along ventral seams. Finally, the manufacture of glass eyes at the time did not really match modern standards, and fluctuations in the climate of the display halls caused the paint on the inside of the glass body to detach in some instances.

3.3 Mechanical Damage

Mechanical damages were particularly common in the plaster surfaces of the model landscapes as a result of occasional treading on the dioramas for effecting essential maintenance work (electrical installations) or cleaning. Although the substructures for the animal specimens were solid enough to withstand the occasional and

temporary additional load, the superstructure was made from wire mesh and jute that would yield under these circumstances. The topcoat, however, was plaster that did not have this elasticity so that it would crack and eventually shed flakes and crumbs. Furthermore, various metal components in the substructure showed evidence of severe corrosion.

Aside from all this, cracks were obvious in the lateral separator walls of the dioramas with plaster falling off in patches in some more serious cases. This was particularly true for areas where there were vertical central steel supports inside the walls. Vibrations caused by construction and restoration works on the building from 2007 had then led to a notable increase in the formation of new cracks and substantial expansion of the existing ones.

3.4 Dust

The objects and model landscapes of all dioramas were badly affected by deposits of dust that found entrance mainly through leaky spots in the skylights, but also via former ventilation shafts. All objects were thus coated with a grey shroud that together with the fading of colours would leave even less of the original colours visible. This dust was mixed with soot particles from the fire damage sustained during the war. As though this was not enough of a problem, the dust that had accumulated in the dioramas was heavily contaminated with Lindan, which had been distributed to protect the objects from infestations with pests until the late 1980s.

3.5 Pests

In spite of many years of dispensing Lindan, arsenic and other biocides at regular intervals, almost all dioramas were found to be heavily infested with moths and beetles, which severely compromised the substance of the display specimens over and above the mechanical and climate-induced damages.

4 Restoration of the Dioramas

4.1 Documentation

Before any restoration measure was effected, the original condition of a diorama was documented to the last detail. It included as a first step the cataloguing of all objects present. This was followed by gathering a systematic comprehensive photographic catalogue of the exact positions of the objects and the landscape details of the display, after which these positions within the diorama were accurately measured and plotted. Finally, the existing damages were catalogued.

The standards applied prior to the commencement of restoration works were also maintained at every stage of the restoration itself in that every measure effected was

recorded in painstaking detail. This applied to the treatment of every object as well as to the restoration of all landscape details and paintwork and included recording the exact spots where repairs were done, the type of work effected, and the materials used in the process. It was deemed essential to go to these lengths in order to be able to evaluate on the basis of solid information possible subsequent changes and select appropriate counter measures should any become necessary in the future.

4.2 Construction Measures

The following construction measures within the framework of the restoration of the museum building were planned to extend to the areas housing the dioramas and executed accordingly:

a. The outside windows of the skylights had to be replaced in order to guarantee proper sealing against the intrusion of rainwater, dust and pest insects. At the same time, they were to contribute to more stable climatic conditions. The new outside windows were furthermore fitted with UV screens that in conjunction with shading with a maximum permeability of 150 Lux would prevent further damage from exposure to natural sunlight.
b. The narrow service aisles between the separating walls of neighbouring dioramas as well as all supply tunnels and ventilation shafts leading to the dioramas were closed off and sealed. This was meant to facilitate pest control measures in individual dioramas and prevent at the same time that infestations with pests would spread basically unobstructed to all dioramas. Targeted pest control should therefore be possible with much greater ease in the future.
c. The “display windows” separating the public area from the exhibits were replaced by exchanging the old normal glass panes with security glass. In order to make the dioramas accessible to maintenance and cleaning personnel, the new windows are fitted with a mechanism that allows for opening them towards the public aisle.
d. The electrical installations inside the diorama cubicles were replaced to achieve an adequate, modern and at the same time conservative type of illumination of the exhibit. The dioramas are now illuminated with daylight-quality floodlights with UV screens that ensure a balanced diffuse lighting situation. Additional spotlights can be used to highlight smaller areas wherever necessary. All dioramas were furthermore outfitted with individual smoke detectors. As the new dynamic captions for the dioramas would require local electricity supply points, these were installed right during the course of revamping the window fronts.
e. Comprehensive construction work was found to be required in the diorama “Arctic” in that a new shaft for proper power lines needed to be built in the rear wall. This necessitated that this diorama be completely dismantled. Considering that the diorama “Arctic” is the youngest exhibit, whose historical value is therefore to be regarded as low compared to all others, the risks associated with this unavoidable measure appeared acceptable, especially in the light of no feasible alternatives.

4.3 Cleaning

As the dust in all dioramas was contaminated with Lindan, all their surfaces had to be thoroughly treated before they could safely be worked on. Adequate measures were therefore applied to capture and bind the toxic dust and so created a risk-free environment for the actual restoration works.

The problem of toxic contamination of course extended to the display objects whose surfaces had to be treated likewise as a precondition for their restoration. All these decontamination and cleaning operations required that staff be properly protected by working only under an adequate extraction system and wearing safety clothing and masks. Cleaning was effected both dry with specialized vacuum cleaners (Fig. 10.2) and wet with a specialized cleaning fluid. By combining these two measures the largest part of the contamination with biocides could be reduced to a level that was low enough to subsequently work on the objects on site with greatly reduced safety measures.

4.4 Pest Control

In a drive to limit the infestations with pests inside the dioramas and on the display objects, but also to facilitate the restoration work in the model landscapes, the dioramas were completely dissembled. The risk of transport damage was reduced by employing a heavy-duty transport cart with pneumatic tires and rollers. It greatly reduced the vibrations the objects had to endure during transport and thus the associated risks.

All objects that could be moved were stored in two 40 ft. overseas containers (Thermo-King) in which they were frozen at −35 °C for a minimum of four weeks to kill off pests and their developmental stages. They were then defrosted for restoration (see 4.5.) and once these works had been completed, deep-frozen once more to eliminate the products of possibly cold-resistant egg clutches.

Following the second deep-freezing phase, the display objects were not subjected to a preventative insecticide treatment, but it was decided to rather opt for a continuous pest-monitoring programme. To this effect, all rebuilt dioramas are equipped with light and sticky traps with pheromone baiting.

4.5 Restoration of Specimens

In order to conserve the animal specimen contents of the dioramas these had to be restored in a professional manner. This was even more important in cases where the acquisition of replacement individuals for taxidermic purposes would have been impossible. It concerned the unit “Australia” as a whole in particular, but also extended to various display objects of other units. These instances usually involved highly endangered species on the brink of global extinction, which are therefore

Fig. 10.2 Different steps of restauration in the dioramas "Alpine" and "River Bank". **a** Removal of contaminated dust from surfaces using a certified vacuum cleaner. **b** Spots of repair of damaged lanscape. **c** Repair of damaged branches on artificial tree. **d** Coloration of walls and ceiling subsequent to repair of cracks using air brush technique and a hair dryer

most strictly protected by laws and as a result unavailable through trading so that their acquisition was neither desirable nor at all possible. The excessive amounts of time required for professional comprehensive restoration work necessitated that the objects be worked over one after the other according to a prioritised list.

During all stages, additional damage from dissembling, transport or cleaning had to be avoided at all costs. Some of the display objects were found to be integral parts of the plaster-coated model landscape by being mounted on wooden supports or affixed right to the substructure. In their cases it was necessary to evaluate whether

it really made sense to remove them from their spots for restoration. If a decision was taken in favour of taking them out, these objects had to be disengaged from the surrounding model landscape with utmost care and circumspection.

In general, restoration works were limited to photographic documentation, cleaning, conservation of object details, optical retouching and modelling that, amongst others, also extended to the colours of feet, claws, beaks, eyes and other parts of the facial field. Broken feathers had to be repaired and/or reaffixed, and tears and cracks in skins had to be repaired or at least concealed. The mechanical cleaning of the display specimens with a variety of tools had to be effected with only a minimum of pressure, as friction from the liquid-soaked aids (brushes, cotton pads, sponges etc.) has the potential of damaging or even destroying hair or feather structures. Mechanically cleaning of the very old display specimens with their inherent loss of hair or feathers therefore proved to be a genuine challenge.

Recolouring animal skins or exchanging glass eyes could be effected only in a few exceptional instances due to time constraints. The investment into time per individual specimen unfortunately had to be compromised in favour of the completion of the entire restoration effort. This led to the decision to postpone the more detailed restoration of many objects to a later stage. After the specimens had been worked over, they were returned to their exact original positions within their dioramas.

4.6 Restoration of Model Landscapes

Existing damage in the model landscapes had to be repaired and visually concealed. Almost all dioramas showed substantial damages in their lower parts from having been treaded on and more generally from the deposition of dust. Some areas suffered additional damage from construction work (replacement of windows, sealing, electrical installations) that occurred in spite of these measures being executed with utmost care. This made respective restoration works even more inevitable. Aside from the optical reconstruction of the landscapes, which included conserving their original colour designs, it proved necessary to protect all support components from further deterioration. This was done by adding reinforcements and support beams in strategic places, mainly with the aim to increase the carrying capacity in certain areas so that it would be possible to step on them without much risk of renewed damage. Accessing the individual display objects within the assembled dioramas safely would be a basic requirement for the intended future restoration measures.

The restoration of the model landscapes included the mechanical general cleaning by thorough vacuuming and the reinforcement of weak spots by means of glass fibre mats and modified hard plaster (Fig. 10.2). Spots in which a stepladder or other working aids would need to be set up received additional substructure supports or the existing structures were reinforced. In all dioramas the cutouts for the new window fronts were adjusted to the new frames and fitted with new substructures where required. It sometimes necessitated that structures close to the windows be

carefully moved backwards to create the space needed for building the frames in. Finally, the model landscapes were partially or completely repainted, depending on the extent of the modifications (see 4.7).

4.7 Restoration of Mural Paintings

The paintwork in the dioramas in the West Wing was in part executed with great detail and little abstraction as compared to those in the older dioramas in the East Wing. They depict naturalistic landscapes that of course reflect the artistic influences of the zeitgeist of their time. They are unique in the choice of colours in that their painters used shades of ultramarine blue to an extraordinary extent.

The basis for an evaluation of the historical mural painting present was a professional assessment (Torsten Moser, unpubl.). A number of standard references (Welthe 2001; Doerner 2010) provided important first pointers as to the painting techniques used, and further professional support was gratefully received from Georg Kremer of the company Kremer Pigmente who made available information on important old recipes.

The following pre-restoration findings were made: Over the years, glue and emulgators in the glue-based paints used were subject to decomposition processes that reduced the paint on the walls to pure pigment. This had resulted in severe chalking, the appearance of cracks, and overall fading of the colours. It was then only once contact could be established with Manfred Huesken, the former chief restorer of the art collections of Northrhine-Westfalia, that a sensible approach to their restoration could be designed. He recommended using a mix of an epoxy emulgator with powdered pigment and distilled water for replacement and repair paintworks after the original paintings were fixed and secured with the means and techniques recommended by Georg Kremer. Areas with superficial cracks were photographed, treated with fillers, and eventually repainted to match the original paintwork (Fig. 10.3). The ground and some larger painted areas had to be repainted completely as a result of wide-ranging repair work. Some paintwork had to be complemented or newly designed accordingly to probabilities to fill gaps. The mirrors on the ceiling were left as they were as they could only be accessed with great difficulty via scaffolding or very long ladders (height of the ceiling approximately 7 m).

4.8 Reconstruction of the Arctic Diorama

The described construction works (see 4.2.e.) required that the “Arctic” diorama in its postwar redesigned version of the 1960s be completely dismantled and removed. With its rebuilding being therefore a necessity anyway, the question presented itself whether to rebuild it in this form or use the opportunity to try and reconstruct it in the very original design from the beginning of the twentieth century. A decision was made in favour of the latter option as it would also reintegrate the “Arctic” diorama

Fig. 10.3 Left front corner of diorama "Alpine" **a** before and **b** after restauration and modified wall paintings. This corner contained a less detailed and poor wall painting when compared to other parts of the diorama, probably due to quick provisional modifications during installation of a heating system in the past. After restauration, all paintings show the same style and detail

into the general style of the dioramas of the West Wing and not have it stand out as an isolated postwar-style display. Historical photographs documenting the original design were available, but an entirely authentic reconstruction was eventually impossible since some of the display objects had been lost in the war and replaced with others. These differed in their body postures and therefore needed to be positioned accordingly. It meant that the existing display specimens determined to some extent the framework within which they could be arranged within the diorama. The latter was otherwise to be reconstructed as closely as possible to the very original plans

Fig. 10.4 Diorama "Alpine" after restauration in 2012

with regard to its model landscape and paintwork. In order to not fool visitors into believing this to be an original historical display, a special notice board provides information on the history of this particular diorama and its changes in appearance over time

Conclusions

The historical importance and uniqueness of the Darmstadt dioramas made a conservative restoration strategy necessary even though the original style of display may in some instances not quite conform to today's standards. These displays are major testimonials of time and therefore monuments that illustrate the history and evolution of building dioramas in museums in a manner that is truly unique. The measures selected by ourselves are meant to preserve these dioramas in their existing condition. This quest necessitated that some technological installations be upgraded in certain areas (fire prevention, illumination, UV protection) without letting them become obvious to the visitor. By their having been subjected to restoration measures the dioramas have gained in their appeal to the visitor in that they have benefited from thorough cleaning, repairs, reconstruction, the recolouring of display specimens, and the repainting of model landscapes. This afforded the dioramas an appearance they are deserving of, considering their historical importance, and now probably creates an impression that comes very close to what it was like more than a hundred years ago (Fig. 10.4).

Even though the Darmstadt dioramas have remained nearly untouched in their overall substance, the investments into time and expense for the less than radical measures they have been subjected to must not be underestimated even when compared to a complete replacement. A substantial portion of the effort went into material analyses that were necessary to ensure the compatibility between old and new materials so that their use and application would not cause new damage in the future, for example. For its part, the restoration of the invaluable historical animal specimens required a high degree of care and therefore time lest there be a risk of destroying them. At the present stage, compromises had to be settled for in that some restoration work was postponed to the future.

We believe that we have found an adequate and feasible approach to preserving the Darmstadt dioramas that might possibly provide ideas for other museums and should be taken into consideration before the dismantling and discarding of historical dioramas in favour of new ones is contemplated.

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Part III
Learning at Dioramas

According to the ICOM definition,*a museum is a non-profit, permanent institution in the service of society and its development, open to the public, which acquires, conserves, researches, communicates and exhibits the tangible and intangible heritage of humanity and its environment for the purposes of education, study and enjoyment.* To us, it seems obvious that the educational function of museums has grown over the past few decades. Natural history museums often do devise and offer facilities and programmes for both, formal education groups and leisure visitors. Educating can mean many things to many people, and museum education can be defined as a set of values, concepts, knowledge and practices aimed at ensuring the visitor's development; it is a process of acculturation which relies on pedagogical methods, development, fulfilment, and the acquisition of new knowledge (ICOM 2010).

In this section we consider various aspects of 'education' at natural history dioramas, from opportunities for formal instruction related to curricula requirements to informal learning, e.g. during family visits. To elicit emotions and thereby facilitate learning and meaning making at dioramas, we need to acquire a baseline of the entry knowledge of visitors together with considering the different ways in which the interest of visitors can be attracted so that they intellectually explore the diorama content.

In her chapter, Scheersoi considers interest development at natural history dioramas, investigating how the attention of leisure visitors may be 'captured' and 'held' in various ways.

There are different interactions that may stimulate and encourage interest amongst visitors of whatever age, and Tunnicliffe explores how we can interpret, capture and record the spontaneous interpretation of victors to the dioramas from an analysis of the narratives constructed by them.

The important role of narratives in learning is also highlighted by Cotumaggio from the American Museum of Natural History in New York who shows that narratives help to connect the museum's educational purposes to the real lives of visitors.

A chapter by Livingstone considers the critique of habitat dioramas as a representational strategy through which anthropocentric cultural norms are implicitly conveyed. The author conducted a visitor study at the Royal Ontario Museum in Toronto, Canada, which innovatively used an interview technique known as visitor-employed photography to test visitor perceptions of a lion habitat diorama.

There have been heightened awards of the sense of place in various environments. Garibay and Gyllenhaal consider such a sense. In their studies at Field Museum (Chicago) and Denver Museum of Nature and Science, they explored the feelings of visitors about the natural places portrayed in the natural history dioramas using observations and interviews. They identified a number of factors which contributed to the feelings of visitors.

Another comparatively recent trend in facilitating interpretive access for visitors at natural history dioramas has been the use of people called enactors, in costume of a character associated with the diorama. Denver Museum of Nature and Science introduced such approach at particular exhibits. This 'diorama experience' facilitated by enactors is discussed by Tinworth.

Another genre of story telling, another aspect of theatre to engage wide audiences, is described by Dunmall at the Powell Cotton Museums at Quex Park in England.

As stated in the first section of this book, one of the dioramas' messages is to increase awareness about nature conservation. Biodiversity education is considered an essential aspect of education afforded by natural history museum dioramas. Marandino and colleagues explore this role from its earliest museum representations to today, and discuss the potentials and challenges of presenting biodiversity.

Mifsud, working with primary children on their first school visit to the dioramas at the Natural History Museum of Malta, shows how an analysis of their drawings can reveal understanding of biodiversity.

These chapters contribute to the assertion made in the beginning chapter of the section that dioramas are important tools in biological education.

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Chapter 11
Dioramas as Important Tools in Biological Education

Sue Dale Tunnicliffe and Annette Scheersoi

1 Museums as Sites of Learning

Museums have many roles. Essentially they are repositories of artefacts and biofacts, sites for dissemination of new ideas, discussion initiators for controversial issues, sites affording opportunities for formal learning and informal expeditions, entertainment and meetings as well as places for reflection and aesthetic experiences. Trends in some towns, particularly in the United States of America and Germany, use museums as a venue for local issues. At the Philadelphia Academy of Natural Sciences there is a Centre for Environmental Policy. At regular meetings of Town Square issues there are speeches on relevant topic to a volunteer audience. Museums shape exhibitions on issues of topical interest and host visiting exhibitions on issues of the day to catch the attention of citizens or on topics of some spectacle, such as Animals of the Deep Sea exhibition, that toured Germany in the latter half of the first decade of the twenty-first century.

Museums are important sites for informal, non-classroom learning about values, norms and technical knowledge. However, the aims of informal educational settings are generally much broader than those emphasized in formal learning settings (Schauble et al. 1996), The effect of an adult with a group of visiting children can affect the conversational content (Tunnicliffe 1997), and thus they constitute 'institutional arrangements relating to children, their upbringing, and their education' (Frønes 1994, p. 1 48). In the closing decades of the twentieth century and the first years of the twenty first there has occurred a paradigm shift. No longer do many museum people adhere to the traditional museum view that each genre of visitors are like children in being ignorant of the information held in trust by the museum and thus need to be educated in a paternalistic fashion. Instead, museum people

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have adopted a more educationally named view in the socio construction of learning which involves recognition that much learning occurs through facilitating the museum experience through play and interactivity, the encouragement of looking at the meaning and in the recognition that visitors of all ages embark on their visit with previous knowledge and experiences which are relevant to their interpretation of exhibits. Macdonald (2002) argues that part of the motivation for this change is to treat the visitor as a 'customer who is always right' and to encourage visitors to see museums as enjoyable. Such a reflectance in approach is surely the outcome of the emergence in the voice of the people in many walks of life and the decline of the paternalistic society.

Braund et al. (2006) presented six ways in which they considered that out-of-school contexts can and should contribute to science learning. Whilst the first three address what might be seen as conventional attributes of school science—as often framed by curriculum developers and policy makers—the last three are concerned more with wider dimensions of learning and attitudinal and social factors. As such, they are not unique to science education, though we maintain that they have a major impact on it.

1. Improved development and integration of concepts
2. Extended and authentic practical work
3. Access to rare material and to 'big' science
4. Attitudes to school science: stimulating further learning
5. Personal development and responsibility
6. Socialization

There is (limited) evidence of cognitive gains. 'Authentic practical work' was taken to mean that which helps demonstrate or replicate the sort of work that scientists undertake or is perceived (by pupils) as having relevance to solving real life problems. Practical work is valued by learners where it is seen in a different context to that in school, e.g. in the case of visits to industrial or commercial premises (Parvin and Stephenson 2004).

Out-of-school learning has been considered as non-formal learning (e.g. Bitgood 1989), a term also used to describe family learning. Learning within the school, even out of the classroom, is part of the child's educational entitlement and, as such, is part of a planned learning experience and is thus formal learning (Tunnicliffe 1996). Learning with families, or other social groups such as youth groups, which occur in the leisure time of the learner is not under the aegis of either school or formal curriculum requirements, is appropriately referred to as non-formal learning.

Especially in the case of non-formal, 'free-choice learning', where the visitors choose the exhibits and themes they want to focus, it is important to catch their interest. Otherwise no interaction with the objects or themes and respectively no learning will occur. Dioramas offer different anchor points (Scheersoi 2009) and therefore seem to be especially suitable to attract a large variety of museum visitors with different individual backgrounds.

Museums have acquired an increased sensitivity to the subject matter of what is happening between people at exhibits. It is recognised that there are entry points

to enter into dialogue and that such dialogues can be scaffolded or assisted through cues. The role of educators is moving from telling in a declarative manner to facilitating such scaffolding by various techniques of questioning, phrases and terminology. The value of studies, which ask visitors some weeks after a visit, such as those reported by Stevenson (1991), reveal the learning that has occurred and open dialogues, as opposed to the closed declarative type can facilitate the learning process with active participation of the potential learner. People find out 'things' at exhibits, they do not necessarily learn and whilst the phenomenon noticed is of great interest at the time of seeing it, it is often forgotten even a few minutes later as another phenomenon catches the attention. However, some observations and ideas are remembered and here learning has occurred. It is more satisfactory for educators to refer to what is found or noticed at an exhibit rather than what is learnt until some time has elapsed from the visit. Learning can take place at dioramas. Educators act as mediators in focused learning and as facilitators. If there is an insufficient foundation to interpret the diorama there is not a state of readiness to learn.

Museums contribute to what has been named the 'organizational frameworks of childhood'. This meaning that out of school institutions traditionally in their design and products offered to visitors have the avowed objective to teach particular topic and have sight to do so in declarative fashion with instructional labels in 12 point. The last quarter of the twentieth century saw the emergence of hands-on-activities through the establishment of science centres, where particular 'lessons' to children through planned activities for families and school groups were designed through exhibits. Zoos and aquaria followed this trend by introducing types of interactive supplemental to animal enclosures and museums through placing artefacts outside dioramas such as in the Field Museum in Chicago, whilst zoos aspire to be leaders in environmental concerns through their work in environmental education. A spokesperson's job title impacts on credibility when conservation messages are delivered to the visitors and outcomes from such communications (Fraser et al. 2008). Natural history dioramas do not overtly seek to do so but have an implicit message in their essence when they depict the natural world of yesteryear.

2 Museums as Sites of Socialisation

Sociologists have studied childhood socialization in other organisational settings, such as schools (e.g. Thorne 1993) and zoos (e.g. DeVault 2000). Like these sociologists, we conceptualize socialization as a multiday-sectional, multi-layered process of becoming and being socially competent. Individuals who possess the interactional skills to participate in a given type of organization (or any other sort of social group) must understand the culture of the organization and the expectations of its members and the cultural norms of the times.

Socialization may be regarded as complex interactive processes. Considering such at natural history dioramas which can be a solo participant experience, with a soliloquy with the diorama through the objects, the seeing and the interpretative

tools provided, or a one to one interaction with another person. Thus, the diorama experience may be multigenerational or peer generational. It is definitely varied and on going. Such interactions are not uniform across a visit and the dynamics of the various interactions occurring are subtle and varied. They have been little studied.

Museums, with the vast range of exhibits and topics are venues of 'social interaction in shaping visitors' experience of museum exhibits (Von Lehm et al. 2001). Interest can be increased regarding an object or scenario by a member of a group, and the key interested visitor may draw this item to the attention of peer group members, or in the case of an educator with a school group to their students, or parents with a mission to inform their children may to their offspring.

Socialization is a complex process but looking at dioramas with other people, adults or peers affords children opportunity to engage in social dialogue, learning appropriate responses depending on the context of the visit and their relationship to the others with them, and express their thoughts and interpretation to others. Such interactions help them to develop the socialisation skills of their society as well as learning the skill of interpretation of a concrete object to verbal images. Viewers of dioramas too can strive to understand the culture of the organization displaying the dioramas, the expectations and rationale of the management who installed them and the expectations of its members and the cultural norms of the times when the dioramas were constructed. For instance, the now dismantled dioramas in Leeds museum, Yorkshire, England, had information about the hunters and the times when the specimens displayed had been collected. The dioramas in the Powell Cottons Museum in Quex Park display information about the time and rationale when the specimens were collected. The interpretation panels also provide information about the collector himself and background information such as the transporting of the enormous elephant specimen, on display under this information panel, from the taxidermist in London by road to Quex Park. The Natural History Museum in New York has documented the expeditions of Carl Akeley to collect specimens featured in the dioramas he constructed replicating the flora and typography in which the specimen lived, thus recreating authentic reality images. The Powell-Cotton Museum at Birchington-on-Sea, in Kent, England has wildlife dioramas but also neighbouring cases of weapons and photographs of hunters bringing some of other cultures to the visitor.

Children are active participants in the production of both their own affective, social and cognitive experiences. At the present time (early twenty-first century) the emphasise is on socio cultural aspect of dioramas and many aspects of construction of dialogue for interest and producing further understanding and learning through the recognition and identification of scaffolding inhered, spontaneously or actively planned by educators, other adults and peers (Ash and Lombana 2011). The intuitive use of appropriate questioning or planned intervention is the subject of research at the present time (e.g. Piqueras et al. 2011).

3 Museum Visit Outcomes and Their Rationale

The nature and outcomes of visits depend to a certain extent on the rationale for the visits and the participants, teacher, museums educator, docent or chaperone as leader as well as the age, interest, previous experience and motivation of the participants and the organisation of the experience (Birney 1998; McLaughlin et al. 1998). Visitors come with their own agendas of why they attend, in what they are interested in seeing or their reason for visiting. However, the differing agenda of group members may compete (Anderson et al. 2008). Moreover they often have their own time budget of how they divide their time (Doering et al. 1996). The motivation of groups of visitors is not the same. The 'identity', e.g. expert, novice, which the visitors feel they posses also affects the dialogues and foci of a museum visit and recognising such identities (Falk 2006) helps museums understand the needs of various groups of visitors (e.g. Falk et al. 2008). The type of museum 'tour' can affect the attitudes of the participants, too (Stronck 1983). Families create interactive discourse as they move between exhibits in a natural history museum as they do in zoos (Patrick and Tunnicliffe 2012). Museums contribute to the organizational frameworks of childhood in that they deliberately attempt to teach particular 'lessons' to children through planned activities for families and school groups.

Agendas of visitors, including those of children, which all compete within a group (Anderson et al. 2008) and cover a wide variety of objectives. Agendas are compiled from many different missions and their rationale with which visitors come to the venue are known to directly influence their behaviour and learning. Conversations between visitors, reveal entering motivations and their learning on exit. They have an entry narrative likely to be self reinforcing learning and behaviour satisfaction relates to the visit matching their entry narrative with a small number of motivational categories (Doering and Pekarik 1996). There is a problematic situation facing visitors animal's collection, real or not, with numerous objects or animals to see, a veritable enlarged Noah's ark. A focus may be provided through a charismatic sensational school leaders' agenda and probably curricula objectives. Thus social oriented conflict may arise between that which one section of a group wishes to see and what the leader, parent or educator has planned for them to visit (Falk et al. 2008). DeWitt and Osborne (2007) consider that school visits to places out of school are not always planned and conducted in a way that could maximize learning and suggest a Framework for Museum Practice.

The experience moreover is dependent on the identity which the visitors has taken at that point of viewing and thus the motivation for their visit in the first place (Falk 2006; Falk et al. 2008). Furthermore, the social grouping in which a person visits and views exhibits, as well as their age, affects the identity and motivation of the viewer as well as the construction of dialogue (Tunnicliffe 1996; Tunnicliffe 1997; Ellenbogen 2002; Ellenbogen et al. 2004).

4 Renaissance of Dioramas and Their Role in Biology Learning

Natural history dioramas went out of fashion, and many were dismantled in the second half of the twentieth century and even demolished. However, their renaissance has started and new dioramas are being constructed with techniques to augment reality. There are issues with the care of established dioramas but some museums continue to cherish and augment their dioramas and new ones are constructed with ease of maintenance in mind. We have realised through our educational research that natural history dioramas have a powerful and effective role in assisting museum visitors in understanding biodiversity and ecotypes as well as the interconnections between organism and the physical world portrayed in the dioramas. As snapshots in time, dioramas provide children with the opportunity to stand and stare, observe, identify, raise questions and seek answers. Such opportunities to 'stand and stare', are not available very often in zoological gardens with live specimens. Thus, for educational purposes of the cognitive type, a natural history diorama in a museum is superior. Visitors, particularly school children with a curriculum learning focus, are able to recognize, identify and work out ecological interconnections between eat and be eaten specimens as well as other phenomena such as flora and fauna of biomes, climatic features, and interactions including socio-cultural aspects.

4.1 What Is Said About Learning at Dioramas?

Museum literature (such as Hein 1998, and Falk & Dierking 2000), or educational literature contains little about dioramas. Existing literature considers dioramas draw visitors and have a high intrinsic value (Reiss & Tunnicliffe 2011). Moreover, all kinds of dioramas provide emotional access to topics (Insley 2007) and offer different anchor points which enable visitors with varying individual background to relate previous experiences to the scenes or artefacts presented (Scheersoi 2009). As depictions of reality, contrived and authentic replication (Tunnicliffe 2007), they are valuable records of the animals and the site on which the diorama is based (Quinn 2006). They offer visitors the opportunity to 'stand and stare' (Tomkins & Tunnicliffe 2001) and stimulate narratives (Reiss & Tunnicliffe 2011). Furthermore, dioramas yield the personal perspectives of visitors, their interpretation and they can stimulate inquiry (Tunnicliffe 2007).

4.2 A Window into the Natural World

Moneyed peoples can travel to other countries and see the natural world remaining; in particular the mega fauna still living in parts of Africa, and eco tourism is big business. However, the majority of the population cannot afford such visits. In

the manner that Zoos also provide the opportunity to see, what to endemic people of the venue are to them exotic species. Natural history dioramas provide a far richer glimpse into the living world and the animals are guaranteed to be on view. The Powell Cotton Museum in southern England is one of the remaining diorama collections in England which is still available for visitors to attend and vicariously explore a rich variety of habitats and species.

4.3 Lasting Memories

Collections of any type which portray the past provide places for reminisces and oral heritage. Visits to museums seem to stay in the memory for many years as is recounted by a person in their middle life by the following piece.

'In those days my parents could safely put me on a train from York to London where I was met by Nani (Hindi for grandmother) or one of my many aunts, transferred from Kings Cross to Victoria and taken by steam train to Westgate-on-sea in Kent to spend the summer at the sea side. One of the inevitable and unvarying highlights of my stay, was a visit to the Powell-Cotton museum. Nani, having been brought up in India, had a particular affection for the Indian dioramas, blackbuck, tigers, elephant, water buffalo, cobras and other exotic species in close juxtaposition. Even then I realised that it was unlikely that they would have all been seen in the same place at the same time, nor striking such magnificent poses. However, I was still oddly disappointed when on my first visit to India many years later and long after Nani's demise, not to be greeted by such a tableau straight outside the airport. What I did see was neither as exotic nor as edifying.

I was aware that there were other parts of the world represented in the museum, but it was India that we spent most of our time enjoying.

I was too young to consider what the museum meant to my Grandmother, but I suppose it was memories of a lost world, shooting parties and the other privileges of her race and class, a group of people who although having never seen England, still thought of it as home and India a temporary exile.

For me the museum was an exotic diversion from the beach and the funfair and I would have been disappointed if my summer had not included at least one visit.

Having recently returned to live in the area, I am looking forward to visiting the museum again, I hope it hasn't changed too much and those magicians dioramas are still there to thrill and excite the imagination of small boys and their grandmothers alike.'

4.4 Record of the Past, Understanding the Present

Natural history museums, however, have a responsibility towards a repository of records of the past, a legacy to the present. They offer an opportunity for people to find out about the past, present changes and cultural aspects and history regarding

the artefacts of biofacts on display. Such records of the past, as for example the natural scenes with flora and fauna shown in setting dioramas of real places that are recorded, such as those in the Hall of African Animal in the American Museum of Natural History in New York, or dioramas constructed around concepts to portray life as it was, such as the three dioramas of the fauna and fauna of Scotland since the last Ice Age in the Museum of Scotland in Edinburg the present, and the California back yard recently installed in the Natural History Museum in Los Angeles. Fewer and fewer children have access to the wild (Louv 2006) and are frequently referred to as having a nature deficit. However, the built environments of their countries are also habits for living organisms, so dioramas of the everyday inside and outside the towns can bring a second hand view of the wider living world whilst dioramas of the constructed environment, for example in the Natural History Museum in Berlin, Germany, help them to understand the everyday living world.

4.5 Exotic and the Everyday

Some museums use dioramas and other related exhibits to show fauna and their habitat with particular emphasis on dangerous animals to humans, such as cases in the dioramas of the Museum in Mumbai (formerly the Prince of Wales Museum) or the dioramas of every day life in the outside environment in Dhaka National Museum, Bangladesh. Whilst there is an increase in the use of images of animals in the everyday lives of western citizens, the first hand observations are none the less limited often to domestic pets and street fauna such as pigeons, some invertebrates and for animals such as foxes in the United Kingdom and raccoons in some parts of the USA for example, that venture into urban areas. Animal images are used for marketing and for design, in wall papers, soft furnishings in animations in the media, on greetings cards and particular in children's story books, nursery rhymes and oral stories, and soft toys (Atran and Medin 2008; Tunnicliffe et al. 2008), in clothing hence the importance of children particularly being able to observe the authentic form of animal portrayed is important in their scientific and affective development.

Museum animals are by definition non living but their structure is human constructed usually through various aspects of taxidermy. However the image of the once living animal provides opportunity to observe and look at the species portrayed with meaning and such provides a more manageable opportunity for dialogue or talk and co-construction of further understanding than often provides viewing live specimens.

The animal and the setting communicate a message to visitors who may have their interpretative and educational experience enhanced by a significant someone or something e.g. facilitator, peer or label, to construct a further conceptual understanding (Vygotsky 1962).

Museum or taxidermically prepared animal exhibits are the essence of natural history diorama in three dimensions. Encounters with them and the context in which they are shown form the focus of the journey of visitors and these in situ encounters go hand in hand with the previous experiences, knowledge and understanding, as

well as interest, of the visitor at the start of their encounter journey. Furthermore, such amalgamation of a variety of topics, biological and the other, even cultural in some dioramas such as those in Dhaka National Museum in Bangladesh, provide an opportunity to study the environmental interactions possible or portrayed such as predator/prey encounters of the real world. Dioramas have a unique position in learning biological concepts and assisting in the viewer's development of aesthetic awareness and understanding of the dynamic interactions of the living world.

Conclusion

Dioramas communicate messages from a variety of underpinning areas, biological, ecological, environmental and historical through the medium of the exhibit. They are a unique and essential learning tool for biological education for all.

Children with inquiring minds, and not constrained by rigid teaching, do develop the inquiry approach at dioramas: they observe, ask questions, formulate hypothesis which they try to corroborate by comparing scenes presented in the diorama with their own experiences and previous knowledge.

Learning—especially in museums—is embedded within social events and occurs as a person interacts with people, objects, and events in the environment. Social interactions, as they occur at dioramas, are fundamentally cultural. Therefore, the socio-cultural perspective has profound implications for teaching, learning, and education and it is important to examine the external social world in which an individual life has developed. Thus viewing dioramas is a social experience and will vary depending on the culture from which the participants come and the context and culture in which they are viewed. The interaction with the exhibits as well as the socio-cultural influence contribute to the interpretation of the exhibit constructed by both visitors and museum personnel.

Dioramas can reach a wide audience and increase access to biological knowledge.

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Chapter 12
Catching the Visitor's Interest

Annette Scheersoi

1 Introduction

Some natural history dioramas attract museum visitors more than others. At these specific dioramas, visitors stop and have a closer look. They start asking questions and interpret the biology portrayed.

But what is the difference between these dioramas and other ones where visitors just pass by? Which of their features catch the visitors' attention and cause them to stop? What makes the visitors stay for a while and observe more in detail?

In the context of museum learning, these questions are very relevant: In museums as leisure-oriented settings, visitors may be regarded as independent learners (as long as they do not take part in a particular program or guided tour). They are often only looking for an experience, rather than for specific information or skills (Falk 2005). Learning in museums is voluntary and self-directed. Visitors decide where, in which form and how long they interact with the exhibition. To communicate information and improve the visitor's attitudes or cognitive skills, it is crucial to catch their interest and make them stop and look. Such situational interest is essential for learning as it can hold the visitors' attention and render them open to accommodate new knowledge.

This study considers data from work at natural history dioramas in three German museums with diorama galleries. The behaviour of leisure visitors was observed to find out where they stop and what they talk about. In one of these studies, additional post-viewing, semi-structured interviews were held and children's drawings were collected to find out why they were attracted by these specific dioramas and which features made them stay and observe closer.

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2 Theoretical Framework

As a theoretical framework, we used an educational theory of interest, also called 'person-object theory of interest' (POI; Krapp 1999, 2007; Schiefele 1991), which refers to interest as a psychological construct that includes attention, persistence in a task and continued curiosity.

According to this theory, an interest represents a specific relationship between a person and an object. An object of interest can refer to concrete things, a topic, a subject-matter, or even an abstract idea. The environment not only provides possibilities for experiencing new 'objects' of interest but also represents a complex structure of conditions that influence developmental change. The realization of an interest requires a situation-specific interaction between the person and the object. This refers to concrete, hands-on engagement with the object (e.g., touching an exhibit), as well as to cognitive working on a specific problem (e.g., the analysis of a scientific question) and to occupying oneself with certain ideas without conscious control (e.g., day-dreaming). If the experiences during this interaction are positive interest is likely to emerge in response to situational cues (= situational interest). The person will show increased attention, greater concentration, pleasant feelings of applied effort, and increased readiness to acquire new domain-specific knowledge. She/he will start to ask questions and seek answers.

In educational settings, instructors can also trigger students' interest by weaving colourful examples into lectures and using attention-grabbing technology. These strategies have the potential to help students be engaged and focused on the material while the material is presented (Linnenbrink-Garcia et al. 2010).

Interest can be clearly distinguished from other motivational variables by its content specificity. Interest is not a global construct but always directed towards an 'object' (topics, tasks, activities) – you cannot just simply have an interest, you must be interested in something. Interest includes stored value and stored knowledge, as well as feelings and therefore is both a cognitive and an affective variable (for the distinction between interest and other motivational constructs see also Krapp and Prenzel 2011; Renninger and Su 2012).

Two stages of situational interest (SI) can be differentiated—*triggered SI* and *maintained SI* (Hidi and Renninger 2006): Triggered SI is similar to the conceptualization of 'catch' (Mitchell 1993) and involves grasping an individual's interest; it reflects the affective reaction museum visitors can have to the way learning material is presented. Once the first phase of triggered SI has been elicited, it may provide a basis for a person to begin forming a connection to content. In the second phase of interest, maintained SI, a person finds ways to relate this information to other available information. In this phase, as interest is sustained, a person is also beginning to develop value for content (Hidi and Renninger 2006). According to Linnenbrick-Garcia et al. (2010), who conducted different studies in various academic settings, maintained-SI consists of feeling-related compo-

nents (=maintained-SI-feeling), which characterise a person's affective experiences while engaging with the object/domain content (e.g. joy, excitement), and value-related components (=maintained-SI-value), which emerge as individuals come to believe an object/domain is important and meaningful. Maintained-SI is distinguished from triggered-SI because the enjoyment of being engaged with the object is based in the particular domain (in this case biology) rather than peripheral aspects of learning material (such as a colourful text label) or the environment (the social grouping and the ambience of the site).

If situational interest endures, repeated engagements with specific aspects of the object stabilize this relationship and create a dispositional readiness to re-engage contents related to the domain of this object. Situational interest can then grow into a deeper form of interest (=individual interest). Individual interest is relatively stable across situations. It holds special value to the person and he/she will invest time and effort pursuing it.

In our studies, we focused on situational interest (SI) emerging from a person's interaction with the museum exhibit (diorama).

In museums, as informal learning environments where visitors set their own goals, it is crucial to develop the visitors' interest to hold their attention and to encourage learning. Therefore, we wanted to find out which specific features at museum dioramas encourage person-object-interactions by catching the attention of visitors and making them stop, look and start interpreting or even explaining the biological themes presented:

Which specific features in dioramas support the development of situational interest by attracting visitors ('catch') and encouraging focused observations and continued curiosity ('hold')?

3 Methods

Interest development can be measured using both quantitative methods, such as questionnaires or rating scales, and qualitative methods, such as participant observation or interviews (for more information about the measurement of interest see Krapp and Prenzel 2011). These methods are generally used to provide information about variables that are theoretically associated with interest (aspects of the interest construct=cognitive/epistemic ('wanting to know more'), emotional ('enjoy') and value-related ('considered to be important'), see above).

Renninger and Su (2012) stress the need to use several methods in combination (=triangulation) to be able to precisely capture the different phases of interest development. For example, while triggered situational interest may be assessed through the observation of visitors' behaviour, it is not likely to be easily assessed using post-viewing interviews alone, given that visitors in this phase are often not aware that interest has been triggered.

In our study, a qualitative methodology with different methods in combination was deemed the most appropriate means to use to understand the development of the visitors' interest in the actual situation (for a similar approach see also Dohn 2011).

This article summarizes the data from studies in three German natural history museums. All three of them have at least 12 dioramas, the oldest dating from 1908.

The first two studies were conducted in Frankfurt (Senckenberg Museum) and Bonn (Museum Koenig). Dioramas in these natural history museums represent local as well as non-local environments (e.g. Alpine regions or African savannah). Leisure visitors were observed during their visit of the dioramas and their behaviour was noted on observation sheets. This method was primarily related to the measurement of triggered SI or 'attracting power', e.g. Where do the visitors stop? Do they express feelings (also nonverbally)? How long do they stay at one specific diorama? Do they interact with other visitors?

To increase the validity of the data and to put a stronger focus also on the measurement of maintained SI or 'holding power', more methods were used in combination during the third study, including content analyses of visitors' conversations at dioramas, post-viewing interviews and children's drawings. This third study was conducted in Fulda (Vonderau Museum) where dioramas represent local environments only. In addition to the observation of leisure visitors ($n > 300$) at dioramas, their spontaneous comments concerning their engagement with the exhibits were recorded (by writing them down), e.g. Which features of the diorama do the visitors mention? Do they just name the specimens or do they interpret or make connections? More data is based on retrospective interviews with a smaller number of randomly chosen visitors (adults and children, $n = 276$; 137 female, 139 male): after the visit to the diorama gallery, semi-structured interviews were conducted to find out which dioramas they liked most, and why, and if they were willing to acquire more knowledge about the subject presented (taking into account the above mentioned aspects of the interest construct). To analyse the data, qualitative content analysis as developed by Mayring was used (Mayring 2010): The interview transcripts were structured and analysed by extracting the relevant information from the text, determining units of analysis, coding these units into separate categories and finally interpreting the results referring back to the research question.

Additionally, children between 4 and 14 years old from family groups were asked to draw their favourite diorama. These drawings were used to access the children's perspectives and experiences—children make choices about what they draw and generally pick out elements that are important to them. They were asked to comment on their drawings, so these drawings were also used as facilitator of communication. These comments directed the semi-structured interviews. Forty drawings and corresponding interviews could be collected (from 22 girls, 18 boys). For the analysis, qualitative content analysis was used (see above). The goal was to identify aspects in the diorama on which the children focused and to find out why these are relevant to them.

4 Results

The data indicate that the development of situational interest depends on the quality of subjective experiences and the immediate emotional feedback during the visit, and that some dioramas evoke more emotional responses than others.

The visitors' emotional reactions, as observed during their visit to the diorama galleries, can be categorized in three main aspects, hinting at sources of situational interest: emotional reactions in respect to (1) the animals presented, (2) the diorama design or arrangement and (3) cultural aspects presented in the diorama.

The responses to the post-visit interview questions reflect the same three aspects that had emerged during the visitor observation: visitors explain their choice of a favourite diorama by a preference for specific animals, aesthetic features of the diorama or cultural aspects. These were anchor points for further engagements with the exhibits, mainly due to surprising moments or personal connections (e.g. previous knowledge about certain animals, childhood memory or recognition of familiar elements in the diorama's wildlife scenes).

4.1 Emotional Reactions to Specific Animals

Visitors stop particularly at dioramas with big or young or rare animals. They talk about the big animals' force, often associated with reputed danger for humans (e.g. wild boar), and are fascinated by their size using expressions like 'gigantic', 'impressive', 'beautiful' or 'powerful'. Young animals or animal families with babies also have a strong attraction power. Adjectives used to describe them were 'sweet', 'funny' (beech marten or fox babies tussling with each other) and 'delicate'. A third group of animals that was very attractive to the visitors and made them stop and look closer, consisted of rare or endangered animals (such as saiga antilopes in Frankfurt's Senckenberg Museum or beavers in Fulda's Vonderau Museum). At dioramas with these kinds of animals, visitors often start to discuss about these animals, e.g. where they come from or why they are endangered.

In the interviews, visitors express their astonishment about the unexpected size of some animals:

e.g.

> I was impressed by their size—I did not know that beavers are that big!
> The wild boar, how big they are, this is very impressive.

Some mentioned that they had never seen these animals before except in pictures or films. Such 'animal encounters' were very much appreciated by the visitors in general, and even more if the animals are normally not to be met, e.g. because they are very shy and run away when you come closer or because they are seldom:

e.g.

> This is my favourite diorama, because you can see animals here that have almost disappeared in the wild, like the hamster or the eagle owl.

Because of the bats. Almost all of them are endangered, they are very rare now.
My favourite diorama is the one with the black stork, because you never see it in the wild. We saw a lot of other storks but never a black stork.
Because normally you do not get as close as here to the wild boar. They run away.
I liked the diorama with the badger. Because I have never seen one alive.

Seeing certain animals reminds the visitors of their own childhood or earlier times: e.g.

This also reminds me of my childhood, these salamanders. I have not seen them for a long time.
Other animals are of particular interest because visitors have a personal connection to them, for example as pet or due to specific experiences with these animals:
e.g.
This reminds me of a situation when I was in the forest, collecting mushrooms, and suddenly a big deer like that stood next to me.
…and the kingfisher—I am always on the lookout for this bird when we go for a walk.
My interest was caught by the tick, because we have a cat that often brings these ticks at home.
I liked the diorama with the wild boar. They taste great—my grandmother sometimes cooks it.
Because at home, in the backyard, the ground is often dug up by boars and you never catch sight of them. Here you get them in plain view.

Seeing local animals is very much appreciated by many visitors, either because they want to show them to their children (who often do not know these animals) or because they enjoy the immediate connection and want to know more about them: e.g.

I like these dioramas where you can see the real animals like that. Many children do not know them—I have worked in a Kindergarten—and I appreciate this kind of exhibit.
Because these animals live here. Deer and fox—especially to show them to the kids.
Especially the fish, as children know them already a bit. They do not have a connection to many animals, but a 7-year old is able to recognize an eel.
Because animals are shown which live in the region. You sometimes see them here.
The small local animals which you encounter in your daily life. These are interesting to me.
Maybe because these are local animals, which you can see in this way. And which you know.
I think because I was able to name all the animals in this diorama.
Because of the stoat, because I had never seen one before—there are some animals I know by name but I have never seen them.

4.2 Emotional Reactions to the Diorama Design or Arrangement of Specimens

In evoking the visitors' emotional responses, aesthetic and design features of the diorama also play an important role: Visitors are excited about the realistic representation of natural habitats and animals (mounted in a way that they seem to be alive) and comment on bright, friendly colours (e.g. of snow or flowers) as well as on the remarkable atmosphere created, often supported by the background paintings which simulate endless space. They are fascinated by dioramas which show a great

richness of details (e.g. butterflies on elephant dung at Bonn's Museum Koenig or a tick sitting on a deer's ear at Vonderau Museum in Fulda). They stay longer at these dioramas and look closer to find 'more and more little surprises'.

This is in accordance with the interview data. The visitors' favourite dioramas are the ones that seem the most realistic, e.g. because of very elaborated background paintings and three-dimensional effects or because of very accurate preparation work:

e.g.

Because I was intrigued by the surface of the ice. It looked so real! You really think it is thin ice.
… and with the little stream that flows across, and the background painting. As if the stream came out of the background.
The background painting is so beautiful.
For me, the best one is where the real fence blends into the painted one.
Nicely three-dimensional.
You can really see how the tyre track goes into the field, and you think it continues ad infinitum, but in fact it is only 2 or 3 m.
Especially the puddle was done in a brilliant way. It is wet, even if it is not.
I remember where a bird is drinking water and there are little circular waves on the surface around his beak. To me, that is terrific!
You just feel like being in the forest.
It was really as if I walked outside along a path. Absolutely authentic. That's a lasting impression.
Because this diorama seems to be even more realistic.
I do not know—it looks like real life.

The museum visitors are excited about animal specimens who are mounted in a way that they seem to be alive, e.g. interacting with each other or in motion:

e.g.

And they look so real, you can be lucky that there is a glass in between!
The fact that the hawk is about to catch the other bird, that makes it look even more real.
I also think that the eagle looks so real, with this colour that is supposed to be blood. To me that looks really nice.
In addition, he has the prey in his mouth.
Because there is so much activity.

They also appreciate dioramas which show a great variety of plants or animals and lots of little details to discover.

e.g.

And I also liked all these little mushrooms and plants very much.
What was really amazing for me was the love for detail in this diorama. Very interesting with all these little bits and bobs.
Because there is a lot to discover. For me, that's the point.

Visitor are fascinated to get new insights in 'hidden parts of the world'—some dioramas offer new perspectives, e.g. a look inside an anthill or underwater scenes.

e.g.

Because you can look straight into the water and you normally cannot see the fish like that, from that perspective.
Because normally you can never see it. The animal how it lives in his burrow.

Dioramas with bright colours attract visitors more than darker ones. Some visitors explain this preference by the dioramas' friendliness.

e.g.

> As I said before—the forest is rather dark, but this [diorama] here has got something bright.
> Just because of the colours und the brightness and friendliness, the flowers.
> Probably also because of the flowers, so colourful. And the butterflies.
> I like colourful meadows.

Older visitors comment particularly about the variety of plants in their favourite diorama and explain that this reminds them of beautiful nature in the past.

e.g.

> It is just so beautiful, also with all these flowers. It reminds me a beautiful meadow, as you hardly find them anymore today.
> Such colourful meadows or fields with flowers, you do not see them anymore because everything has been destroyed, supposed to be weed. It is so beautiful, full of colours. As child I have seen this, but today you do not find it not anymore.
> Because I know it from my childhood, this biodiversity. […] We used to collect bunch of flowers to put them on a little altar for decoration, every day new flowers. And there was this huge diversity. That's why this is my favourite diorama. Lots of animals as well. I know all these flowers [she names different plant species in the diorama].
> This beautiful old garden with the natural stone wall. Just as it used to be in this region in former times.
> Exactly, the farmland diorama, there are lots of flowers. And when you look today, you do not even see a poppy anymore.

4.3 Emotional Reactions Concerning Cultural Aspects or Human Traces

Dioramas where nature and culture are presented together make visitors stop and look. The reasons are often surprising moments or a personal connection to the scene presented: Visitors are surprised about seeing human artefacts or traces in the wildlife scenes presented, e.g. they comment on a beer bottle in an elk diorama at Senckenberg Museum in Frankfurt. Another surprising occurrence for many visitors is the immediate proximity of animals and humans, e.g. a diorama representing an old building's attic as animals' habitat (see Fig. 12.1)—'I did not expect all these animals living there!'. Personal relations to the scenes presented also evoke emotional responses. These are especially often observed at older dioramas presenting environments of earlier times with adults who recognise things from their own past, e.g. an agricultural diorama in Frankfurt representing a deer standing next to a sheaf (=bundle in which cereal plants were used to be bound after reaping). In these cases, visitors often start telling about their own experiences and explain the context to younger visitors (children). Dioramas which represent recent local environments or habitats (e.g. a house garden) attract visitors as well; visitors comment on familiar scenes and human artefacts.

Fig. 12.1 Diorama *old building's attic* (Vonderau Museum, Fulda, Germany)

The interview data reveals that visitors enjoy discovering such human connection to nature and appreciate the presentation of former habitats and scenes (similar to a 'Garden of Eden feel', mentioned in Reiss and Tunnicliffe 2011):

e.g.

> Our neighbours used to have this old farmhouse with a barn. […] We roamed around as children. The attic was really rustic. When I saw this here, I thought: Yes, exactly like on Kapp's [neighbour's name] attic.
> This reminds me of my childhood, when I hid at my grandparents attic. It looked very similar.
> I know this kind of boundary stone from where I come from. I like this diorama, so realistic. Maybe because I would like to have a garden like this. Human culture integrated in nature. This always fascinates me.
> It was impressive to me because there is an immediate connection to oneself. You can easily imagine an old house like that.
> These different objects laying around there were very interesting for me. Like on an attic, maybe 60 years ago. The old birdcage, hammer and gouge, planer, flour sack, dried apple rings on the string. It reminds me of my childhood.
> This is really interesting for me, these synanthropic animals. That's why I like this one most. Animals living in areas developed by man. That's really interesting.
> I like the attic the most. Because it is the closest to us humans.
> The attic impressed immediately. Maybe because it is manmade.

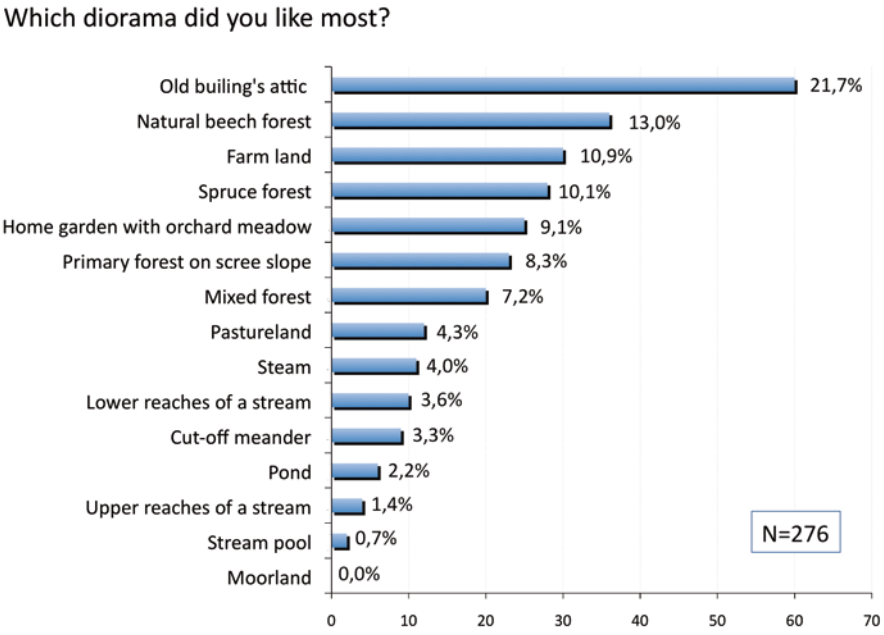

Fig. 12.2 Choice of the favourite diorama (post-visit interview data, $n=276$) at Vonderau Museum, Fulda

4.4 Choice of a Favourite Diorama

Comparing and quantifying the visitors' answers concerning their favourite diorama (Fig. 12.2), it becomes clear that dioramas that combine all the three aspects mentioned above (=animals, diorama design, cultural elements) are the most successful.

At Fulda's Vonderau Museum, a diorama representing an old buildings attic (see Fig. 12.1) was chosen by almost 22% of the visitors who took part in this study ($n=276$). The reason for this choice, as reflected in the post-visit interviews, is the positive emotional feedback which is provoked by (a) certain animal species (rats, owl, beech marten), (b) the design features of this diorama including the preparation and arrangement of specimens (very detailed presentation, animals in motion and "doing interesting things", variety of animals including insects) and/or (c) cultural aspects which are very present in this diorama (attic as habitat, human artefacts).

The moorland diorama, however, was not chosen as favourite diorama by any of the visitors in this study, and the observational data confirms that visitors were not attracted specifically and did not stay longer at this diorama. Obviously, this diorama did not evoke positive emotional reactions and the visitors' attention was neither caught nor held. This fact could be due to the lack of attention-catching animals in this diorama—mainly birds are presented, none of them in motion or doing interesting things, no baby animals. Aesthetic features (diorama design) are not obvious, and due to the specific habitat, flowers or other colourful bright ele-

ments are missing. The third aspect that was identified in this study as being able to develop the visitors' situational interest—cultural elements—is absent as well in the moorland diorama.

4.5 Selective Features in Children's Drawings

Drawings of children record selective features, those which they find most relevant. The diorama elements selected and the comments given about their drawings reveal the sources of emotion and each child's interest. In general, they are connected with the children's personal experiences, including every day observations of animals around (pets, farm animals, local wild animals), media representations and narratives.

For some children, an existing individual interest in a certain animal species is the reason for preferring a specific diorama, namely the one where this animal is shown. Other children are often attracted to a certain diorama not because of an existing individual interest but due to emotional feedback (positive feelings) in the actual situation. The following example shows that the same diorama can be chosen for individual reasons, differing from person to person:

Several animals are shown in Fulda's spruce forest diorama, including wild boar, an ant colony, different birds, and burying beetles on a dead squirrel (see Fig. 12.3 for a depiction of this diorama).

Three children (two girls, 7 and 12 years old, and an 8-year-old boy) drew this diorama and explained that it was their favourite one. The interview data reveals that the 7-year-old girl chose this diorama because of the ant-hill—she is very interested in ants and told the interviewer that she even has her own ant colony at home. The boy, however, has chosen the spruce forest diorama because of a personal connection to the wild boar. In the children's drawings, these two animal species are represented as central elements while other elements are completely neglected (see Fig. 12.4a and b). The 12-year-old girl chose the same diorama because she was impressed by the wild boar's teeth (tusks) and liked the richness of animal species shown. In her drawing different diorama features are represented, and she highlighted the wild boar's tusks with a yellow pen (see Fig. 12.4c).

Interview with 7-year-old girl

I: Which diorama did you like most?
C: I know which one I like most. This here [points at the spruce forest diorama], it is beautiful. This one, because I like ants a lot.
[child was asked to draw this diorama]
I: So can you tell me about your drawing, please?
C: Ants. This is their sleeping room, this is the food depot, there is a fly and a beetle, and there is the nursery. […]
I: Why did you decide to draw this?
C: Because the ants were my favourite.

Fig. 12.3 Depiction of the *spruce forest* diorama at Vonderau Museum, Fulda, Germany

[The girl was asked which other elements of the diorama she remembered. She listed a lot of different specimens but did not want to draw them. However, the interviewer noted them on her drawing, e.g. wild boar, birds, frog, beetle, plants.]

Interview with 8-year-old boy

I: Which diorama did you like most?
C: My favourite one is the one with the wild boar [spruce forest diorama], because my granddad is a huntsman.
[child was asked to draw this diorama]
I: So can you tell me about your drawing, please?
C: Wild boar and the piglets, the ground with some water, sky and clouds.
I: Why did decide to draw this?

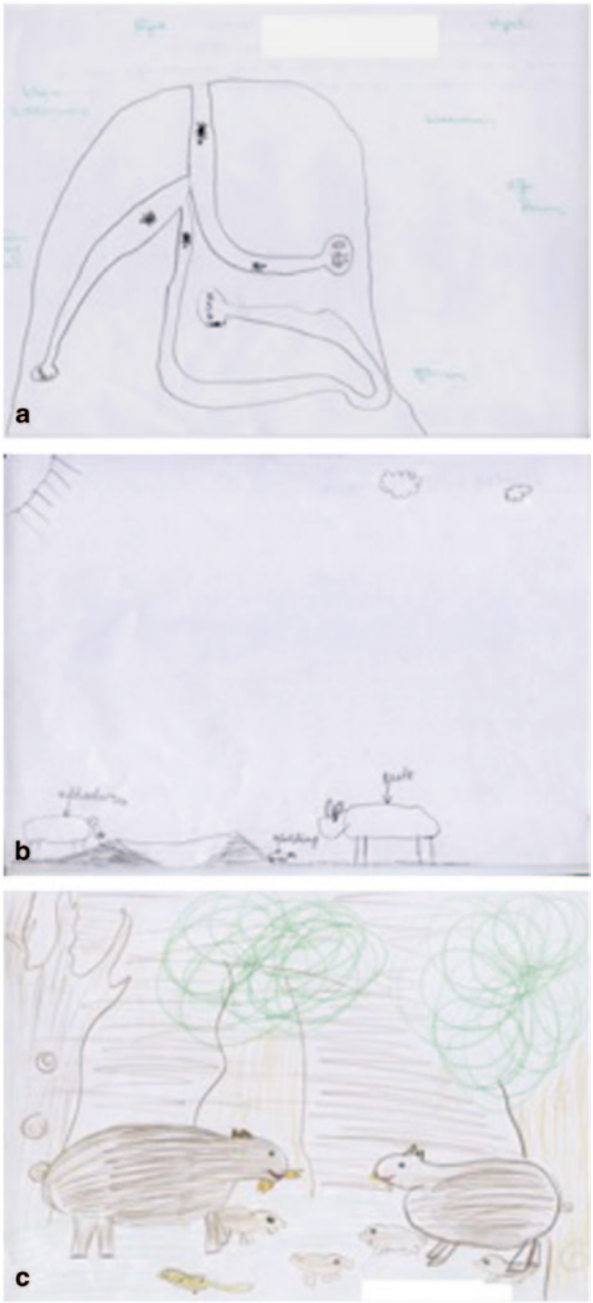

Fig. 12.4 Children's drawing of the spruce forest diorama (**a** 7-year-old girl, **b** boy, 8-year old boy, **c** 12-year-old girl)

C: Because my granddad is a huntsman and I want to show it to him.
I: Why do you like these boars?
C: I just like them. And it is my nickname—my father calls me like that when I drive with my bike through the mud. [laughing]
I: He calls you boar?
C: Yes.

Interview with 12-year-old girl

I: Which diorama did you like most?
C: Well, I stayed watching the longest here [points at spruce forest diorama], because of the boar, they are nice. Here with these teeth, you can observe them very nicely. And their small babies. Well, you can see a lot of animals as well. I do not know, but I like this one most. [The child was asked to draw this diorama]
I: So can you tell me about your drawing, please?
C: Well, the wild boars with their babies. And this I do not know exactly—a weasel or something like that. And a lot of insects crawling about. […] and the background with the forest.

The drawings as well as the interview data show that these three children are attracted by the same diorama for completely different reasons: two children find in the diorama their object of individual interest (=two different animal species), the third child is attracted by different aspects of the diorama—a large animal (wild boar with it's enormous tusks), baby animals (piglets) and the design of the diorama (the richness of details including insects and the realistic reconstruction of the habitat).

Conclusion

We conclude that dioramas stimulate situational interest if they evoke emotional responses. The reasons for such responses are manifold as visitors differ from each other in relation to their individual interests, backgrounds, experiences or preferences. Nevertheless, if a diorama provides a variety of anchor points enabling visitors to relate their previous experiences and knowledge to the scenes or artefacts presented, person-object-engagements with this sort of diorama result in visitors' feelings of enjoyment, involvement, and stimulation which are the most typical emotional aspects of an interest-based activity.

Some general conclusions concerning 'successful' dioramas can be derived from this study: Visitors appreciate 'animal encounters' as they are provided by dioramas because of the possibility for close observations. These are even more attractive and the visitors' attention is maintained if unusual perspectives are offered or if there are a lot of details to discover. Visitors enjoy seeing both, exotic animals as well as familiar local animals with connection to their every day life. However differences can be determined in relation to the dioramas' colours—visitors seem to prefer bright and colourful presentations. Some other diorama features have been

identified in this study which seem to evoke emotional responses and catch and hold the visitors attention: Big, young or rare animals, animals in motion, interacting with each other or doing interesting things, realistic and detailed representations of habitats, and human traces or artefacts in the diorama. The more of these features are included in a diorama, the bigger is the chance to attract visitors and encourage them to stay and observe closer.

Educators, formal and informal, can build on the situational interest evoked at dioramas to encourage and support the learning of biological science. Further studies will be conducted to find out which sort of learning activities can be used to deepen the engendered interest and thereby optimize the educational endeavour.

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Chapter 13
Naming and Narratives at Natural History Dioramas

Sue Dale Tunnicliffe

1 Visitors Interpreting Natural History Dioramas

When people look at biological exhibits they experience a journey of interpretation and understanding. They construct meaning from what they see, what so ever it is, animal, vegetable or mineral or constructed artefacts. Roberts (1997) points out that visitors actually construct their own narrative during a museum visit with inputs from all aspects of the visit, not just the exhibits. The visitors follow the 4 'I's sequence (Tunnicliffe and Scheersoi 2010a). In most cases, this typical biological diorama interaction sequence occurs: identify—interest—interpret—investigate. They identify, they 'label' it, that is name the animal and the artefacts, such as rocks, items recognised in the background paintings, and plants providing the context, which is the fundamental vocalized activity at dioramas. Some viewers, once they have orientated themselves to the story represented in the dioramas, begin to ask questions and enter into an inquiry learning dialogue, which is an investigation into meaning. Communications, of particularly adults acting as teachers or as chaperones, and parent or carers, may use questions to focus the attention of the children on the diorama, sometimes with a particular emphasis of a topic the adult wished the child or other learner, to focus or to develop together the line of thought. Thus the role of questioning is important for educators to appreciate and analysis of questions employed by the adults informs us about the pedagogy, as does an analysis of those of children. Appling the schema designed by Chin (2007) can reveal valuable insights into the learning that can occur at dioramas. Young children use the appearance of an animal to classify it. Thus, if the object has certain shared characteristics with other members of the same group, it shares a membership. Recognizing the identity of animals is a complex procedure. Older children can use exemplars matching what they see to what they hold as a mental model, but can also use unique features and commonplace ones in identifying a species e.g. recognizing that a type of zebra is very like a horse. Indeed both animal types do belong to the equids.

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Recognition by educators and other museum personnel of the increased sensitivity of visitors to the subject matter is part of understanding what is happening also between people at exhibits. It is recognised that there are 'entry points' which signal admission of speakers into dialogue and that such dialogues can be afforded or assisted through cues. The role of educators is moving from telling in declarative manner to facilitating such scaffolding by various techniques of questioning, phrases and terminology. The value of studies, which ask visitors some weeks after a visit, e.g. Stevenson (1991), what they recall, reveal that the learning which has occurred in open dialogues compared with that which the closed declarative format, can facilitate the learning process with active participation of the potential learner. People find out things at exhibits but they do not necessarily learn them. Whilst the phenomenon noted by the visitor is of great interest in the terms of their making sense of whatever they are focusing upon at a given moment, it is most often forgotten in even a few minutes. However, some things are remembered and here learning has occurred. It is more satisfactory for educators, really interested in learning rather than instant feedback evaluations, to refer to what is found out or noticed at an exhibit rather than what is learnt, asking about learning after some time has elapsed from the visit. Learning can take place at dioramas. Educators act as mediators in learning and as facilitators, as do other interpretative materials, such as audio guides or QR code cards and people associated with a diorama such as explainers in costume or docents with a relevant bifocal or artefact. If there is an insufficient foundation held by the viewer to interpret the diorama there is not a state of readiness to learn.

2 Specimens or Objects?

Animals and plants are a genre of exhibits. Whether they should be considered as objects and a part of the study of objects in museums which is a large part of classic museology education, or whether they should be considered as biological specimens is a moot point. Geofacts too need to be considered. There is much to be learnt from close observation of specimens and indeed the handling of objects. The specimens of biological organisms possess salient features, as do structures of the diorama, backdrop, and other biofacts. The animals, plants and the setting communicate a message to visitors who may have their interpretative and educational experience enhanced by a significant 'someone' or 'something' e.g. facilitator, peer or label, to construct a further conceptual understanding (Vygotsky 1962). Visitors look for things, name, describe salient features and behaviours, make affective comments, and interpret in anthropomorphic terms at the level of their biological and other knowledge, which is generally basic.

Naming is the fundamental vocalised activity at dioramas. There are three theories about concept categorisation, the classical, the probabilistic and the exemplar theory. To what extent do child visitors and their accompanying adults use either everyday or zoological hierarchical terms for naming and deductive reasoning?

Natural history dioramas are a historical repository or a modern construct. However, are they to be regarded as old and out of date or recognized as an essential and optimum tool to assist learners in constructing understanding the basic ideas of biodiversity and climate? As such, as exhibits in a museum, they communicate messages from a variety of underpinning areas, biological, ecological, environmental, historical and aesthetic through the medium of the exhibit, the dioramas. They are a record of past biodiversity and habitats, which compared with today, reflect changes due to both climate and human activity.

Moreover, the natural environment is made from physical, geological and biological and features of these aspects, such as rocks, plans, watercourses, may be observed. Additionally the culture and particular uses of science and technology by the community with whom the children live are evident and noticed. The American Museum of Natural History use dioramas from the late nineteenth century portraying actual sites and the weather at the time of painting to assist school students to learn the basics of meteorology, by studying the dioramas and then going outside to look at the sky and even visiting the original site, leading to climate change learning (Holmes 2009).

Some science educators have an interest in the potential of dioramas as a location for science learning, particularly that of biology whilst accepting that dioramas portray an ideal world, a Garden of Eden where animals are prefect in health. Moreover, because the animals are still, (Reiss and Tunnicliffe 2011) dioramas offer opportunities to 'stand and stare' (Tomkins and Tunnicliffe 2001). Visitors often do not observe carefully at first glance and require some time to discover and identify biological phenomena.

Such opportunities to 'stand and stare', are not available very often in zoological gardens with live specimens which often do not facilitate such an opportunity! Thus, for educational purposes of the cognitive type, a natural history diorama in a museum is superior because the specimens can be seen all the time, frozen in time and in the appropriate ecology relationships in the authentic naturalistic setting, albeit the specimens are portrayed in prime condition. Such portrayal does present a teaching opportunity to discuss the reality of the natural world of eat and be eaten, very much a focus with food chains and predator prey relationships of school biology teaching in England. Visitors and particularly school children with a curriculum learning focus, are able to recognize, identify and work out ecological interconnections between eat and be eaten specimens as well other phenomena such as flora and fauna of biomes, climatic features, interactions which zoos are largely unable to show. We need to remember that children are intuitive scientists (Gopnik 2009), if given a chance and will use their instinctive science skills to interpret that which they observe

Dioramas thus:

1. Communicate messages from a variety of underpinning areas, biological, ecological, environmental, historical through the medium of the exhibit, the dioramas.
2. Exist as a record of past biodiversity and habitats, which compared with today, reflect changes due to both climate and human activity
3. Show a world free of disease and injury, which is not altogether realistic

Dioramas are like other science exhibits in that they are presented so as to arrest the attention of visitors to them. Visitors, if they stop to look, may lead themselves to develop further learning.

3 The Socio-Cultural and Constructivist Aspects of Interpreting Dioramas

The study of visitors in museums, in the widest sense, has developed from studying individual programmes to a coherent field based on socio-cultural and constructivist theories. Furthermore, here is an increasing acceptance and use of qualitative rather than quantitative methodology, or mixture of both approaches (Phipps 2010). There has been a change in the interaction between museum and visitor. An increased recognition of visitors, adults and students, parents and visitor teachers, offspring and students, as active participants and constructors of interpretation of exhibits has occurred. Moreover, the recognition of the participative role of museum educators as reflective practitioners, as well as increased and continuing research concerning the responses of teachers, has changed practice in museums in interacting with visitors (Ash and Lombana 2011).

3.1 The Entry Knowledge of Visitors

Visitors come to the diorama on their visits with some knowledge relevant to the content in most cases. In their view their knowledge is pertinent to the exhibit and they often use this and only this in their interpretation of what they see. What the visitor holds in their mind is their mental model. What they saw, or draw, about the exhibit is their expressed model (Buckley et al. 1997), which calls on information held within their mental model. Families and school groups do ask some questions of each other as they make meaning out of dioramas (Tunnicliffe 1995) and such questioning can either enable movements towards scientific understanding or hinder it. Schools could also use the observations and discussion of their pupils as a starting point for inquiry science. Children allocated names according to the salient and criteria features, which they recognised in a mental matching process.

A family group with parents and a 4-year-old girl constructed the following sequence in which the girl recognised animals. The father began by asking, ‘What are those?’ The girl replied, ‘Reindeer, reindeer’. They were a species of antelope. Dad responded, ‘They do look like a kind of deer’. The father went on to ask what else she could see, he pointing to other animals.

Father, ‘What can you see there?’
Girl, ‘Hippo!’.
Girl, ‘Elephant’.

A 9-year-old girl said at the Angolan grassland diorama in London, remarked, 'I can see… animals. I don't know their names. That one looks like a bull [gnu] that one looks like a horse with big horn [Giant Sable Antelope] and this one looks like baby antelope [adult of a small species]'. Thus children were making observations and seeing patterns a key aspect of biological inquiry. Whereas a boy aged 9 years remarked, 'Not sure, I think that is an antelope of sorts', thus raising a hypothesis.

The children whose comments are given above were making observations and seeing patterns, a key aspect of biological inquiry.

3.2 Identifying the Conversational Content at Dioramas

The expressed model which we as educators have available to try to understand the response and interpretation of viewers to the dioramas are vocal comments, written comments, drawings and body language. Tunnicliffe and Reiss (1999), identified three main ways of analysing pupil conversations, which apply to any visitors at exhibits. Using a systemic network approach the content of a conversation in terms of the context in which the exhibit is shown and a description of and identification of the object, its behaviour and the feelings elicited by the object in visitors as well as their statements of knowledge can be identified effectively changing qualitative conversations to quantifiable data (Tunnicliffe 1995). Bloom (1990) described, what he termed 'contexts of meaning'. In conversations the talker makes a description of expression based on personal experience, which gives rise to episodic knowledge statements or expressions of emotion, the use of metaphors and similes or using interpretive frameworks such as 'That a daddy because it's bigger'. Such a phenomenon occurs in the conversations of children when engaged in science work. The types of conversations can be further divided into descriptive, factual and explanative conversations to peers or teacher. This classification was originally made about a science investigation, (Cosgrove and Sacheverin 1996). They identified that the conversation progressed through three incremental levels the first of which started with the asking of why and how questions, often associated with episodic memories, through conversations which raised and tested hypotheses to, lastly, philosophical conversations. Such a progression is heard in the content of some conversations at natural history dioramas after identifying the content through questions. For example at an African diorama in England, a girl remarked, 'The giraffes are tall and the other animal has horns!'. Some visitors proceed to speculating on issues portrayed, explaining them, such as a 12 year old boy commenting about the story he 'read' in a diorama with a number of different animal species from Africa, he remarked 'Looks like they are fixing their entire gaze on them. The lion that's fighting, they are all watching all the fight!' Finally, some visitors do become philosophical although such dialogue is infrequent. An example is below:

Boy 1: Nature.
Boy 2: It's natural thing.
Boy 3: It's nature, life's like that, they fight.
Boy 2: The food chain!

Table 13.1 Levels of responses at natural history dioramas

Level of response	Sub category of response	Example of activity
First Locate	1. Spontaneously	Pick out things in dioramas e.g. wolf, fungus, snow
	2. Assisted—using signage	See things on interactive and then locate them in diorama
Second Identify by name	1. Spontaneously	From own knowledge or that of companion
	2 Assisted	From signage or guide
Third Describe	1. Physical aspects 2. Behaviours	From own experience and knowledge- e.g. wolves chasing wild pig, beaver swimming, 'fox' is white
	2 Scene	It's winter because there is snow'
Fourth Interpret	The visitor's story using own knowledge	E.g. 'It's telling the story of the seasons'
	Visitors story using museum information/ message	'It's about the changes in the landscape'
	2. The museum's story	The change in flora and fauna since the ice age

Table 13.2 Age and numbers of comments made at the three African dioramas

Age	Total	Male	Female
4 years	5	5	0
5/6 years	55	36	19
7 years	12	3	9
8 years	30	15	15
9 years	13	7	6
10/11	21	6	15
Total primary children	134	71	64
Secondary12–14 years	20	8	12
Adults	9	0	9
Total commentaries	163	78	84

4 Levels of Response

Categories of question types (Chin 2007) can be usefully employed to recognise the structure of dialogue developed by someone in a 'teaching' mode with others at a diorama, which is working in the experiential space (Tunnicliffe and Scheersoi 2011) and experiencing a scaffolding of dialogue to assist construction of further understanding. Themes can be identified in dialogue of spontaneous conversations e.g., Piqueras et al. (2008), for the stages of the interaction identified or the content of the conversation identified using systemic networks (Tunnicliffe 1995). When visitors look at exhibits, especially dioramas, varied types of conversations are present which locate, identify, describe and interpret (Tables 13.1, 13.2, 13.3, 13.4 and 13.5).

Table 13.3 Number of naming comments

Age group	Boys	Girls
5–8	156	136
8–12	111	165
12–18	16	21
Adults		20
Totals (725)	383	342

Pre school children with their families and children of school age, but in the museum with their families or carers as leisure visitors, were invited to tell the researcher, with adult permission who was present throughout, one at a time if they were in a group or only one of the groups, what the dioramas meant to them. What was it that they understood as the story? Not all children were prepared to talk. The walk round the three dioramas in the Rowland Ward Pavillion, took about 10 minutes, then the researcher returned to the entrance to the pavilion and asked the next group who entered. There were three dioramas constructed by the British Victorian taxidermist Rowland Ward. The dioramas were situated at the end of the Evolution gallery on the first floor of the Natural History Museum, London. They were dismantled in the autumn of 2004, as was the Evolution gallery, to accommodate the Entomology Department whilst the Darwin 2 centre was built. This unforeseen plan prevented further data from being collected. There are no other natural history dioramas in this museum.

Table 13.4 Number of comments other than naming, which are inherently observation

Describe structure/scene	Describe behaviour	Interpret (including affective interpretation)	Science process (Other than observation)
218	175	102	77
5 year old boy ‘Giraffe, has a long neck’	He continued ‘Looking down at a deer. Mum is looking at the ground’	He continued ‘Looking for some food’	Girl, 10 yrs., ‘I think over there must be where they do their business’
		Rain Forest 8 year old girl’, I feel really calm’	8 year old girl ‘May be he, (the Giant Sable antelope) only lets them have so much water?’
		10 year old boy Rainforest ‘It’s a different atmosphere!’	12 year old boy ‘That’s a female probably because she has no horns.’ (Impala)
		6 year old girl ‘The giraffe is so beautiful’	
		Boy aged 4. at Rain forest ‘ I don’t like them’	
		6 year girl, ‘I like the scenery’	

Table 13.5 Use of questions at dioramas. The following does just this with a family transcript at dioramas in an English Natural History museum with dioramas. The group was their mother, her daughter of 8 years and her son of 6 years of age

Questioning approach and rationale	Feature	When used	Exemplar
Socratic questioning	Use a series of questions to prompt and guide student thinking	To encourage viewers to generate ideas based on reasoning and prior knowledge	A: What is the name of the animal?
Pumping	Encourage viewer to provide more information via explicit requests	To encourage talk and interpretation of dioramas	1. A: Kids what can you see? 2. A: What kind of a place is this? 3. A: What can you see?
Reflective Toss	Pose a questioning response to a prior utterance made by the student	Throws the responsibility of thinking back to the viewer who spoke	S: The giraffe's are tall and the other animal has horns (looking at the blue wildebeests) A: Do you know what it's called? S: Yes…but they are not real now! A: What makes you think they are not?
Constructive Challenge	Pose a question that stimulates student thinking instead of giving direct corrective feedback	Encourages child to reflect on and reconsider his answer if he gives an inappropriate or reply that could be more defined response according to the adult	S: It looks like a black bull! A: Why do you think it's a bull?
Verbal Jigsaw	Focus on the use of biological terminology, keywords and phrases to form integrated propositional statements	When topics and contents of dioramas can be referred to several technical terms for students weak in language skills	E.g. ecosystem, predator/prey
Linking Key words and phrases	Guide students to form a series of propositional statements to form a coherent mental framework	To introduce factual or descriptive information and to reinforce scientific vocabulary	A: Do you know what it's called? S: The fox is behind the long grass (pointing to a hyena). A: I think that's a hyena!

Table 13.5 (continued)

Questioning approach and rationale	Feature	When used	Exemplar
Verbal Cloze	Pause in mid-sentence to allow students to verbally 'fill-in-the-blanks' to compete the sentence. (Can be used when labels are present for child to find answer)	To elicit or emphasize keywords and phrases, for viewers who are not particularly articulate or verbally expressive or to develop understanding	H: No there are big ones (pointing to the gorillas)… S: They are monkeys? A: Not monkeys they are… *(Can be used to encourage the child when labels are present for a child to find answer)*
Semantic tapestry	Help viewers weave disparate ideas together into a conceptual framework like constructing a tapestry of ideas	To focus on ideas and abstract concepts; for topics not associated with an abundance of technical terms	
Multi pronged questioning	Pose questions from different angles (and physical perspectives) that address multiple aspects of a problem	To help viewers understand a problem, observations, identification from different angles and perspectives	S: It looks like a black bull. A: Why do you think it's a bull? S: There are lots of monkeys. A: Are they all the same?
Stimulating multi modal thinking	Pose questions that involve the use of a range of thinking (e.g. verbal, visual, symbolic, logical-mathematical) using talk, diagrams, visual images, symbols, formulas and calculations	To encourage viewer to think in a variety of modes and understand the concept from multiple perspectives	A: Are they real? S: No, they are just made out of stone! A: Do you think they are made out of stone? S: Yes! (*S compares the animal figures to statues which are still and made of stone*)
Focusing and zooming	Guide viewer to think at both the visible, macro level and at the micro or molecular level; or use questions that zoom 'in and out', alternating between a big, broad questions and more specifically focused, subordinate questions	To help viewer understand a concept at both the macro, superordinate and the micro, subordinate	A: Do you think they might have been real a long, long time ago?
Framing	Use questions to frame a problem, issue, or topic and to structure the discussion that ensues	To help viewer see the relationship between a question and the information that it addresses	

Table 13.5 (continued)

Questioning approach and rationale	Feature	When used	Exemplar
Framing	Use questions to frame a problem, issue, or topic and to structure the discussion that ensues	To help viewer see the relationship between a question and the information that it addresses	
Question based prelude	Use question-answer propositions; questions act as an advance organizer and lead-in to information presented subsequently	For expository talk to preface declarative statements and to focus s thinking at the diorama	A: What is the story in this diorama?
Question based outline	Present a big, broad question and subordinate or related questions visually (e.g. on slides)	To visually focus thinking of viewer and help them identify the links between the big question and subordinate questions	A: What kind of a place is this? S: It's like a jungle… H: It's a jungle! A: What makes you say that?
Question based summary	Give an overall summary in a question-and-answer format to consolidate the key points	At end of viewing to recapitulate key concepts succinctly	*Question such as:* 1. So what did you find out? What did you like most? What did you not like? Why? 2. How will you record your observation? 3. What have you found out?

A adult, other letter denote a child with the initial of their given name

The first diorama, of an African Water hole, focused on animals gathering around it. There was a mother and baby giraffes, a kudu with an oxpecker on it, some baboons and a variety of birds. The second diorama was of the Rain Forest. It featured a bongo and an okapi amongst the trees and a water chevrotain, but there was a scorpion, some butterflies and some birds amongst the foliage, which was dense. The last diorama featured Grassland in Angola and focused on antelopes. A Giant Sable Antelope was standing on top of an earth mound and there were termite mounds. There were other types of antelope near the front of the exhibit. All exhibits were behind glass. An information panel was in the Pavilion but not directly by the dioramas, hence few people read it or even noticed that information was provided.

Investigating the sense children made of these dioramas 58 commentaries were collected at the Water hole, 51 at the rainforest and 54 at the Grassland. Some children began their walk round at the Grassland although most began with the Water hole and those who did not want to continue then stopped after the first, hence the higher figures for the first and third dioramas. A total of 163 commentaries were recorded and then transcribed. A few adults interviewed were singletons, when they entered the pavilion permission to listen to their commentary was obtained as well as their age and a first name for reference.

5 Naming

Children allocated names according to the salient and criteria features, which they recognised in a mental matching process. Children were making observations and seeing patterns, a key aspect of biological inquiry. Such is exemplified by the following commentary from 9-year-old girl.

> I can see animals I don't know their names. That one looks like a bull (gnu) that one looks like horse with big horn (Giant Sable Antelope) and this one looks like baby antelope (adult of a small species).

Listing of names of objects and specimens identified was common, more amongst the youngest children. For example, a 5-year-old boy at the Water Hole announced, 'Big goat'. At the Angolan Grass land the same boy remarked, 'Different sorts of Goats.'

Such misidentification is common amongst visitors to animal exhibits, live or museums animals. They recognise the salient, criterial features of a super ordinate category, in the case of allocating the name goats to an unknown animal, when justification of the identification is given it has been, '… hair, hooves and horns'. The identifiers match that which they notice with their mental model of nearest fit which, in the case of the Arabian Oryx and similar animals, as above, is usually a goat.

Naming also occurred as the initial and sometimes only commentary amongst older children. For example, Jessica aged 10, said at the Water hole, 'Baby giraffe, monkey by big giraffe, and there are ducks and birds'. A 9 year old boy at the Angolan grassland said '…. and that one looks like an ox (Gnu)'.

There were 77 comments, which indicated the science process other than observation. Description, explanation, and interpretation were occurring. Children also

raised their own questions, another science process in trying to find out more. For example, Cyrus, aged 10, asked at the Angolan grassland.' Do you know what they are? (Termite mounds) Are they for the ants?'.

Not all children used all aspect of the science process/ inquiry science at every exhibit. A boy aged 9, viewing the African Waterhole, listed what he recognised, and hence matched what he saw to his mental model of the animals thus enabling him to name them, 'Giraffe and its baby; few monkeys and small birds'. However, at the Grassland scene he adopted an inquiry science approach about the large Sable antelope by saying, 'That looks like the alpha male, it has big horns'. This reported dialogue illustrates the observing of specimens, recalling information and then raising an hypothesis. In this example it was that the male with the big horns was the dominant animal. The boy went on to compare several animals and raise another hypothesis, 'It looks like the younger ones (were smaller ones, he concluded that small might be young and not another species) are a bit lighter than that one which could be a female'.

A 35-year-old female biology teacher described the scene and identified the African Waterhole. 'This is savannah. I would say Africa', and interpreted the scene with her own narrative, 'Animals have made their way to the water hole'. She used evidence to explain something which was not apparent, 'Birds (ox peckers) on that animal (Greater Kudu) are eating parasites off it, very much a symbiotic relationship'. This comment was assessed as one of interpretation because she used evidence, which she saw to link with what she knew and produce a conclusion.

Children sort out a mental model of nearest fit for specimens they saw and for which they have no vocabulary. A 5-year-old boy at the Water hole announced, 'Big goat'. At the Rain forest he said. 'Looks like that animal (the okapi) is giraffe'. At the Angolan Grass land he remarked, 'Different sorts of Goats'. A 6-year-old girl remarked at the Angolan Grasslands, 'I can see a goat (it was an impala) over there and a sand castle (termite mound)'. Whereas a boy aged 9 years remarked, 'Not sure, I think that is an antelope of sorts', thus raising a hypothesis.

Affective interpretation was evident, but not to as great an extent as has been observed in other studies on museum animals. In conversations of primary children at the Natural History Museum London, affective comments were heard in 54% of conversations, the figure was 42% in the London Zoo (Tunnicliffe 1995). An 8-year-old girl said at the Water hole diorama, 'It's beautiful.' The 35-year-old female biology teacher remarked at the same exhibit, 'I think this is really nice'. In contrast, a 5 year-old girl interpreted the dioramas by announcing. 'These things are all dead, the giraffe and its baby', and promptly began to cry. She said she did not with to see anything further. It is interesting that the affective comments uttered were all made by female visitors.

Thus we identify three main aspects of learning at dioramas:

1. Identifying and naming the specimens portrayed. As children acquire early language they begin to label phenomena. This naming is an inherent human need (Bruner et al. 1956).
2. The narratives engendered at dioramas through the interpretation given by the child from his mental model of the phenomenon exhibited. Narratives are

important in learning science. Osborn et al. (1996) argue that science knowledge can be reworked into story-like forms, not merely to add to its 'liveliness' or 'interest', and not merely to show it 'applied' to some real context, but more fundamentally to act as an evolving, memeorable and efficient knowledge carrier. The story is the knowledge in a reworked form.
3. The emergence of inquiry science. Children observe, question, raise a hypothesis, make suggestions, observe, or research, make a conclusion.

Young children use the appearance of an animal to classify it and use exemplars but come to realise that the object represents a natural kind thus the object has certain shared characteristics with other members of the same group so shares a membership. Recognizing animals is a complex procedure. Older children can use exemplars matching that which they see to what they have as a mental model, but can also use unique features and commonplace ones in identifying a species. Sometimes the nearest match of the child is corrected by a 'significant other', in an encounter, usually the adult with them, but it may be a peer. On a family visit a girl responded to her father who asked her, 'What's that thing?' to which she quickly replied, 'A hippo!'. To which her father responded, 'Actually, it's a rhino and front horn is missing'.

6 Difficulties in Classifying

Some of the difficulties that children have to overcome in learning classifications are that they have to first of all learn a name of animals, secondly the categories to which a named individual belongs and thirdly the taxonomic hierarchy into which the category fits. Learning categories presents problems. Children have to learn whether the name being used by their companions or indeed themselves from their everyday knowledge, refers to the whole object or a part of the animal, and which name it is if it refers to an animal. Is it a pet, everyday, scientific name and is it also an alternative name—that of its super ordinate category. For example, carnivore but cat, cat but also a mammal-a mammal belongs to the category of vertebrate and a chordate as well as an animal, which is a living thing. Furthermore the animal has the identifying features for each of the categories they belong from pet name to member of the animal kingdom because of defining features, of which some are unique at the individual level but other are shared with other animal organism the higher up the categorisation hierarchy you proceed.

6.1 Acquiring Hierarchical Names

There are three main steps in acquiring hierarchical names:

- Consider the spatial configuration of the objects as well as there perceptual similarities and unite them into 'graphic collections' and several collections are juxtaposed.

- Non-graphic collections are formed by children and show features of classification but no inclusion, hence all members of a subordinate class are not recognised as belonging to their super ordinate category.
- True hierarchical classification skills, its use requires the classifier to use abstract thought and involves embedded knowledge.

At the exhibit, dioramas or other, the visitor, adult or child or groups, are in their 'experiential space' (Tunnicliffe and Scheersoi 2010b). At any exhibit there is an experiential zone in which the viewer and the exhibit occupy a 'space' and in this something or someone, label or person or interpretation, can act as a 'significant other ' in this zone of potential development (Vygotsky 1962) where situational interested can develop. Through dialogic talk, to the self or to a person, a visitor may link existing concepts to something they know and increase their cognitive development in the area. Analysis of their personal narrative at exhibits can reveal such accommodation and development. The influence of 'a something', such as a label, a video clip, a comment from someone, interactive, recalling own memories and experiences evoked, prompts a dialogue with self or another person, a dialogue trying to focus the child's observation, as is illustrated in the following dialogue at a polar bear exhibit in the USA.

Mother: What do you like?
Girl (6 yrs.): Polar Bear
Mother: What colour is his coat?
Girl: White

From the simplest level of interaction, the 'show and tell' exhibits, through 'step by step' or 're-enact' exhibits, to the 'teach-back' exhibits, which involve the visitor in the manipulation of their abstract thoughts related to the exhibit.

> Children, we now know, need to talk, and to experience a rich diet of spoken language in order to think and learn. Reading, writing and number may be acknowledged as curriculum 'basics' but talk is the true foundation for teaching. (Alexander 2008, p. 9)

The starting point for science is observation. We aim to encourage their adult, parent, teacher or carer to share the observations and talk about such and increase their own self-esteem and literacy.

A child's development of interpretation

1. A narrative produced verbally when a child asked to tell the story of a diorama.
2. Child spontaneously tells the story as they see it.
3. Children develop a dialogue with a peer or adult at the child's instigation. An example of narrative at dioramas in the Hall of North American Mammals at the Academy of natural science in Philadelphia, USA, is a follows uttered at Musk Ox b y a 6-year-old boy.

> I think the animal is a bison…I see dead flowers, rocks and clouds. (1) It could be cold there because I see snow on the ground but it might be warm because the sky is sunny and blue. (4) The animals could be sleeping because they are lying on the ground. (3) The moose is my favourite because it is big.

The boy stopped talking and went to go to the Moose diorama. His narrative displays Knowledge (1) through identifying items, and a hypothesis raised about the temperature and behaviour as well as applying knowledge to interpret (4) and hypothesising on behaviour (3)

Thus factors affecting the naming process are

- Noticing for themselves salient features and the features of their diorama, backdrop, other biofacts besides the animals,
- communicate a message from the diorama to visitors who may have their interpretative and educational experience
- enhanced by a significant someone of something e.g. facilitator, peer or label, to construct a further conceptual understanding (Vygotksy 1962) in a socio cultural environment.
- compare fauna, flora and weather and biomes depicted in older dioramas with situation today (Holmes 2010)
- visitors look for, name, describe salient features and behaviours, make affective comments, and interpret in anthropomorphic terms. They interpret at the level of their biological knowledge, which is generally basic.

Young children use the appearance of an animal to classify it and use exemplars but come to realise that the object represents a natural kind, thus the object has certain shared characteristics with other members of the same group so shares a membership. There is complexity in this learning. All animals for example do not have the same form in life cycles, they change in process of complete metamorphosis; larva and imago of some insect orders are the same kind of animal for instance but have different forms. Learners thus have to learn to recognise identity class members, the different forms of the same animal assumed during its life cycle as well as other members of they species to which it belongs, with similar different forms. The learners have to recognise equivalence categories (Bruner et al. 1956) and it is claimed cannot do this until about 10 years of age (Piaget and Inhelder 1969).

A 10-year-old girl constructed this narrative when asked to tell the story of the diorama. It shows what are typical observations and interpretations.

> Muddy ground and like a little stream over there all straw and a big stag thing (Antelope) a big thing, a deer like a red deer (gnu) over here is another deer, an orange deer, and a baby deer eating the straw. So is that one (gnu) and that big one is looking at the baby (impala) and the mud is shaped into a castle.

7 Fantasy

Fantasy has its place in the interpretation given by some visitors whilst others see adjacent dioramas as part of an overall story. A 12 year old girl at another waterhole dioramas reflected, ‘It’s animals playing having fun’. At a sequence of 3 African dioramas depicting differing locations but in the same small gallery, a girl aged 8

commented at the Water hole: 'I think they are being friendly to each other. The Mother and the giraffe always stand together they never go apart. It tells a story about being kind'. She then went on to explain and raising hypothesis as to why the animals are kind, 'Because no predators come and there is water'.

At the next diorama, the rain forest, she remarked, 'Different! This is only green; it is jungle, not much water only one puddle [all identification and description]. Tells me that the animal's being friendly and walking away'. Whereas at the last diorama in the room, an Angolan grassland, she said, 'This is desert! He [the Great Sable Antelope] is master of all the land and he [the wildebeest] is eating the grass and the big one [the Sable Antelope] seems to say 'You all obey me!' but one is answering saying, 'No way I'm not going to bow down to you.' Then the girl raised an hypothesis to explain her interpretation. 'Maybe he [the Giant Sable Antelope] only let them have a certain amount of water?'. Younger children made similar science inquiry statements other than the observations noted. There were 77 comments, which indicate the science process other than observation, and description, which revealed explanation and interpretation. One 12-year-old girl at a large diorama of Kashmir with many primates announced'. It's a party because there are a lot of animals!' a very human based interpretation.

8 Inquiry

> That one looks like a bull [gnu] that one looks like a horse with big horn [Giant Sable Antelope] and this one looks like baby antelope [adult of a small species]. Whereas a boy aged 9 years remarked, Not sure, I think that is an antelope of sorts, thus raising a hypothesis.

The boy who raised the hypothesis as to the species of an animal could have then pursued his ideas had he had suitable scaffolding materials in terms of keys, a facilitator who would ask the appropriate questions of necessary features to be held in order to belong to a certain group of animal could have helped him confirm or not. The dialogues heard show that children notice both biological specimens and artefacts and label them according to their existing knowledge. They then interpret that which they see and will produce narrative, again interpreting the science in terms of their own understanding. Once this process is over they begins to ask questions, raise hypothesis and postulate answers. Again we reiterate that children are given the opportunity to stand and stare (Tomkins and Tunnicliffe 2001) inquiry begins. This situation provides a starting point for further study and research in the museum or back at home or school. It is our opinion that these natural history dioramas are a much under utilised educational resource and have been dismissed as old fashioned and irrelevant by non educator management wooed by effective technology sales advances. The dioramas are a powerful potential tool in science education and should be developed as such.

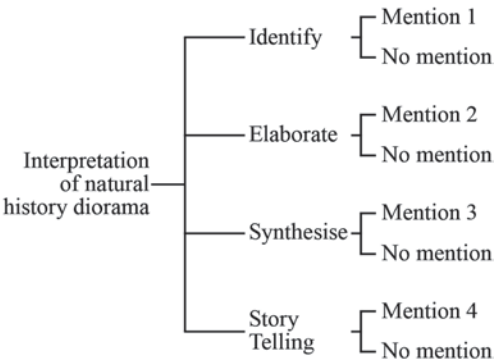

Fig. 13.1 Visitor responses levels

9 Analysing Conversational Content—Systemic Networks

In order to effectively obtain rigorous data from conversations having identified the words and thus ideas voiced as above through read reread, one of various means of achieving such is using a systemic network. This is a way of changing such qualitative data into quantifiable data. Once the broad categories of conversations have been identified by a read reread approach a systemic network can be devised, This is a means of grouping or categorizing things, in this case categories identified by words in conversations, to be' a parsimonious representation of the data, whilst preserving the relationships between categories in such a way that comparisons can be made between groups'. Systemic networks were developed by Bliss et al. (1983). This is a more rigorous method of categorizing data than just reading and identifying the concepts followed by making straightforward tables and manual counts. Such tables can be arranged in systematic order which is effectively, what the simplified TCOR (see page 23) achieves, but based on the hierarchical system designed for the topic.

On a simple level, hearing the dialogues engenders at natural history dioramas can give an indication of the level at which that dialogue is conducted. Similar approaches using various methods have been employed in interactive centers (Borun et al. 1995) and in zoos (Patrick and Tunnicliffe 2012).

In terms of remarks heard in front of natural history dioramas they are similar to those heard in zoos and at museum animals displayed alone. The following conversation is an example of this

Boy 1: Look over there, there's a crocodile.
Boy 2: Where?
Boy 3: Leopard! Over there!
Boy 1: Yes, with a little baby one up there, and elephants!
Boy 2: It's so big!

This conversation was captured at the large African diorama in gallery 3 at the Powell Cotton Museum, Quex Park, England.

A simple categorization that may be used is shown in Fig. 13.1.

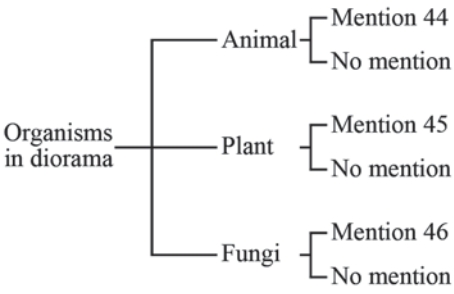

Fig. 13.2 Part of the network for superordinate category of organisation

Through listening to these conversations and reading the subsequent transcripts, broad categories of topics of conversations become apparent. At natural history dioramas the are context comments, identify organisms as animal, plant or fungi recognition of the genre of organism mainly plant and animal, Occasionally, aspects such as comments about the ambience of dioramas and the feeling it generates, at such from labels, the ethics of displaying the animals as well as the identification of organism, their structure, the relationship portrayed, e.g. mother and baby, family as well as the behaviour or function of the organism in the dioramas. Such categories in these diorama networks are based on those used in similar research at live biological exhibits (Tunnicliffe 1996a, b, c; Tunnicliffe et al. 1997), on field work (Tunnicliffe 2000) or at plants in a botanic garden (Tunnicliffe 2001). Fuller details of the methodology can be found in these papers.

Several examples of the network used at dioramas are presented for categorizing conversations. Spontaneous conventions are dioramas unless the viewers have a prescribed task, often scaffolded by an adult, usually in an educational context. The conversations are short and can be easily captured by writing. Permission for listening to the visitors in the museum is sought from the museum and by the parents or teacher before hand from the school organising the visit. Leisure adults are asked personally.

9.1 Examples of Conversations

Each conversation captured is considered as one conversation unit. Each conversation unit was categorized with the appropriate number from the network for the variety of organism and for natural features such as category of organisms; names in a diorama are shown in Figs. 13.2 and 13.3.

Twelve-year-old children on an organised school visit, but allowed to look, through free choice, at some natural history dioramas, responded to a large diorama of African animals at Powell Cotton Museum in England. A girl remarked, ‘ It’s amazing, the leopard!’.

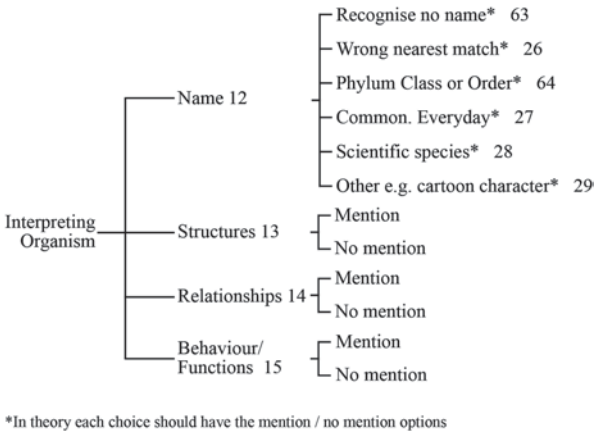

Fig. 13.3 Part of network for categorising comments about the organism, focusing on naming

9.2 Anthropomorphic Comments

Many anthropocentric comments are heard at animal such as a boy remarking at the African dioramas, 'I just want to stroke them, they look soft'. Schoolchildren at the Powell Cotton Museum in England made a number of anthropomorphic interpretative comments at the dioramas in that museum. For instance, a girl looking at the African diorama and focusing on the leopards, remarked how life like it was. Her companion, however announced, 'I think it's wrong. It's wrong to kill the babies, only kill one of them!'. This statement reflects the concern with ethical issues expressed by upper primary and lower secondary children about the preserving of animals for display. This attitude is met neither as frequently in zoos nor in natural history museums with solitary species although a few comments are heard and one child referred to the Natural History Museum London as the 'Dead Animal Zoo!'. When the cultural situation and historical basis for the taxidermic animals from the past are explained and that the reality of living in the wild is not of a perfect 'Garden of Eden' actuality, (Reiss and Tunnicliffe 2011), children think about the issue further. They have never had the situation explained and are unaware of the historical context. The girl quoted above did suggest only one animal should be taken for display!

10 Systemic Networks

The network can be regarded as a stacking set of boxes into which the researcher puts each part of the conversation. A square bracket ([), indicates that idea can only be in one category, they are mutually exclusive, not a member of other categories, Thus a square bracket indicates that an attribute may be either/or whilst a bracket

({) indicates one of a number of categories, which any organism in the diorama or the one which is being discussed may belong.

At one extreme of the continuum of categorizing the conversations are highly specific items, whilst at the other end is the main descriptor, in this case 'children's comments.' The numbers at the right of the figure label the most specific level of table categorization. There are number of networks, which can be fitted together to make one large one of children's comments. Finer and finer terminal can be added to each category depending on the detail of the analysis required.

For ease of working and printing it is easier to use each network on separate pages. Each country is only scored once, e.g. if the person says' Lion! Lion! Lion!' it is only counted once as the topics of content which are noticed are being counted, not the number of times, that is different study and depends on the number of specimens of the same species in the dioramas.

The code number is written above the relevant words. Then the incidence of each category can be entered in a separate sheet for each consecration having a reference number and a separate line, and then various calculations can be performed.

Thus, the conservation of the girl. 'It's amazing, the leopard.' mentioned above would be coded in the folioing manner, referring to numbers in the network not shown in diagram here according to the category designator numbers below.

44	24	27

It's amazing, the leopard!

The definite article is obviously referring to an animal, hence it is classified as a 44 as it was mentioned, the girl named it in her next phrase and that common name is allocated to category 27.

One of initial stages in analysing the content is to identify which Kingdom of living thing the specimens belong, hence a network can be devised for each of the. In an overall network of all specimens there wooded be there superordinate categories, Animals, say 44 in a number sequence for mention, plants (45), and Fungi (46) it would appear as below. Each of the three Kingdoms would then have further networks stemming from the mention branch after the kingdom name.

11 Categories in the Network

There is the basic locating of the setting and then interpreting what the diorama is depicting in terms of animal behaviour. As in this following conversation,

Girl: 'It looks like nature and it show animals dine and feed!'

Referring to the above comment, although both 'dine'; and 'feed' refer to the same behavioural concept of eating/drinking they both express different eating concept, dining being a human construct, so could be categorised as (38) in Behaviour/

Functions (15), see Fig. 13.3, which is the category number allocating to the behaviour sub category feeding and drinking (not shown in the network example above) or it could be classed as (41) Anthropomorphic behaviour? The researcher has to take the decision and be consistent throughout the same work. Looking 'like nature' reflects the ambience of the diorama, engendered by the way in which the overall diorama impacts the visitors first view, how the scene is depicted, thus is categorized as a (25). Ambience presupposes that the diorama is recognized as depicting nature. This is a given for natural history dioramas that there are of the living world (or extinct world in the case of dinosaurs).

The network is broken down for convenience into smaller networks, Exhibitory comments is subdivided into Social comments, (59) which are considered, as either management categories (60) or instructions to others, social conversations such as acknowledging a conversation, using person's name, and 'Exhibit access' where visitor is trying to locate something or draw attention with an ostensive comment such as, 'Look' to an item in the dioramas. This category in turn can be subdivide into a statement of location (64) and question seeking information about location (63) or an ostensive comment, 'Look!' (65). 65. Other categories in Exhibitory comments are physical artefacts/exhibit furniture (9), The Ambience of the exhibit (10) which is divided into Feelings (21) which is subdivided in turn into 'Positive' (Like) or negative comments, (22), calming (23) and 'other' (24). Interpretation is category (11), again is subdivided into interpretation provided by museums (66) which in turn divide into people e.g. explainers/enactors (67), labels (68), video (69) into other (70) such as hand held devices. The ethics engendered by the dioramas (47) can be divided into conservation aspects and action such as capturing/killing. Whilst category (50) concerns anthropomorphic interpretative comments with anthropocentric comments at (51). A category for 'other' comments is included in (52). Behaviour likewise in assigning numbers to the comments on the Organism network following naming the Structure (13) category is subdivide into colour (30) Size (31) parts of body (32), Life cycle e.g. baby adult (33) and other (71). Relationships (14) contain symbiotic/parasitic (44) for example when an Oxpecker sits on cattle is shown, that illustrates symbiotic relationship. Family grouping (35) is another relationship sometimes shown whilst other carry (36) can include predator prey relationships.

The categorization of the statement, ' I think it's wrong. It's wrong to kill theory babies, only kill one of them.' was analysed like this:

47	50	31

I think it's wrong. It's wrong to kill the babies, only kill one of them.

Other categories are allocated a unique number such as raising anthropocentric comments (51) and ethical ideas (47). Babies is judged to be part of the description of a structure (13) and is coded with a unique number (31).

Hence the following conversation made at a Rowland Ward diorama by an adult female is coded as follows:

‘ I think this is really nice’, is categorised as 21 for ‘really nice’. It is an expression of feeling within the category Ambience.

This remark of a 5 year-old girl ‘These things are all dead, the giraffe and its baby’, is coded:

63	48/41	27

These things are all dead, the giraffe and its baby.

Baby could be coded as 13 (structures) then 31 size as viewers often decide the smaller animal is the baby, usually erroneously.

The dialogue at the Powell Cotton which is reminiscent of the straightforward descriptive comments of observations found often in zoos given above (page OOO) is coded:

54/63/65	64	27	
Boy 1 Look over there, there’s a crocodile			
54/63			
B2 Where?			
	27	63/65.64	
Boy 3 Leopard! Over there!			
54/67	13/31	61/62/64	27
Boy 1 Yes, with a little baby one up there, and elephants!			
	13/31		
Boy 2 It’s so big!			

12 Using a TCOR

Quicker means of assessing conversational content is to use a TCOR Observation Record (TCOR) as a data-gathering tool. This is based on the systemic network approach and was adapted by Tunnicliffe in her research in zoos, botanic gardens and museums of various types and for field work (Tunnicliffe 2000; Patrick et al. 2011). Essentially a category is ticked on the form if it is heard to be mentioned once in a dialogue. Each conversation is one column of the chart. An example of such a TCOR is shown for the Context which has five categories; natural context, physical phenomena, ecological description, off-topic comments, such as ‘When is lunch?’ and management comments like ‘Stop it!’ can be regarded as a context (see Fig. 13.4). Various lines can be added for what so ever content the observer wishes to investigate e.g. name, structure or behaviour.

Name of Diorama being observed											Total
Family FM or school S or adult only A											
No of adults and gender F or M											
No. Learners in group: F or M											
Natural context in which diorama situated											
Physical phenomena e.g. clouds, sky, soil											
(TCOR) Geographical location E.g. Africa,											
Ecological description e.g. grassland, rainforest											
Off topic. E.g., What time is it?											
Management. E.g., Stop it! Let's go											
Additional lines to be added depending on category of interest											

Fig. 13.4 Tunnicliffe conversation observation record for natural history dioramas context

13 Scaffolding with Questions

In science primary teachers, as well as secondary teachers, use questions as part of their pedagogical tools. Questions are asked by the adult acting the role of pedagogue and also by children as part of their forming questions in inquiry. Parents and other adults use questions with children in museums as do the museums educators in various modes such as questioning factual recall and interpretation. Moreover, when children learn science they not only construct meaning but also develop their understanding in a social context (Duit and Treagust 1998). The learners are doing so in a context, different for each locality. In teaching, as Chin (2007) remarked, the use of questions by teachers is a technique frequently. As such they can encourage the thinking of a learner and their answers can provide the teacher with information feedback about the understanding of the respondents. However, such questioning does have an influence on the journey of that learner being questioned through the activity in which they are actively engaged. Mortimer and Scott (2003) discussed the way in which the different types of interaction between teacher and learner in secondary classrooms affects the ways the learners made sense or meaning of the issue in hand hence their learning. Chin (2007) identified how traditional teacher questioning differed from that used in constructivist teaching where learner assumes more responsibility for their thinking, teachers do not expect precise answers to questions and an answer is not wrong and teachers adjust their questions to respond the direction of the dialogue of the learner.

Questions are asked too by adults and children at natural history dioramas as they are at other museum exhibits. Ash (2003) showed that the use of question is an ‘powerful strategy’ which facilitates the conversations generated to develop thus changing from discourse employing everyday interpretation and understanding to that of a more scientific, and thus bologna and environmental view.

Chin, working in science classrooms in schools, identified 4 major areas of using questions to stimulate thinking in learners in science learning, which is about questions! Firstly, Socratic questioning where a sequence of questions is used which bath guide and prompt the leaner who may generate ideas based on prior knowledge and thinking. This has three divisions. These are: Pumping, where teacher strives to develop the talk of the learner and in which they provide more information. Reflective toss, which 'throws back' the question back to the other, by replying to the leaner's responses to a previous question with another question. The last category of Socratic questioning is Constructive Challenge, which is aimed at encouraging the learner to reflect and reconsider an inappropriate answer.

The Verbal jigsaw category focuses on key words of science and is important for leaner with weaker language skills, perhaps working in a second language/verbal jigsaw can be a verbal cloze sentence where the teacher stops and the learner fills in verbally the missing words or associating key world/ phrases to reinforce the use of scientific vocabulary.

Semantic Tapestry is a category to help learners 'weave' a picture from a number of ideas and is useful with concepts. Such a category is seen in multi pronged questioning when the teacher asks questions from several standpoints of an issue. Multimodal thinking encourages learners to think in a variety of ways or modes such as visual or 3.d or in formulae. Focusing and Zooming helps learners think in terms of the big picture but also focuses in on detail and the leaner can switch from macro to micro.

Framing is the fourth category identified and is used to assist the learner in realising the link between a question and the information that may answer it, such as experimental data. There is what Chin termed Question-based prelude, which acts as an advance organiser to thinking which it faces. The Question based out line question strives to link the big question to subsidiary ones whilst the Question based summary recapitulates concepts learnt.

Dialogues involving teachers or adults in the identity (Falk 2006, 2009) of a teacher at dioramas can be captured, transcribed and analyses and the various questions allocated to categories defined by Chin, which provides insight into the scaffolding occurring.

14 Learning Begins with Talking

Talking is about sharing the speaker's interpretation of what s/he comprehends. It is constructing their narrative about their journey of interest and interpretation at the natural history dioramas. Talking is the precursor of reading and writing. Why do we strive arrogantly to make our visitors learn? Let us work to encouraging observations and narratives through the stimulating environments. Dioramas are the ultimate in engendering such dialogue about biodiversity. Dioramas of the natural world are a vital part of portraying the natural world to people, adults and children.

They should be cherished and used in effective educational strategies, which assist in an individual's science education.

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Chapter 14
The Evolution of the Narrative at Natural History Dioramas

Alix Cotumaccio

1 The Power of the Narrative

Storytelling is an integral part of human communication. All over the world people tell stories; it is widely accepted among anthropologists that storytelling is a universal phenomenon throughout the history of all cultures (Roberts 2009). In fact, oral tradition is the conduit through which the vast majority of human knowledge has been imparted, whether through oral practices of particular cultures, literature, music, or informal storytelling (Sherman 2010). Knowledge transfer through storytelling occurs throughout ones life, which suggests that our brains are hard-wired to learn and process information when it is presented in the form of a narrative (Ochs and Capps 1996). This idea is further supported by the fact that young children everywhere show a propensity for learning stories and fabricating those of their own.

Narratives place pieces of information in a specific context, connecting fragmented information in a logical way. In this form, stories make meaning out of events that would otherwise seem disjointed (Mott et al. 1999). It is, therefore, not a surprise that people remember information contained in narrative form much better than information presented in lists or other non-narrative forms. The power of storytelling to unify what would otherwise be isolated facts by providing an organizing structure supports the connection of new knowledge and experiences with prior knowledge (Mott et al. 1999), allowing humans to process and retain new information more readily. Because of the important role narratives play in the memory process they have great potential to be a powerful educational tool across disciplines.

Storytelling is often incorporated into literature and history pedagogy, but it is rarely integrated into the teaching of science (Sherman 2010). When we realize that many people perceive data and facts as meaningless numbers and words when they are outside the realm of one's personal experience, we can see the importance of storytelling for teaching science. Osborn et al. (1996) argue that science knowledge

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can be reworked into story-like forms that act as memorable and efficient knowledge carriers. Narratives are able to place data and facts in a context and make them come alive, which in turn makes them easier to remember. Natural history museums have been harnessing the power of narratives for decades through dioramas. However, educational programming at museums has not always capitalized on the innate desire of participants to help shape the story and/or become a part of it. Facilitated tours of exhibit halls, and the dioramas contained within them, provide the perfect opportunity for doing this while utilizing narratives that aid in the learning and retention of new information.

2 Engagement in the Narrative

Natural history museums are free-choice settings with a goal of exciting, engaging and educating the public on aspects of science (Falk 2001). One of the many informal learning opportunities often provided by museums is the facilitated tour, often focused on a set of dioramas. Traditional, lecture-oriented tours have been shown to be ineffective in terms of engaging visitors, impacting learning, and sparking interest in science (Cox-Peterson et al. 2003), which is what museums were originally designed to do (Bell et al. 2009). Tours that utilize narratives to put facts into context and connect them to an audience's prior understanding are much more successful. Moreover, museum experiences that emphasize the importance of learners' prior knowledge and choice, while promoting social interaction have been found to be most effective in engaging visitors and generating an interest in science (Griffin and Symington 1997; Falk and Dierking 2000). Since museums are important educational institutions (Cox-Peterson et al. 2003), it is paramount that they utilize storytelling and engagement techniques to further the scientific understanding of visitors.

The Museum Education and Employment Program (MEEP) at the American Museum of Natural History embraces these ideals. In this program, college-aged youth are given in-depth training on the content of the Museum's exhibit halls and in pedagogical skills. The MEEPers, as they are affectionately called at the Museum, use the information they learn to develop their own unique themed tours set in the form of a narrative and infused with inquiry to engage participants, mostly camp groups visiting the Museum, in the story. MEEP tours are designed to draw on the audience members' prior knowledge, encourage observations and questions, and pique their desire to learn more. This type of tour harnesses the power of the narrative, and allows the facilitator to utilize social interactions and connect learning to prior knowledge in order to create a richer learning experience.

3 Evolution of the Narrative

The inquiry-based approach used to give tours in MEEP is designed to allow flexibility for the tours to change based on participants' interests, prior knowledge and understanding. The case studies presented in this article were derived from research

focused on documenting how the narrative of these tours changes based on tour participant's insights and questions. The focus of the study and the structure of the program studied led to using video and audio recordings, observations, and follow up interviews and surveys with MEEPers to collect data over the course of two summers—2011 and 2012. For anonymity, the names of the MEEPers have been changed. The tour groups observed were selected at random, were informed of the reason for the observations and/or video and audio recordings, and were given a chance to decline being part of the study. For the purposes of this research, we focused on speech acts (Allen 2002), and in particular, those acts that functioned to show use of prior knowledge, observations and questions that tended to lead the direction of the conversation.

The outcomes of the study support the supposition that the more inquiry-driven the tour, the more the narratives, and in particular the conversations at each diorama, change with each group. Visitors come to the Museum with preconceptions about how the world works, including some of the themes and concepts covered in the tours. By using inquiry techniques, facilitators are able to draw on this prior knowledge and allow it, and the observations and interests of the audience, to drive the direction of the narrative. One facilitator said of his experience, "[m]ore than half my tour was inquiry… using the [participants'] prior knowledge was instrumental in the success of my tour."

During this research, it became apparent that the MEEPers that used inquiry as the foundation of their tour narratives ended up having drastically different conversations with each camp group. These tours offer important insight into how one can integrate inquiry into narratives in order to achieve a higher engagement level, and impart more new knowledge and understanding upon the audience. Therefore, the case studies chosen for inclusion in this article exemplify the use of inquiry within the narrative.

3.1 Case Study: Tara

Tara focused her tour on animal behavior, and had learners use their "detective skills" to uncover the behaviors of animals from clues, or evidence, found in the dioramas in the Hall of Asian Mammals and the Hall of Saurischian Dinosaurs. Naturally, this tour was shaped by the clues the campers found and how they related those clues to particular behaviors. At the leopard diorama in the Hall of Asian Mammals Tara usually asked tour participants, "based on what we learned from the previous dioramas, what makes something like a leopard a good hunter?" (Fig. 14.1)

The answers to this question led different groups to focus on different characteristics that make a particular animal a good hunter, and at times even led them to discussing the hunting skills of other animals not in the diorama at hand. On one tour that was recorded, Tara noticed the group was more advanced so used inquiry to expand the discussion into forensic evidence. She related the diorama to a still picture where the campers did not see the event happen, and asked "what evidence

Fig. 14.1 Leopard diorama. Photo by Craig Chesek©American Museum of Natural History

did you see that clued you in to the fact that the leopard killed the peacock?" Answers from the camp group included: "the leopard pacing with a hungry look on his face," "the [pacing] leopard is looking at the living peacock like he wants to eat it," "the leopard on the ground has a peacock feather in its mouth." Because the group was doing so well and seemed to have a good grasp on what clues in the dioramas could tell them, Tara took it one step further and asked, "what if the leopards were not in this diorama at all? How could you tell what caused the peacock's death? What clues could you use?" The campers came up with a great array of answers on which Tara expanded:

Participant 1:	"Bite marks."
Tara:	"Yes, each animal has a unique bite mark and that could be used to help identify which animal killed it."
Participant 2:	"Paw prints."
Tara:	"Yeah, foot prints. The size and shape of the print in the dirt nearby could be useful."
Participant 3:	"Any fur left behind."
Tara:	"Fur left behind. Yes, you could tell by the color. Or, and I don't know how much you guys know, but DNA can be on fur, so that could be used."

Tara's use of inquiry within her narrative at individual dioramas presented her the opportunity to capitalize on each audience's level of understanding of biology and the particular species they were observing. She was able to quickly assess the group's prior knowledge and either stick to the basics or direct the conversation to encompass more difficult concepts, such as forensic science, thereby keeping the group engaged and interested while imparting new knowledge.

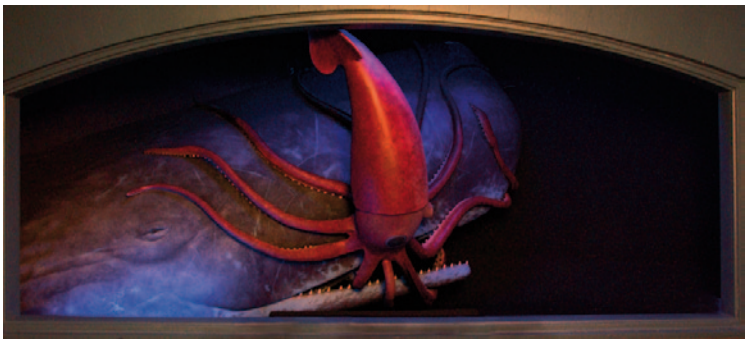

Fig. 14.2 Sperm Whale and Giant Squid. Photo by Denis Finnin©American Museum of Natural History

3.2 Case Study: Sarah

Sarah's tour, Alien Worlds, creatively combined the Dorothy and Lewis B. Cullman Hall of the Universe and the Milstein Hall of Ocean Life to show how extreme living environments shape what life forms can live there. Depending on the age range and interests of the children she used a different combination of dioramas, but always stopped at the diorama of the sperm whale and giant squid (Fig. 14.2).

Sarah always opened up the dialog at this diorama with, "what do you think they're doing?" The participants inevitably answered, "fighting!" To which Sarah would respond, "who do you think will win?" Controversy usually arose immediately, with half the groups expecting the whale to win and half the group saying the squid would win. To decide who was correct, Sarah would guide the group in making observations of the scene depicted. Participants generally pointed out that the squid had its arms wrapped around the sperm whale, the squid was using its powerful suckers to hold on, and one of the squid's arms was in the whale's mouth. On one of the observed tours, Sarah took this opportunity to talk about the various parts of the squid and whale's bodies and how they would help or hinder the animal to live in its deep ocean environment. She talked about the squid's eye, beak and tentacles, and the whale's baleen, size, and ability to dive deep and withstand pressure. Sarah then focused the conversation back on the fight through more inquiry, "imagine you're a scientist who just found a dead sperm whale that washed up on shore. You see it has lots of scars all over its body. What could have caused them?"

Participants:	"A squid!"
Sarah:	"If you look inside the whale's stomach you find something very interesting: remember the only hard part of the body?"
Participant 1:	"The squid's beak?"
Sarah:	"Yes. So what do you think happened?"
Participant 2:	"The whale got in a fight with the squid, the whale won and it ate the squid."

Sarah took it from there and told the story of how a sperm whale hunts for its food, the giant squid, in the deep, dark ocean. Sarah believes that because the information was given as part of a story, the children on the tour were immediately engaged. "They were no longer looking at a diorama, but at a story frozen in time," she said (Sherman 2010). This allowed Sarah, as the facilitator, to put the facts about the organisms and environment she wanted to teach into a context that made it easy to grasp and understand, and provided the opportunity to change up the way she told the story and what specific details she talked about based on the tour participants' interests and knowledge level.

Conclusion

The two case studies presented show how eliciting tour participants' pre-existing understandings on topics and providing opportunities to build on or challenge them is a powerful tool, which allow visitors, in particular children, to make connections and gain deeper understandings of the topics covered. Reframing how we structure the museum experience, by utilizing narratives infused with inquiry, helps us connect our educational purposes to the real lives of visitors, which better engages them and extends their learning beyond the present (Vallance 2004). Another prime example of this was Maria's tour, A Brief History of Time, which utilized the Harriet and Robert Heilbrun Cosmic Pathway and the Anne and Bernard Spitzer Hall of Human Origins. Because Maria's tour involved difficult, and often controversial, subjects, such as the Big Bang and evolution, she was constantly assessing her audience's knowledge. Maria used cues received from the audience to frame the narrative in a form appropriate for the group at hand. Because of this, her tour was constantly evolving. For example, one group that was observed came with a lot of prior knowledge of, and interest in, the beginning of the universe. Maria was able to gear the conversation so that the group could expand upon their knowledge by delving deeper into this area, allowing them to talk in detail about how and when the Big Bang happened, how scientists know what happened and when, and what the universe is made of. While with another group Maria ended up glossing over these concepts because the audience didn't have the foundational knowledge needed to form a basis on which to really conceptualize the astrophysics topics. Instead she used the knowledge they did have in biology to talk about the origins of life. To help the children visualize what they were talking about and make connections to their understanding of life on Earth, Maria added a new stop to the tour—a picture of a prehistoric ocean. Inquiry allows for this type of on the spot assessment of knowledge and interests, giving the facilitator the opportunity to take full advantage of the power of storytelling to maximize learning and retention.

Traditional museums, like the American Museum of Natural History, that are largely collections-based and house many dioramas often struggle with how to

make the content more accessible to the general public. Using floor facilitators, such as the MEEPers, can be a useful strategy to engage visitors in the stories within the dioramas and draw out key messages. By engaging audiences in narratives about the complex topics presented in dioramas, facilitators serve as human interfaces between the exhibit's intended purposes and the visitors' interests (Rodari and Xanthoudaki 2005). In this way facilitators become the direct link between the visitor and the dioramas (Kos 2005), creating a more engaging, meaningful visitor experience. When using inquiry-infused narratives facilitators can go further and create a scaffold between the visitors and the content of the dioramas, helping visitors not only understand the content but also connect it to their existing knowledge and interests. Implementing more educational experiences, such as these, that utilize inquiry-infused narratives may increase learning and retention because of the active, social nature of the learner's engagement, and the power of the narrative to connect new information and prior knowledge.

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Chapter 15
Imaginary Places: Museum Visitor Perceptions of Habitat Dioramas

Phaedra Livingstone

1 Introduction

How can significance be both meaningfully and appropriately conveyed in exhibitions? The contextualization of objects on display is one of the most debated topics in the history of museographic discourse. Contemporary museographic discourse is now more concerned with exhibition narrative and visitor experience, but establishing context remains a defining design feature for habitat dioramas. Habitat dioramas are a genre that attempts to represent a naturalistic glimpse into the environment-of-origin for the species on display. These dioramas usually include animals in the form of a taxidermy mount, posed against detailed background paintings, foliage and other props, as if to recreate the 'scene of the crime' just before the animal was killed, stuffed and immortalized, and returned to the same spot. The best-executed habitat dioramas evoke the sense of a moment frozen in time, which the visitor has stumbled upon. Yet, as elaborate works of art, these artificial scenes are anything but natural or documentary. This chapter considers applied research on representation issues and visitor responses informing the development of educational exhibitions such as dioramas.

Dioramas are an evolving art form still being installed in halls of science, applying current scientific concepts and interpretive plans to address a very different visual culture than that which shaped the first habitat dioramas. Old dioramas now connote new meanings—leading to some being refurbished and others being dismantled. Not long after their widespread North American adoption in the early twentieth century, habitat dioramas fell out of favor with curators as the cutting edge form of public science communication (Rader and Cain 2012), yet they remain a significant format for museum display, and not simply because there remain old ones waiting to be replaced.

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The muséum national d'histoire naturelle (Paris) offers a prime example of the evolution of natural history display types. The current *Grande Galerie de l'évolution* African Savannah display (opened in 1994) is a post-modern diorama–a Noah's Ark-like herd of taxidermy animals marching away from glass cases. The visitor brochure (2010 edition) lists the display under the heading "Diversity of Life: Terrestrial Habitats" with the simple explanation: "stretches of grassland scattered with trees and shrubs where life is defined by alternating dry and wet seasons." Some will argue that this free-standing mise en scène arranged without habitat artifice escapes the definition of a diorama. A modern, abstract aesthetic and conceptual interpretation are applied with the goal of affective provocation, balancing contemporary scientific thinking and visual culture, in a radically different manner than Buffon or Cuvier applied, curating the same museum centuries before dioramas were in vogue (Van Praët et al. 2000). As this project also illustrates (see Eidelman and Van Präet 2000), dioramas (and long-term exhibitions generally) are big budget projects that entail years of research and development on design, scientific content, and end-user needs. Dioramas might generally be perceived as a dated mode of display, yet they remain one of many genres a natural history museum might select to meaningfully present collections and provoke visitors in particular manners.

When researching a new exhibition, developers regularly consult with external experts on the subject matter, but may not see the relevance to a project of prior work by visual culture experts critiquing habitat dioramas installed in other institutions. Given the expense and endurance of such projects, it is prudent to do everything possible before an exhibition is installed to make it educationally effective and accurate in a semiotic sense; visitor studies offering front-end and formative evaluation are now the recognized method for testing this. Visitor studies capture the trends in visitor responses to an exhibition concept and are not designed to draw out the nuanced opinions of singular readings, as a semiotic analysis would. After installation, summative and remedial evaluations identify changes needed to better serve visitor needs. Currently under-utilized research methods might also feasibly contribute to the interpretative planning of dioramas before final designs are installed.

In her essay *Teddy Bear Patriarchy*, Donna Haraway deconstructs two of the habitat dioramas developed by Carl Akeley at the American Museum of Natural History (AMNH) in New York, offering an exceptional analysis of their epistemological underpinnings. The dioramas of the Akeley Hall of African Mammals opened to the public in 1936 and are still recognized today as the zenith of the genre. Conducting her study in the 1980s Haraway (2004, p. 155) asked: "What is the experience of New York streetwise kids wired to Walkman radios and passing by the Friday afternoon cocktail bar to see the lion diorama?" She assumes they are too distracted, but that others, looking into the window will be visually transported to an imaginary past. Each of the dioramas in this hall have a group of animals "… which tell of communities and families, peacefully and hierarchically ordered. Sexual specialization of function … is unobtrusively ubiquitous, unquestionable, right" (Haraway 2004, p. 156). Perhaps the most striking design feature

is that "Each diorama has at least one animal that catches the viewer's gaze and holds it in communion. … The gaze holds and the wary animal heals those who will look. … No visitor to a merely physical Africa could see these animals. This is a spiritual vision made possible only by their death and literal re-presentation" (Haraway 2004, pp. 156–57). Haraway goes on to describe how returning the gaze of the dominant male in the gorilla diorama is staged to evoke recognition of him as 'natural man', who cleanses and heals us of the decay civilization imposes upon our being. Read in the context of the essay, the gaze also implicitly frames the viewer as a male hunter just about to shoot the animal he is in communion with in the diorama. But, as she points out "… the viewer does not know these things when he sees the … animals in a naturalistic setting" (2004, pp. 157). Rather, the static display fixes the moment, allowing one to come to such a realization in the museum experience of the animal. Her description of the moment of communion is poetic but lacks the pedestrian ring of an average visitor interview transcript. It is just such disconnections that I contend limit the practical impact of the critical literature on museums.

Yet, the exchange Haraway suggests is utterly credible when you witness first-hand the dioramas in question. Visitor research generally measures conscious visual perceptions of an exhibition, as reported through intercept interviews. The disconnection between visitor research reports and Haraway's observations led me to consider how work like hers, which is rigorously researched and intimately concerned with the visitor experience, but which does not apply the usual techniques of visitor studies or the usual discourse of exhibition developers, might help better inform museographic practice in the future. Haraway's piece also made me curious as in a prior study (Livingstone 2003) I found visitors largely insensitive to explicitly gendered exhibit content. These questions inspired me to conduct an experiment, testing for responses like Haraway's in the viewing of a similar diorama. Following some further discussion of the literature, this chapter reports on that study, conducted at the *African Savannah* habitat diorama at the Royal Ontario Museum (ROM) in Toronto.

Given the significance and preponderance of dioramas in museum history, the associated literature is smaller than one might expect. English language publications on habitat dioramas can be organized into at least four primary orientations: those that consider such dioramas as a trope in contemporary art (e.g., Marchand 2003; Kamps and Rugoff 2000); those that discuss the history or technique of habitat diorama production (e.g., Henning 2006; Metzler 2007; Wonders 1993); those that apply critical theory to analyze the social representations and signification imbedded in habitat dioramas (e.g., Bal 1996; Haraway 2004; Luke 2002; Machin 2008) and those that analyze visitor engagement with habitat dioramas as an educational technology (e.g., Korenic 1995; Mair 2012; and most related visitor research sponsored by museums). It is the latter two orientations I am interested in here, both of which focus on the diorama as a communication medium; I am specifically interested in the work that considers visitor responses. While both critical analyses (e.g., cultural studies of museums as media) and instrumental analyses (e.g., studies measuring visitor learning within an exhibition) of habitat dioramas are ultimately

concerned with visitor apprehension, the respective authors pose very different questions in their research and do not tend to cite one another across the orientations. Further, the practical application of instrumental research, such as most visitor studies, is clear. Critical analyses generated by media scholars, however, are not written for exhibition developers and criticism of past exhibitions may be seen as having limited relevance to current development projects both methodologically and in terms of specific content.

On the one hand, informal science learning research demonstrates the pedagogical value of habitat dioramas, and on the other hand, various analyses of exhibitions applying critical theory have articulated representation problems with the social symbolism imbedded in such displays. While *anthropomorphic* displays, using taxidermy animal mounts posed and often dressed as human characters, explicitly invoke an *anthropocentric* understanding of the moment depicted (Henning 2007; McTavish in press), what does the less obviously socially staged habitat diorama genre communicate? During their experience of such a display, are casual adult visitors actually recognizing any anthropocentric significance in the staging of animal habitat dioramas? Is the social meaning they make of the displays anything like Haraway's reading of the AMNH dioramas? Even if so, can visitors articulate that to researchers in a measurable way in the course of their brief visit? Just because visitor study trends have not identified a given issue using current methods, it should not be assumed that no communication concern exists. The disconnection between the critical and instrumental analyses is particularly relevant here.

As a first step in exploring the further application of critical perspectives in exhibition development practice, I conducted a visitor study to test for critical perspectives in visitor responses. In the first phase of my project I conducted content analyses to compare habitat dioramas at the AMNH, the ROM and the Royal British Columbia Museum (Victoria, Canada). I then conducted a visitor study on the African Savannah diorama at the Royal Ontario Museum, which I describe below.

2 Study on Visitor Perceptions of a Habitat Diorama

I saw the AMNH Hall of African Mammals for the first time after reading *Teddy Bear Patriarchy.* Skeptical though I was, standing in front of the gorilla display I did recognize in my own reaction some of the visitor engagement Haraway proposes in her essay. I watched fellow visitors to observe their reactions and found that, of all 28 dioramas in the hall, the gorilla and lion ones seemed to have the strongest attracting and holding power. It was also observable that visitors' gaze was generally directed at the focal point of each display. By the time of my visit, the digital camera and cell phone had replaced the Walkman as personal technologies of choice. But rather than distracting visitors, as Haraway inferred such technologies would, I observed a focusing effect. Visitors used their camera to return the gaze of the dominant animal in the diorama scene, and "shoot" it. This observation and the huge significance of photography in the collecting and planning for the AMNH dioramas

Fig. 15.1 African Savannah diorama, Mammal Hall, Royal Ontario Museum

(as Haraway reports, Akeley even founded a camera company to support his need for technical developments) both further inspired me to adopt a visitor-employed photography technique in my subsequent visitor interviews.

In my analyses of the AMNH gorilla and lion dioramas I documented the sightlines, diagramming all visual axes. In both cases the staging and scene painting creates a similar dynamic whereby the visitor is visually directed, through the use of perspective, sightlines and focal point, to return the gaze of the dominant actor in the drama. Archival photos of these dioramas are posted on the AMNH research library website (http://images.library.amnh.org/photos/ptm/browse/) under the diorama tab; The African Lion diorama is depicted in image numbers 283077 and 330586. I subsequently diagrammed the ROM African Savannah diorama and found the same pattern of visual axes was used in the staging of that display. The ROM's exhibit, which opened in 1982, clearly referenced the design elements of the 1936 AMNH African lion diorama, using similar sightlines to direct viewers to return the dominant male lion's gaze. So, when visitor interviews at the AMNH were not possible, the ROM lion diorama was selected as a suitable substitute for testing Haraway's assertion about gendered visitor gaze.

The hall in which the ROM diorama was located (which was dismantled in the course of recent major renovations, in favour of a newer display aesthetic) included life group displays and a number of medium-sized glassed-in dioramas. Like those in the AMNH Africa Hall, one looked into a "window" to view the scene arranged behind a wall. The savannah diorama was well-lit and larger than most displays in the hall (see Fig. 15.1). Unlike the AMNH African dioramas, this ROM one depicted multiple plant and animal species within the same habitat, by a watering hole in Nairobi National Park. Like the AMNH lion diorama, there are five lions staged on the right hand of the scene. In the ROM scene three of the lions are mounts and two are juveniles painted into the background (a clear design reference to the older AMNH diorama), effecting a similar five-member "nuclear family" scene. When viewing either lion diorama, one is visually directed to engage the gaze of the stand-

ing male as the focal point. Female and juvenile male mounts or painted lions are arranged in more passive or subordinate poses (i.e. lying or sitting down).

Applying criterion sampling, I collected 30 adult participants' responses to the diorama through observation, intercept interviews, and visitor-employed photography. Visitor-employed photography (not to be confused with photo elicitation interviewing) is an interview technique commonly used in tourism research (e.g., Balomenou and Garrod 2010; Garrod 2007; Haywood 1990), but not in museum visitor studies. This was selected as a good technique to bridge the two orientations in my study of visitor perceptions. The technique also taps into behaviors visitors very regularly perform in the context of a museum visit (taking photos and talking about displays). Viewers who demonstrated interest in the diorama were invited within the first minute of viewing to participate in the interview and I ensured they were neither busy caregiving nor minors, and that the sample was gender balanced. To elicit responses, I asked visitors four questions that had them frame a narrative about the scene, which I could then analyze to determine what kind of scientific, affective or aesthetic meaning they made of the diorama content. These questions and summaries of the responses to them are offered below.

3 Visitor Responses

The study was conducted over a series of weeks, collecting interviews for a few hours at a time, on different days of the week. Study participants' self-reported demographics describe a diverse group of visitors, characterized by dominant characteristics as follows. Sixteen identified as male and 14 as female; almost all interviewees were 45 years old or less (14 were 16–25 years old, 12 were between 26 and 45, and four were 46 or older); Four reported visiting museums four or more times per year, whereas most (14) reported visiting 1–3 times per year and 12 reported only visiting museums when they travel. Twenty-two of the 30 were Canadian, six were international visitors and two abstained from sharing their nationality. Occupations were reported by job title and cluster as follows: student (13); retired/unemployed (4); applied engineering (4); service industry (3); medical professions (3); one lawyer, a clergyman and a musician.

Have you visited this particular exhibit before? (*If so, how recently*?) Twenty-two of the thirty visitors had not seen the diorama before, and of the other eight, only two had visited in the last 12 months. So, respondents reported fairly fresh impressions.

I am interested in how people make sense of habitat displays like this one. In as much detail as possible, please tell me about what you see in this display. Tell me a story about this scene. The descriptions twenty-seven people gave were comprehensive, describing the whole scene (animals and plants). Interestingly, only twenty-one made specific mention of the lions. However, some estimation of the relationships depicted was the next most frequent descriptor, with fifteen visitors commenting the animals looked calm together, ten commenting on the predator-

prey relationships (which were usually noted as unrealistic, i.e., having lions and guinea fowl, for example, placidly side by side), and seven referring to the lions as a family or pride. A few mentioned some ongoing event, namely feeding, resting or migration. Finally, two people commented on the realism of the depiction (i.e. the quality of the scenic painting), but fourteen commented on the unreality of the scene depicted (i.e. not believing the animals would behave that way in reality).

Look at the lions for a moment. How do they make you feel? Tell me what thoughts come to mind when you look closely at this display. Again, "calm" was a common answer (10/30), followed by "threatened" by the lions (9/30) or "sad" (7/30) because endangered or hunted animals were killed for the display. Some commented that the animals looked sad or confused. Feeling intrigued or put-off was mentioned by a couple of visitors each. Finally, a few also mentioned feeling like the scene was a familial one.

I was cautious to avoid leading interview responses by making any mention of my broader research agenda on gendered representations and interpretations. The various unprompted familial comments are particularly interesting in relation to Haraway's analysis of the AMNH dioramas. The following response to Question 3 (how do the lions make you feel) offers a young man's reading of the relationships depicted in the ROM diorama:

> V26: Yeah, they definitely make me feel sad– in response to the lions. There are also some ones there. [*Indicating the background painting*.] It seems like a pretty big family. Is that the mom? Yeah, that's the father…. Yeah, it seems very family-oriented. And that kind of appeals to humans I guess…. Lions have families. So do we. Umm, yeah, that's pretty much all. I actually really like the female now that you mention it. No, not the female, the male.
> PL: The one in the middle [*i.e. standing male*].
> V26: Yeah.

For the final question I handed visitors my digital camera, set without flash, and asked them: *Please photograph the most significant element of this display (you may zoom in or out using this button)*. I gave them time to shoot the photo, then looking at it together, I asked: *Why did you choose that?* While the descriptions of the total scene (responding to Question 2) had tended to be comprehensive, when choosing the most significant aspect, twenty-three of the thirty took photos of the lions: nine composed photographs of just the dominant male; three photographed just the juvenile male; and eleven composed photos of the male and female pair (Fig. 15.2). The rationale given most often (15/30) for framing these photos was that each depicted the focal point of the scene (i.e., they were narrowing in on the key design element). The other seven photos included one of the guinea fowl (see Fig. 15.3) and one of the snake (because they were interesting) and five of the full diorama (because they could not decide on just one aspect). However, a number of the full diorama photographers pointed out that they were most interested in the juvenile in the middle, because he was "cute"; unlike the juveniles in the AMNH lion diorama this one faced the viewer, returning one's gaze.

In the associated observations I conducted, the African Savannah diorama had the most attracting power in the hall and engaged visitors' attention the longest. The labels were the least viewed and commented upon element of the installation. Both

Fig. 15.2 Visitor photograph demonstrating a negotiated perspective, African Savannah diorama

Fig. 15.3 Visitor photograph demonstrating an oppositional perspective on the ROM diorama

the transcripts and the photos demonstrate that the mature male lion, followed by the juvenile male in the middle, were the key visual elements for the majority of visitors interviewed. The implicit gendering of the social scene was not explicitly commented on but many of the visitors made reference to the inferred relationships as depicting a family or pride.

Exhibit developers are properly interested in visitor studies evaluating exhibition effectiveness, looking for significant trends in the functionality and intelligibility of the display elements they have designed. Such studies will generally leave the data analysis at this point, unless visitor feedback indicates some unanticipated concern with the exhibition, requiring further study. Critical analyses are more theoretically oriented and pose different questions, the answers for which, unless explicitly posed in a visitor study, are not likely to emerge as anything but outliers in visitor response

trends. To make sense of my study responses in relation to a critical understanding of their meaning and their relationship to Haraway's critique, I further analysed them applying the positions articulated in Hall's reception theory (1993). Below I make a brief presentation of the reception positions evident in the ROM visitor responses.

According to the prevailing concerns of any who still put forward a 'viewer as victim' understanding of program users as passive consumers of knowledge products, most visitors will read the diorama in keeping with the meaning intended by the curatorial team in the interpretative plan. Hall defines this understanding of the content as applying a "dominant" or hegemonic code. This understanding is also in keeping with but distinct from the "professional code" (including application of professional standards and best practice), the application of which reinforces the dominant code interpretation. A dominant code understanding of an exhibition reads (decodes) it at 'face value'. Hall does not, however, suggest viewers are passive recipients. Visitor responses applying a "negotiated code" recognize the dominant position as generally legitimate, but also apply alternative understandings to details of the exhibition. Finally, some visitors will recognize the intended meaning but interpret an exhibition in a fully contrary manner, applying an "oppositional code" such as Haraway's reading of the AMNH dioramas (which is truly exceptional in that she critiques both the dominant and the professional codes). Dominant, negotiated and oppositional positions were all demonstrated in the ROM study responses.

Visually, the dominant/hegemonic position is reflected in most of the photo responses. Both Fig. 15.1 and 15.2 are visitor photos illustrating such narratives, with the dominant (in both senses) male lion as focal point within a savannah scene. The following visitor response demonstrates a reading in keeping with the dominant position. As the visitor lists what he sees, in two instances he muses about the reality of the depiction, but immediately reasons that the situation must be possible:

> Okay, I see carnivores, I see grazers, birds. Carnivores are associated with the bird. [long pause] bird wildlife as well. You've got the grassland inside surrounded on the edges by mountains. This looks like it's probably a little watering pool or something….You also have rhinoceros over there. Umm, I'm not sure whether a rhino would be in this sort of environment. *It probably could*. [emphasis added] And I see various bird species all the way from pheasants to big ostriches, with the flying birds. And different types of antelope. There seem to be one, two gazelles there. And the zebras as well. So you'll have your herbivores as well as your carnivores and you have sort of a hierarchy of things here too. Umm, in terms of– it's not likely– the close proximity of the lions to the giraffe. *I guess the giraffe for the most part may not be a prey or consider the lions a threat right now*. [emphasis added] [Visitor 5, responding to Question 2]

Overall, most visitor interviews demonstrated a negotiated understanding—usually articulating an understanding of the curatorial message in the framing and explanation of their photos, but criticizing the reality or scientific integrity of the diorama in their answers to my other questions. The following quote nicely illustrates such a response. The same visitor took the Fig. 15.2 photograph.

> Umm. I don't know. What I see is just probably what I think would not be an accurate representation of the savannah. Because you probably wouldn't have all of the animals in one spot at one time…. That's just the way I see it. But in order to get them all in one display, they've all been put there. Rather than have like a million different pictures or something.
> [Visitor 20, responding to Question 2]

One would expect oppositional readings, as critical theorists like Hall and Haraway apply them to cultural performances, to be extremely rare in visitor study responses. Individuals being intercept-interviewed by a stranger in the course of a free-choice visit are not likely to spontaneously form and share a sociopolitical or institutional critique of a display they are in the midst of viewing. Yet, if we focus on the educational and scientific ideology of the dominant understanding, some respondents shared clearly oppositional readings of the ROM diorama applying idiosyncratic priorities in their reading and use of the display. Again, such readings understand the code that authored the exhibition, but opt to interpret it according to their own priorities. One visitor offered the following oppositional response and the Fig. 15.3 photo:

> Well, it looks like it's supposed to be reflecting a typical day in the life of a lion. I don't know how realistic the picture its, but I've never been to Africa before. I get distracted by the background because it doesn't look like something that would actually be a prairie in real life. It just doesn't seem like there would be giraffes right there and lions right there. But I think what they're trying to go for is looking at something that looks nice, not really realistic. And I guess, yeah like I said, it's supposed to be representing a typical day.… like if you look at the birds that are over there– they actually looked like they were doing something instead of just sitting and standing around.… [They] look like they're actually kind of foraging around and pecking at things. And I think that's interesting. And you've got the snakes right there, and that bird right there. *It's the little things that just mean a lot more than the actual bigger parts of it.* [emphasis added] And those birds, they look like they're going to eat something. You know? The lions just look like they're standing around and waiting for something to happen.
> [Visitor 16, responding to Question 2]

> They don't really look– the way they have been set up, they just kinda look like big cats. Even though they are, but they don't look in any way the way you would expect one to look, you know, kind of you don't want to go near the lion or it will eat you. They look kind of sad actually, which is a little weird. I don't really know what I think about them too much. But it definitely does look like they're just kind of relaxing and not– like I said, just kind of waiting for something to happen. This one right here [*indicating a lion*] though looks kind of like it might be watching something.
> [Visitor 16, responding to Question 3]

My second question prompted visitors to articulate the narrative the diorama portrays and my third question cued visitors to focus on the lions and their own affective response. This visitor (a student in her 20s) clearly recognized the intended message, critiqued the presentation and, resisting a focus on the lions as the most important element of the drama depicted, found her own significance for the diorama.

4 Discussion

The critical literature is largely concerned with museum presentations as master narratives, in which habitat dioramas implicitly naturalize local social norms (for example, male dominates female) as common sense universals. While both critical analyses and instrumental analyses are ultimately concerned with visitor apprehension, the respective authors pose very different questions in their research. In an attempt to draw together the critical and instrumental orientations in the diorama literature, I conducted a small experiment to see if casual adult visitors recognize anthropocentric significance in the staging of animal habitat dioramas, and if so is the meaning they make of the displays anything like Haraway's reading (2004) of the AMNH dioramas? In my test of Haraway's assertion I did not find visitors articulately explaining experiences of a timeless moment with an undead king of the jungle. This is as one would expect; The experience Haraway describes is liminal and private. However, a good number of visitors did, unprompted, articulate their recognition of the lions as a family, applying an anthropocentric and gendered analogy to make sense of the staging of the animals. Humans have a stronger empathic responses to beings we perceive to be closer to ourselves (Westbury and Neumann 2008), suggesting visitor response to the gaze of a fellow primate is likely to be a somewhat different experience than returning the gaze of a lion. The likelihood of anthropocentric readings is also lower in viewing lions than primates (like the gorilla diorama Haraway critiqued). Yet, the visitor quote cited earlier about the lions as a family uses plain language to explicitly articulate the anthropocentric analogy Haraway critiques in her reading of the AMNH dioramas.

In response to Questions 2 and 4 the same visitor offered a negotiated perspective on the diorama, commenting that the scene depicted was unrealistic in its portrayal of so many species in close proximity, but that the staging provided an educational opportunity to learn about the various savannah animals all at once. For visitor studies testing communicative effectiveness, finding that all visitors recognize, to some degree, the dominant narrative for a diorama would be adequate confirmation of effectiveness. However, applying Hall's model to further interpret the data we find that a majority of visitors I interviewed expressed negotiated interpretations. A small number offered alternative, oppositional interpretations. Most visitors offered a meta-analysis critiquing the realism of the diorama as they shared their narratives and focal photos in answer to interview questions 2 through 4.

Instrumental studies evaluating visitor responses against the intended/ dominant messaging of exhibitions have rarely reported either significant gender-based trends in visitor behavior or, even more rare, gender critiques. How then, might concerned exhibition developers deal with a contention like Haraway's stating that the way a diorama displays taxidermy shapes a visitor's gaze as a sort of masculine subjectivity? First, as Hall puts forward, all visitors recognize the dominant code of an exhibition and will respond to visitor study questions in relation to it. If one wishes

to learn about other positions, they need to look at visitor answers differently or to pose altogether new evaluation questions. One cannot generalize the experience and critique of an expert viewer to stand-in for the average visitor's reading of a display, nor of course will the average visitor response offer the nuance of an expert criticism. Hall's encoding/decoding model is a lens for evaluating the match between the producer's intended messages and the messages the visitor receives/ interprets, and recognizes the agency of the visitor in the learning process, making it very compatible with constructivist theories informing current free-choice programming and evaluation.

While the methods of either the critical or instrumental research orientations alone have limitations for understanding the complex nature of visitor perceptions of a diorama, looking across the literatures produced enriches our understanding of pitfalls and benefits associated with the use of habitat dioramas for science learning. Museographic research needs to be utilization-focused (Patton 1997) if it is to have any influence in the field of practice. Exhibition practitioners whose work might otherwise be fruitfully informed by the critical analysis, may dismiss the critique as unfair and irrelevant. On the other hand, visitor studies are often conducted in the context of evaluation offering limited scope to be critical of the overall merits of an installation or to contribute to theory building. While Hall's model is unusual in acknowledging the "professional code" in association with the "dominant code" the critic applying other theoretical frameworks may not take into account the practical constraints (e.g., taxidermy specimens mounted years ago in poses now awkward to arrange for newer scientific narratives) faced by exhibition developers in the production of a diorama.

Dioramas are being removed, reinvented, and various interventions have been used to animate or reinterpret them. The National Museum of Natural History, for example, briefly added "dilemma labels" pointing out stereotypes imbedded in the older displays, which brought out a controversy that eventually led to the closing of the Africa hall (McConnell and Hess 1998; Museum's Labels Now Carry Corrections 1993). In recent years the critical and instrumental approaches to exhibition analysis have come together to some degree. As further diorama design developments are tested, an expanded repertoire of methods (such as visitor-employed photography) and theoretical influences could be productively adopted.

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Chapter 16
Habitat Dioramas and Sense of Place: Factors Linked to Visitors' Feelings About the Natural Places Portrayed in Dioramas

Cecilia Garibay and Eric Gyllenhaal

The scholarship on dioramas and diorama halls suggests that place is an important aspect of wildlife dioramas. Curators and preparators spend significant time and effort planning and creating the places in which mounted animal specimens are placed (e.g., Anderson 2000; Holmes 2009; Wonders 1991). Yet research on the extent to which dioramas help visitors connect to the places depicted is limited. In this chapter, we present preliminary findings for an exploratory study which investigated whether habitat dioramas contributed to visitors' development of sense of place.

1 Defining Sense of Place

Sense of place is a popular but complex concept addressed within many academic disciplines including psychology, geography, anthropology, and architecture. Noting that each field often defines the term too narrowly based on an individual discipline, Ardoin (2004, 2006) attempted to map the multi-dimensional nature and range of factors that contributed to developing a connection with places. She defined sense of place as a term that "describes the complex cognitive, affective, and evaluative relationships people develop with social and ecological communities." The concept's four dimensions include:

- The Biophysical Dimension of place, which describes the physical environment as the context within which sense of place develops. Sense of place can develop with either outdoor (natural) or built environments.

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- The Psychological Dimension of place, which works on the individual level. Three place-centered psychological concepts that have been studied: (a) Place identity, which "includes the environment as an important factor in developing self-concept" (p. 115); (b) Place dependence, which relies on places to support individuals' goals and desired activities; and (c) Place attachment refers to the bond that individuals feel to a place. It starts with the psychological (place identity and dependence dimensions) but moves beyond to include sociocultural components such as experiences shared with families and communities.
- The Sociocultural Dimension, which recognizes that the meanings that create a sense of place are created through culturally specific social interactions and practices. Individuals function within societies, which include "cultural and symbolic elements [that] sustain society's views of and beliefs related to place" (p. 116)
- The Political Economic Dimensions of place, which recognizes that political entities (such as states) are situated within a physical place and that any place is not isolated but rather connected in many ways to other places.

Several studies suggest that developing a strong sense of place can lead to environmentally responsible behaviors. Some research supports this view (Kudryavtsev et al. 2012). Sense of place can be developed not only through extended experience with a particular place (for example, living in or visiting a place over a long period) but potentially also through indirect means even to places individuals have not visited. For example, individuals may express a sense of attachment to the Amazon Rainforest or the Grand Canyon even if they have never been there. These feelings may derive from indirect experiences such as watching documentaries, reading stories, looking at photographs, or other means. Thus, it is possible that sense of place can be developed through more interpretive experiences (such as diorama museum experiences) that may, in turn, lead to positive environmental behaviors.

2 Connections to Place in Dioramas

In their literature review of visitor outcomes at dioramas, Gyllenhaal et al. (2010) noted some, albeit limited, findings that visitors show evidence of sense of place when interviewed after their diorama experiences.

In studies of the dioramas at the Chicago Academy of Sciences (Perry et al. 1995; Fialkowski et al. 1992), visitors recognized that the dioramas represented real places in the Chicago region and discussed connections between the dioramas and the real places—especially those they remembered from previous experiences. At the Oakland Museum of California's dioramas in the Natural Sciences Gallery, Garibay (2008a) found that visitors seemed to have developed—or were developing—relationships with the wild places depicted in the dioramas. Two-thirds of respondents, for example, gave answers suggesting that they recognized that the Gallery was California-specific; some recalled either places they had visited that were specifically depicted in the dioramas or similar places they were reminded of as they viewed certain habitat dioramas:

> Yosemite. I visited there before and really enjoyed it. This gallery certainly reminds me of there.
> It made me think of my childhood and traveling to the Redwoods and to the water. I felt nostalgic.

The study also asked visitors about the extent to which they were able to personally connect to natural places portrayed in the Gallery. While most visitors agreed that they felt connected to these places, repeat visitors to the Gallery provided significantly higher ratings than first-time visitors. Nearly 60 % of visitors indicating they felt a connection said it was because they had been to that specific place, seen an animal or plant portrayed in the diorama, or had an interest or memory relating to these places.

> I love the coasts, the Redwoods. I used to be a backpacker so I recognize a lot of the places. I've been to a lot of these places and I don't know all the animals, but I see some I've always had questions about and I think, "Oh, I've seen that bird before."
> [It was] reminiscent of growing up in the Great Plains.

3 Study Focus and Design

While some evidence exists that dioramas can stimulate visitors' pre-existing sense of place, we don't know whether dioramas help visitors develop their sense of place, especially for places they've never been. Given that sense of place has not been studied in diorama experiences, this exploratory research focused on a basic but poorly understood question: What role does sense of place play in visitors' experiences with habitat dioramas?

3.1 Measuring Sense of Place

Several valid and reliable scales exist to measure sense of place. In our review of available instruments that measure sense of place and related constructs (e.g., visitors' general feelings about the natural environment), we identified 11 studies that could potentially be adapted for ourresearch. Our criteria for selecting a final instrument included that the scales reflected the complexity of the sense of place concept, that it was not too long, and that it could be generalizable across multiple places/dioramas.

We selected scales developed by Hammitt et al. (2009), which included question items developed in earlier sense-of-place studies. The items were grouped into five aspects measuring sense of place which the authors collectively termed Place Bondedness:

- Place identity—individual's personal identity in relation to the physical environment
- Place dependence—perceived strength of association between a person and a specific place

- Place familiarity—pleasant memories, attribute and cognitive meanings, and environmental images
- Place belongingness—feeling of affiliation with place, a social bond where people feel as though they are connected and hold 'membership' with an environment
- Place rootedness—strong and focused bond that "in its essence means being completely at home"

Hammit, Kyle, and Oh developed three versions of the instrument, each shorter than the previous version. (These were tested and validated with campers and fishermen who used a particular river in Tennessee.) The Full Model included all questions for all five dimensions, the Parsimonious Model included all five dimensions but fewer questions for each, and the Partial Model included only two dimensions (Place Identity and Place Dependence) but included all questions for those two dimensions. To test the predictive validity of the three Place Bonding models, the authors compared model scores for two groups of recreational users (campers and fishermen) and found that:

> The differences in predictive validity of the three models were not great. As a consequence, it is difficult to recommend convincingly which model is best to use. Because the five dimensions, 15-item parsimonious model was as predictive as the full model, we would recommend the parsimonious model over the full model. When deciding between the parsimonious and partial models, one has to ask if the 7% (campers) and 3% (anglers) gain in prediction of the parsimonious model over the partial model is advantageous enough to use it over the partial model (p. 68).

These results were encouraging, because we knew we needed a short instrument to use with causal museum visitors.

Of course, the Hammitt et al. (2009) instrument's scales were developed for respondents who were known users of a particular place's natural resources. Clearly, for this study, some questions would need to be reworded or dropped because they were not appropriate for a survey whose respondents may or may not have visited one specific place and who may or may not be familiar with it from the media or other sources. For example, the place dependence questions focused on ways an individual used a particular natural area (e.g., "Trout fishing in the Chattooga is more important to me than trout fishing in any other river").

The final instrument developed for this study included 11 questions (in the form of statements) taken or adapted from the Hammit, et al. instrument. These statements asked respondents their level of agreement with a statement using a 1–5 (strongly disagree to strongly agree) scale. To give a flavor for the scale, some of the statements follow:

> I feel like I belong at this place.
> This place is very special to me.
> I feel connected to the place shown in this diorama.
> If I visited this place, I would feel like I was part of it.
> I identify strongly with this place.

To account for visitors' non-place related feelings for the natural places portrayed in dioramas, the team used the Connectedness to Nature scale developed by Mayer

and Frantz (2004). This scale was designed to measure respondents' levels of emotional connection to the natural world. Mayer and Frantz (2004) described five studies that assessed the validity and reliability of the scale. As with the Place Bondedness scale, the Connectedness to Nature scale was shortened and the questions slightly reworded for use with visitors in a museum diorama hall setting. As with Place Bondedness, the scale consisted of statements with which respondents rated their agreement one (strongly disagree) to five (strongly agree). To give a flavor for the scale, some of the statements follow:

I think of the natural world as a community to which I belong.
I often feel disconnected from nature.
I enjoy visiting wild places that have lots of insects and spiders.

The instrument also included questions about familiarity with the place depicted in the diorama (e.g., "I feel very familiar with the place shown in this diorama"), prior visitation to that specific place, or to places that look similar to the one portrayed.

The totality of the instrument developed was piloted. During the pilot phase we also included observations and interviews to triangulate our findings and gain a deeper understanding of the nature of visitors' experiences, such as the extent to which visitors attended to and talked about place at the dioramas. Pilot phase investigations took place at the Nature Walk diorama exhibition in the Field Museum and at the Explore Colorado dioramas at the Denver Museum of Nature and Science (DMNS) in its Explore Colorado diorama exhibition. We conducted 24 observations (13 of those groups were interviewed) using purposive sampling to obtain as broad as possible a range of groups (e.g., families, adult only groups, locals vs. tourists, range of ages).

After the pilot study, we included additional questions to address experiences identified during observations and interviews that might influence visitors' experiences at habitat dioramas and the outcomes visitors took away from their experiences. (We termed these "intensity of experience" and "depth of outcomes" scales respectively.) These scales (rated 1–5) included statements such as:

This diorama brought back memories of my own outdoor experiences.
I imagined what it would be like to visit the place shown in this diorama.
I learned a lot about this place by looking at the diorama.
Viewing this diorama made me feel like I want to visit this place sometime soon.

Additionally, interview results suggested that respondents' feelings about places depicted in the dioramas might be influenced by their discomfort with certain aspects of that habitat (insects, snakes, icy landscapes). To account for potential non-place-specific factors that might affect visitors' responses to dioramas, we developed the Preferences for Outdoor Experiences scale, inspired by two existing scales: Bixler and Floyd's (1999) Disgust Sensitivity Scale (which attempts to measure respondents' preferences for, or aversion to, outdoor aspects such as mosquitoes, mud, and cold) and Simmons' (1994a, 1994b) scales for his studies on adult and children's preferences for various landscapes (e.g., rural vs. urban nature scenes). Examples of statements (using 1–5 ratings as with the scales described above) are:

I enjoy visiting wild places that have lots of insects and spiders.
My favorite outdoor places have broad lawns, formal gardens, and neatly trimmed shrubs.

The final instrument included seven scales (38 questions) to measure Place Bondedness, aspects and potential outcomes of the diorama experience, and a range of possible contributing factors such as visitation, familiarity, connectedness to nature, and preferences for outdoor experiences.

In the second phase of the study, the final version of the survey instrument was administered to large samples at the Field Museum's Nature Walk and DMNS' Explore Colorado. The total sample for phase two was 633 randomly selected adult respondents (305 collected at DMNS and 328 at the Field Museum).

3.2 Diorama Selection

To determine which dioramas to use in the study, the team had to decide which aspects of place to focus on—Dioramas of places visitors might have first-hand familiarity with or places with iconic status that might be recognizable to visitors even had they not visited. In the end, we chose a bit of both, selecting five dioramas at each site. The Field Museum included three dioramas that represented local (Chicago Lakefront) or regional places (Illinois Marsh in Lake County, Iron County Woods in Northern Michigan) and two depicting iconic places (Grand Canyon and the Amazon Rainforest in Brazil). At DMNS dioramas we used a similar strategy, selecting dioramas representing a range of elevation-related life zones (from short-grass prairie to mountain-top tundra) and also included the iconic Sonoran Desert diorama (although it depicted a habitat in Arizona, not Colorado). The specific dioramas included were Mesa Verde National Park, San Juan Mountains, Pawnee National Grasslands, Loveland Pass, and Arizona Desert (Superstition Mountains).

3.3 Sample

At both museums, female respondents outnumbered males 58–42%. Some demographic characteristics of the Phase 2 samples seemed to be influenced by the presence of a popular traveling exhibition about pirates at DMNS during data collection. For instance, 60% of the Field Museum respondents were in groups that did not include children, whereas 72% of the DMNS respondents groups included children. The most frequent age at the Field Museum was in the 18–29 range (38%), whereas the most frequent age groups at DMNS was in the 30s (36%).

Perhaps because most of the Field Museum surveys were collected during the summer, only 20% of Field Museum respondents were from the Chicago metropolitan area, and 63% of Field Museum visitors had never seen the Nature Walk dioramas before. In the DMNS sample (collected in the spring), 34% were from the Denver metropolitan area, and only 20% were seeing the Explore Colorado dioramas for the first time. Race/ethnicity data skewed heavily towards Caucasian (82% at Field Museum and 89% at DMNS). Some two-thirds of both museum samples were college graduates, and a quarter of the sample held postgraduate degrees.

3.4 Analysis

Observations and interviews conducted during the pilot phase were analyzed using content and thematic analysis. For the sense of place instrument, basic summary statistics were calculated and compared, including mean and median values for each question for each diorama. Scores for the subsets of scales were also calculated for each diorama. These summary statistics were compared, using tables of data and histograms that displayed mean scores for each diorama. To explore the relationships among the variables that might contribute to respondents' Place Bondedness scores, regression analyses were conducted on both answers to individual questions and overall scale scores. Scatter plots of the data were compared visually and R^2 values calculated and compared in tabular form.

4 Results

4.1 Recognizing Place at Dioramas

One interesting finding of the pilot study was that some respondents did not realize that the dioramas represented specific geographic places. Respondents seemed more focused on the animals than any specific place they might represent. Although respondents talked amongst themselves about many aspects of the dioramas, place played a secondary role in most of these conversations. When place didemerge, it was often mentioned to establish a setting for a story, discussion, or lesson about an animal depicted in a diorama. Often, places visitors mentioned were not ones actually depicted in the diorama, but rather similar places that the diorama reminded them of.

Most of the engagements observed (in both family and all-adult groups) during the pilot phase tended to fit the pattern of engagement described by Tunnicliffe (2005). She identified four levels of interpretation and usage of the dioramas:

1. Locate. Visitors first locate items within the diorama, based on their own observations and assisted by labels if they are available.
2. Identify by name the located object. Identifications may come from the observer, companions, or labels if they are available.
3. Describe form, function, and behavior. Visitors frequently describe the items they have identified, noting attributes like size, shape, and color, and perhaps discuss the function of a feature or the behavior implied by an animal's pose.
4. Interpret. Visitors may interpret what they've seen, using abstract terms to relate the exhibit to concepts, raising questions, or even philosophizing about what they've seen.

When respondents did discuss place, they often tended to focus on habitat rather than the specific location depicted in the diorama. For example, respondents sometimes mentioned the kind of environment in which a particular animal or plant

lived. During interviews, respondents often noted that the dioramas reminded them of places with similar animals, plants, and physical features. For instance, The Michigan Woods diorama inspired memories of other woods in the Midwest and as far away as Oregon.

Dioramas also sometimes stimulated respondents' memories about places. Sometimes those memories were about a specific location depicted in a diorama, but more often, were about events or experiences they'd had in similar places. In cases where two or more members in a group had visited a place (the one depicted or a place a diorama reminded them of), conversations sometimes focused on comparing the diorama with their shared memories of that place. Had they seen similar animals in Costa Rica? Did they remember seeing that many trees at the edge of the Grand Canyon? Memories were, in turn, connected to people in respondents' lives and to events such as vacations, childhood explorations in nature, or even stories about encounters with animals. These findings are congruent with earlier studies (Garibay 2008a, 2008b) suggesting that place served as a backdrop to the stories and memories visitors shared. Memories were sometimes shared at the dioramas but often did not surface until the interview.

Interviews also revealed interesting connections with both the closest and farthest places from Chicago and Denver. At the Field Museum, those respondents from the Chicago area lived close enough to Lake Michigan to visit it regularly (or at least saw it fairly often). They all had memories of the Lake and expressed some level of connection to Chicago's Lakefront. In the DMNS sample, the Loveland Pass diorama (although not immediately adjacent to the city) seemed to represent a similar community-wide experience; it was a familiar place respondents had either visited (e.g., to hike or ski) or drove through when heading west through the Rockies.

At the other extreme, some visitors expressed connections to places very far from Chicago or Denver.

This was the case for the Amazon Rainforest among respondents at the Field Museum. There were indications that respondents were familiar with this place from school or the media—and perhaps influenced by the overall ecological concern for the rainforest's future. Although the Grand Canyon was much closer to Chicago than the Amazon (and more respondents had been there), interviews revealed that it too had a sort of iconic status even with those who had not yet visited. In the Denver sample, the Arizona Desert diorama seemed to be similarly iconic, which may explain why it was the only non-Colorado diorama in that exhibition.

Observation and interview data suggested that place played an important role in many individuals' experiences in diorama halls, although sometimes these connections were not necessarily apparent in conversations at the dioramas. Additionally, place in habitat dioramas seemed to have both geographic and ecological components:

1. Geographic place is the geographic location depicted in the diorama, which may or may not be apparent to visitors. Findings suggested that plants, animals, and landscape features can make a diorama look and feel familiar, even if visitors have never been to that geographic location.

2. Ecological place is the more general habitat portrayed (on which visitors were more apt to focus). Although ecological places can be defined scientifically (Beech-Maple Forest), visitors often connected to them in a more personal or vernacular sense. For example, while the diorama's creators might have intended to depict a specific type of forest, visitors might be reminded of other woodland areas that were personally meaningful.

Furthermore, visitors' connections to place seemed to fall into four not necessarily exclusive categories: personal place, shared place, community place, and "touchstone" place. These could be plotted as concentric circles, with personal place at the center.

- Personal place—A person's own memories of places to which they have been.
- Shared place—Places that members of a group have been together and of which they have shared memories.
- Community place—When many members of a community visit or use a place regularly, it becomes a shared by a larger group (e.g., Chicago's Lakefront). Community places are defined within restricted geographic regions.
- Iconic place—Members of a larger community, perhaps a state or a nation, share some common ways in which they connect to place, even if they have never visited (e.g., the Amazon Rainforest, the Grand Canyon, or the Arizona Desert). These places have some shared meaning, perhaps due to media coverage, learning about it in school, or their status as part of national patrimony (e.g., the Grand Canyon or Yosemite could fit this last category).

4.2 Quantifying Sense of Place at Dioramas

We attempted to measure the extent to which visitors experienced sense of place at habitat dioramas using the instrument described previously in the Measuring Sense of Place section. We adopt the term "Place Bondedness" from Hammitt et al. (2009) to describe connections to place.

Overall, diorama experiences did stimulate measurable Place Bondedness for respondents. Feelings of Place Bondedness, however, differed by diorama; some dioramas stimulated higher scores than others. For example, in the DMNS Museum data, the mean Place Bondedness score for the Arizona desert was 2.5 of 5, while the Loveland Pass mean score was 3.5.

Relationship to Connectedness to Nature Some initial concern existed among the researchers that although we were attempting to measure place-related feelings at dioramas, we might instead be measuring visitors' more general feelings of connection to the natural world. Regression analysis indicated that feelings of Place Bondedness related to Connectedness to Nature in only a few cases. We examined both visitors' overall average Place Bondedness scores and the average values for each diorama. For visitors' average scores, some positive relationship existed between DMNS visitors' overall feelings of Place Bondedness and their Connectedness

to Nature scores ($R^2 = 0.27$). Thus, Connectedness to Nature in the DMNS data accounts for about a quarter of the variance in averaged Place Bondedness within the sample. A positive but much weaker correlation existed between averaged Place Bondedness and Connectedness to Nature for the Field Museum sample ($R^2 = 0.12$). Data suggest that, in general, visitors who felt stronger connections to the natural world were, overall, somewhat more likely to bond with natural places; other factors, however, were in play.

Additionally, when data were disaggregated by individual dioramas the positive relationship between connectedness to nature and Place Bondedness was weak at nine of the ten dioramas in the study. In the DMNS sample, the correlation was strongest for Loveland Pass ($R^2 = 0.24$) and weakest for the Arizona Desert ($R^2 = 0.05$). In the Field Museum sample, Connectedness to Nature was a negligible factor ($R^2 = 0.02$ or below for any diorama). Thus, Place Bondedness for individual dioramas at the Field Museum, and for four of the five DMNS dioramas, was almost completely independent of respondents' overall Connectedness to Nature, and must be explained by other factors. The rest of the analysis examines those factors.

Place of Residence, Prior Visitation, and Familiarity with Place Respondents' feelings of Place Bondedness varied according to where they lived. For example, in the Field Museum data, mean scores for the Chicago Lakefront diorama were higher for Chicago-area residents (3.4) than for all other respondents in the sample (2.4). These differences may have to do with frequency of visitation. Chicago-area residents, for example, were more likely to have visited Chicago's Lakefront more often. It's also interesting to consider that, during the pilot study, the Lakefront was recognized as a community place for Chicago residents. In the DMNS sample, Colorado residents were more likely to have visited Loveland Pass (averaged visitation 3.8) and expressed somewhat greater Place Bondedness (3.5) for this classic Colorado location than did the non-resident sample (averaged visitation 3.2, familiarity 3.3, Bondedness 3.2). Loveland Pass may be a "community place" for Colorado residents but might also be iconic for those outside the state.

While expressions of Place Bondedness tended to be stronger when visitors had some real-world experience with the place portrayed in a diorama, respondents did not need to have visited the exact place depicted to show measurable Place Bondedness. As an example, looking across all five DMNS dioramas, correlations for averaged visitation to the place depicted in the diorama and averaged Place Bondedness had an R^2 of 0.78 while correlation for averaged visitation to a similar place and averaged Place Bondedness had an R^2 of.65 (Fig. 16.1). In other words, it did not seem to matter much whether visitors' real-world experiences were with the exact same place or with a place that looked similar; visiting either one affected their Place Bondedness (Fig. 16.2).

Corresponding correlations for the Field Museum data were lower than those for DMNS (visitation to specific place $R^2 = 0.21$ and visitation to similar place $R^2 = 0.58$). The lower correlation of visitation to specific place may be in part because respondents at the Field Museum were much less likely to have visited the specific places depicted in the dioramas, even those close to Chicago. On the other hand, Field Museum respondents were more likely to have visited places similar

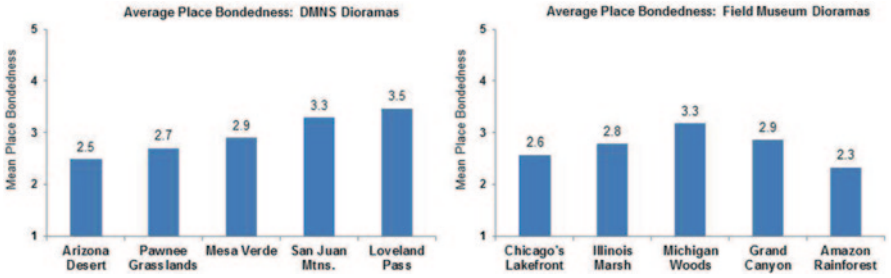

Fig. 16.1 Average place bondedness by diorama

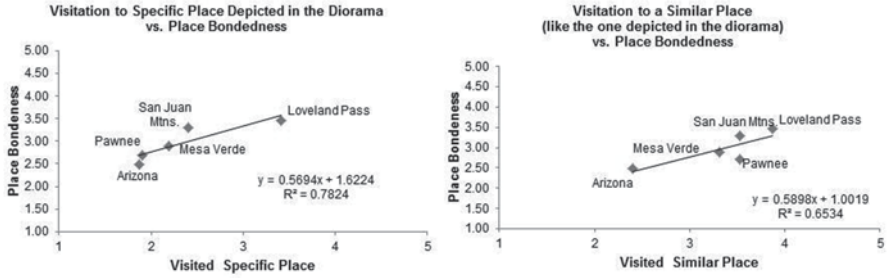

Fig. 16.2 Relationships between place bondedness and visitation for two types of visitations: Visiting the specific place shown in the diorama and visiting place that seemed similar to the visitor

to the ones portrayed in the dioramas, including marshes, woods, and shorelines in other parts of the Midwest, subtropical habitats that reminded them of the Amazon Rainforest, and steep-sided Midwestern canyons reminiscent of Grand Canyon. Therefore, both the absolute values for visitation and the correlations were higher between Place Bondedness and visiting a similar place.

Of course, these mean values do not reflect the variability in scores for individual dioramas, and thus overestimate correlations. When data are disaggregated by individual dioramas, correlations are certainly lower, but visitation still positively correlates with Place Bondedness (although the relationship is not as strong). Clearly, visitation to both specific and similar places played a role in visitors' experiences at dioramas. As we proceeded with the analysis, we needed to decide which measure of visitation to use. Results indicated that for 9 of the 10 dioramas, a simple average of the two measures of visitation correlated more highly with Place Bondedness than either of its components (Table 16.1), justifying its use in these further analyses.

In the DMNS sample, visitation was positively correlated with visitation to the San Juan Mountains and Arizona Desert. Loveland Pass and Mesa Verde also showed positive, although weaker, correlations and Pawnee Grasslands' was lower still. For the Field Museum data, visitation positively correlated with that of the Chicago Lakefront and Illinois Marsh, but the other three dioramas showed weaker positive correlations. That means that even after taking visitation into account, other factors still determine visitors' feeling of Bondedness at individual dioramas.

Table 16.1 Visitation and place bondedness correlations (values) by diorama

	Arizona desart	Loveland pass	Mesa verde	Pawnee grasslands	San Juan Mtns.
Visitation(specific place)	0.21	0.19	0.15	0.12	0.20
Visitation(similar place)	0.18	0.16	0.13	0.15	0.30
Visitation(average)	0.23	0.20	0.20	0.18	0.33
	Amazon rainforest	*Chicago lokefront*	*Illinois marsh*	*Grand canyon*	*Michigan woods*
Visitation(specific place)	0.03	0.31	0.15	0.12	0.06
Visitation(similar place)	0.13	0.34	0.25	0.16	0.17
Visitation(average)	0.11	0.39	0.28	0.19	0.19

Table 16.2 Place familiarity and place bondedness correlations (R^2 values) by diorama

	Arizona desart	Loveland pass	Mesa verde	Pawnee grasslands	San Juan Mtns.
Familiarity(with place or similar place)	0.60	0.57	0.38	0.54	0.49
	Amazon rainforest	*Chicago lokefront*	*Illinois marsh*	*Grand canyon*	*Michigan woods*
Familiarity(with place or similar place)	0.39	0.53	0.48	0.40	0.36

While real-world experience at a place (or a similar place) seemed important in establishing feelings of Place Bondedness, some respondents expressed at least some measure of Place Bondedness for places which they had never visited but with which they felt familiar. Examining the averaged scores across dioramas, Familiarity with Place was highly correlated with Place Bondedness, with an astonishing R^2 of 0.97—perhaps in part because ways exist to get to know a place without actually visiting it (e.g., television or other media). Again, when data are disaggregated by diorama, correlations were lower but moderately positive (Table 16.2).

Familiarity with place, in fact, was more highly correlated than were any visitation variable. Thus, while visits to the actual or a similar place account for a portion of the variation in visitors' expressed Place Bondedness for the locations depicted in the dioramas, it is not the only factor. Place familiarity showed the strongest relationship to Place Bondedness across the full range of dioramas in the study. On average, visitors expressed stronger feelings of Bondedness for places that felt more familiar to them, even if those places were, like the Grand Canyon, and Amazon Rainforest, far from home and rarely—if ever—visited.

It seems that familiarity is likely shaped by factors other than visits to the actual places. These factors may include exposure to a place through some other mechanism—such as television, learning about it in school, or perhaps even visits to diorama halls.

It appears that a complex set of factors contributed to visitors' feelings of Place Bondedness for the places depicted in the dioramas and their influence varied depending on which place was depicted. Findings suggest that Bondedness for the sorts of places depicted in habitat dioramas may develop through interactions between several positively related factors: visits to the place depicted, visits to places that look similar, and familiarity with place (which can be developed, in part, through indirect experience).

4.3 Intensity of Experience and Depth of Outcomes

While we did not directly observe visitors' experiences at the dioramas and the outcomes of those experiences after the pilot phase, the Intensity of Experience and Depth of Outcomes scales, were intended to help us understand the relationship of these factors and their roles in Place Bondedness.

The data suggested that visitors' intensity of experience and the depth of outcomes at a diorama correlated positively with their feelings of Place Bondedness for the place depicted. It was unclear, however, to what extent other variables, such as visitation and familiarity, also played roles in visitors' experiences with the dioramas.

At DMNS, a strong positive relationship existed between the average Place Bondedness score for the dioramas and the averaged scores on the Intensity of Experience scale for the dioramas ($R^2 = 0.88$). Respondents with higher average Place Bondedness scores for the five dioramas were also more apt to report reading and talking about the dioramas, remembered more of their own outdoor experiences, and imagined visiting the place shown in the diorama. For the five DMNS dioramas, average Place Bondedness and average Depth of Outcomes also strongly correlated ($R^2 = 0.79$), meaning that respondents with higher average Place Bondedness scores were more apt to report learning a lot about the place, wanted to visit it soon, and felt more connected to it. Average visitation, however, also strongly correlated with both intensity of experience ($R^2 = 0.88$) and depth of outcomes ($R^2 = 0.70$) Additionally, place familiarity also positively correlated to intensity of experience ($R^2 = 0.81$) and depth of outcomes ($R^2 = 0.66$). The interrelationships here are strong and it is difficult to tease out their relative effects through this sort of analysis.

Field Museum data also indicated strong positive relationships between Place Bondedness and respondents' scores on the Intensity of Experience scale ($R^2 = 0.88$), but a very weak correlation between Place Bondedness and Depth of Outcomes ($R^2 = 0.06$). The relationship between Familiarity and Intensity of Experience showed moderate correlation ($R^2 = 0.39$). Furthermore, the relationships between Visitation and Depth of Outcomes and Familiarity and Depth of Outcomes were actually negative ($R^2 = 0.22$ and 0.13, respectively).

Clearly, we need a nuanced explanation for the differences between the two museum data sets. It seems likely that the DMNS sample contained a robust feedback loop between Visitation and Place Bondedness. Many places depicted in the dioramas are within a day's drive for many respondents in our sample: 86% of them live in the state of Colorado. Perhaps those who feel bonded to the real place depicted in the diorama are more likely to visit that place, which may deepen feelings of both Familiarity and Place Bondedness. There is support for this explanation in the sense of place literature (Hammitt et al. 2009). The results suggest that these relationships might be taken a step further in diorama halls, with the interrelated variables Visitation, Familiarity, and Place Bondedness exerting positive influences on visitors' experiences and outcomes at dioramas.

In comparison, the dioramas in the Field Museum sample included both regionally accessible places (in Illinois and Michigan) and places (Grand Canyon and the Amazon) a thousand miles away or more but that, in the pilot study, were revealed as iconic locales among Field Museum visitors. What could have been a simple set of interrelationships seems confounded by the two iconic dioramas. Visitors were apparently interested and intrigued by these iconic places despite the fact that they had never been there and were less familiar with them than with Midwestern habitats. Therefore, in the Field Museum sample, the Depth of Outcomes relationship was reversed from what we would expect based on the DMNS sample. Field Museum visitors were more apt to report that based on their experiences with the Amazon and Grand Canyon dioramas, they learned a lot, wanted to visit, felt more connected to these distant places, and were more apt to say that diorama was one of their favorites.

4.4 Preferences in Outdoor Experiences

Looking at average scores for the whole sample of respondents, the Preferences in Outdoor Experiences scale related weakly, at best, to the over variables in the study. At DMNS, for example, visitors' Preference scores showed little correlation to their average Place Bondedness scores ($R^2 = 0.01$), a weak negative correlation to Connectedness to Nature ($R^2 = 0.10$), and an even weaker negative correlation to average Visitation for the five dioramas ($R^2 = 0.04$). At the Field Museum, the Preferences in Outdoor Experiences scale showed a weak negative correlation with Place Bondedness ($R^2 = 0.03$), a somewhat stronger negative correlation with Connectedness to Nature ($R^2 = 0.12$), and no correlation with averaged Visitation ($R^2 = 0.00$).

Since a higher score on the Preferences scale means a respondent feels less overall comfort with outdoor experiences, it makes sense that lower Preference scores would be associated with lower feelings of Connectedness to Nature. The very low correlations with Place Bondedness and Visitation, however, are hard to interpret. Perhaps the context in which the surveys were administered (a climate-controlled diorama hall) may have influenced responses. Dioramas might remind visitors of some outdoor discomforts such as mosquitoes, but except for visitors with extreme phobias, this was not enough to register on the Preferences in Outdoor Experiences

scale. (Perhaps we chose to measure the wrong discomforts or asked the questions in the wrong way. Either way, the Preferences in Outdoor Experience scale as implemented in this study had little predictive value.)

Conclusions

This exploratory research set out to investigate the role of sense of place in visitors' experiences at habitat dioramas. Data indicated that visitors to both DMNS and the Field Museum did express feelings of Place Bondedness for the dioramas in this study. These feelings varied across the range of dioramas and between the two museums.

A complex set of factors contributed to visitors' feelings of Place Bondedness, and the effects of these factors varied depending on the place depicted at the diorama. Familiarity showed the strongest relationship to Place Bondedness, and this relationship held across the complete range of dioramas included in the study. On average, visitors expressed stronger feelings of Bondedness for places that felt more familiar to them, even if those places were, like the Grand Canyon and Amazon Rainforest, far from home and rarely, if ever, visited. This finding is encouraging because familiarity may be a factor where museums can contribute through a range of experiences (dioramas, programs) and, along with other media, help visitors become more familiar with a wide range of natural places which they may never visit.

When dioramas depicted places closer to home, visitation often (but not always) played a role in visitors' expressions of Place Bondedness. On average, visitors expressed stronger feelings of Bondedness for places where they had first-hand experience, whether at the exact place depicted at the diorama or a similar place of which the diorama reminded them. While visitation may seem beyond the reach of what diorama halls can influence, this may not be the case. Respondents in our sample indicated that they imagined what it would be like to visit the place depicted in the diorama (average ratings were DMNS = 3.4 and Field = 3.6, using a 1–5 scale) and provided moderately strong ratings that the experience made them feel that they wanted to visit that place soon (average ratings were DMNS = 3.4 and Field = 3.2). Two factors that, at least in this study, seemed less important in developing sense of place were overall feelings of connectedness to nature and visitors' feelings about the discomforts of outdoor experience.

Data analysis is continuing, and the next step will be to conduct statistical analyses that allow us to understand the complex interrelationship between multiple variables. Additionally, as this was a first attempt at adapting Sense of Place and related scales developed for outdoor experiences to diorama-based ones, we hope to further refine and validate the instrument. Current findings suggest, however, that Bondedness for the sorts of places depicted in habitat dioramas develops through interactions between several positively related factors, including (1) visits to a specific place depicted or similar places and (2) overall familiarity with the places portrayed in the dioramas. Furthermore, findings suggest a possible positive feedback loop

among these factors. Results further suggest that visitors' experiences with habitat dioramas contribute to all factors in this loop in that they can increase familiarity with a place, inspire a desire to visit it, and directly help visitors feel more connected to it.

Finally, among the most intriguing findings of this study for exhibit developers emerged, in the pilot phase, from the qualitative data. While interviews revealed that respondents remembered and expressed connections to a place, they did not often share these memories and feelings with others in their group while at the dioramas. It seemed that respondents needed inspiration to talk (or write) about their connections to the places depicted. Exhibit teams might consider finding ways to help visitors talk about their memories of places spurred by their diorama experience, whether they are memories of visits to the same geographic locations shown in the diorama or other place-related memories inspired by their experiences at that diorama.

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Chapter 17
Relics of the Past + People of the Past = Innovation for the Future: Denver Museum of Nature & Science's Enactor Program

Kate Tinworth

1 Introduction

In many great natural history and science museums I have visited over the past several years, classic diorama halls have largely fallen into two categories: (1) abandoned, shabby ghost towns in desperate need of repair and new interpretation or, (2) respite for those attempting to escape throngs of rambunctious, eager youngsters. (Often they are both.) As museums work to keep pace with their technologically savvy twenty-first century visitors, many dioramas have been left as little more than reminders of a museum's past; that is, if they have survived as part of the floor plan at all.

The museum I called home from 2007 to 2013, the Denver Museum of Nature & Science (DMNS), is one precisely like that I describe above. The 104 wildlife dioramas are beloved and known worldwide, representing specific places in the world and capturing the Museum's rich history and compelling story. Many on display since the 1940s, even consistent monitoring by conservators and refreshing by the exhibits department do not seem to infuse them with the vitality and energy they once had.

DMNS has experimented with several ways to enliven its diorama halls; many met with great success. You can listen to the sounds of nature, try on animal ears, touch fur, and see if you can jump as far as a cheetah or impala. There are large, squishy puzzle blocks for children to build up and knock down. Former Chief curator Kirk Johnson, now Director at the Smithsonian's National Museum of Natural History, would go inside the Campbell Island diorama and talk to visitors about nature, ecology, animals, and climate as if he were there. Amongst all the clever, creative things attempted in hopes of bringing visitors into the diorama halls to connect with these beautiful, life-like, deeply educational scenes, the one I have been most surprised by and impressed with has been the enactor program.

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In 2007, DMNS piloted a new programmatic vehicle as a method to reach audiences and enhance the visitor experience in new ways: enactment. Typically a vehicle of history-based museums, festivals, and sites, DMNS saw potential in the technique. The enactor program began with the arrival of a temporary exhibition on Benjamin Franklin (*Benjamin Franklin: In Search of a Better World*) and continued throughout the run of *Titanic: the Artifact Exhibition* (also temporary, 2007–2008). A program evaluation was designed to assess qualitative and quantitative outcomes of the enactor program. Combining visitor engagement, education, and interaction appeared to have dramatic effects; evaluation would test whether the experience truly influenced and changed the visitor experience.

The study showed that the program was successful in both meeting and exceeding its objective and goals, as well as being highly regarded both by visitors and those who work within the program. The study attracted national interest to and recognition of the program. It was time to take enacting into the dioramas.

2 Enacting in the Dioramas

Starting in the summer of 2008, the enactor program took to DMNS' diorama halls. Aligned with the 100th anniversary of the Museum, the enactor team began to portray turn-of-the-century characters to engage and educate visitors in the dioramas and permanent galleries. The characters, which have continued to change and evolve as the program has developed, started with the following descriptions:

- **Miss Margaret Winters** is a club woman, one of a growing number of women in the early 1900s who got together to study nature and promote conservation. Miss Winters can often be found sketching birds or flowers in the dioramas and teaching visitors about how to observe nature. Knowledgeable of women's emerging role in the natural sciences, you many hear her encouraging young people to be part of this "new" movement.
- **Miss Florence Epp** is a young adventurer who grew up in Africa. She draws inspiration from her late 1800s counterparts, Mary Kingsley, Isabelle Eberhardt, and Gertrude Bell, women who explored foreign lands and studied indigenous cultures. Miss Epp is most at home in the Botswana Hall, telling stories and teaching games from Africa and showing her collection of "money cowries."
- **Mr. A. J. Rappaport** is a freelance reporter from Leadville Colorado, here at the Museum to write an article about the brand new Colorado Museum of Natural History and possibly attend the 1908 Democratic National Convention. You'll usually find Mr. Rappaport showing visitors photos of the original building and dioramas, and discussing the natural sciences and new inventions while taking quotes "for posterity" (Figs. 17.1 and 17.2).

Fig. 17.1 Enactor program in the diorama hall: Mary Jane Bradbury portraying Miss Margaret Winters and interacting with a young visitor. Reprinted with permission from the Denver Museum of Nature & Science

Fig. 17.2 Michael Parker portraying Mr. A.J. Rappaport. Reprinted with permission from the Denver Museum of Nature & Science

The enactor program established several goals for their work in the diorama halls prior to the study:

1. To bring attention to the richness of the dioramas and to the individual objects/specimens within them.
2. To connect the visitors to those dioramas and objects through discussion and participatory activities.
3. To allow visitors to chose their level of involvement and to have the opportunity to drive the direction of the discussion content.
4. To make the experience personally relevant to the visitors by putting them at the center of the interaction, having them participate rather than just observe.

5. To enrich visitors' understanding of the themes, concepts, and content of the exhibit and of the Museum.

Several evaluation methods employed—including visitor surveys, observation, tracking and timing, and enactor focus group—shed light on these goals.

3 Surveys

Ninety-two ($n=92$) visitors were approached while exiting the diorama halls in August and September of 2008 and asked to complete a 2-page self-administered survey. This survey mirrored that used in the *Titanic* study to allow for comparisons. Fifty-four ($n=54$) of those sampled had interacted with an enactor in the diorama halls, while thirty-eight ($n=38$) had not. It is important to acknowledge these small sample sizes while interpreting the results below.

Visitors were first asked why they chose to visit the diorama halls on the day of their Museum visit. Visitors cited many different reasons, including interest in wildlife, finding the halls in the course of their visit, looking for the gnomes painted in the diorama backgrounds, and entertaining/educating children in the visitor group. One visitor specifically mentioned the enactors as the reason for visiting the diorama halls (and referred to them by their characters' names), as they had interacted with them on a previous visit.

The goals defined for the enactor program in the diorama halls, as well as previous renditions of the program in temporary exhibitions (i.e. *Franklin* and *Titanic*), point to the program providing powerful, unique, and personal and/or meaningful experiences for visitor. Visitors indicated how the dioramas felt to them in these three areas. Though not statistically significant, **visitors who interacted with an enactor denoted more powerful, unique, and personal and/or meaningful experiences** in the dioramas than did visitors who did not encounter the enactors.

Similarly, visitors were asked to indicate whether they perceived changes in a variety of areas after visiting the diorama halls. These areas included: (**1**) **knowledge about how humans have affected wildlife and natural habitats;** (**2**) **connection to the diorama halls in a personal and meaningful way;** (**3**) **being informed about cultural uses of plants and animals;** (**4**) **being aware of the Museum's history; and** (**5**) **familiarity with methods of preparation and display, and how they have changed over time.** Again, these areas were based on the goals and objectives outlined for the enactor program. Though not statistically significant in most cases, visitors who interacted with an enactor indicated greater positive changes in four out of five of these areas compared to visitors who did not encounter the enactors. In the area of feeling more "familiar with methods of preparation and display, and how they have changed over time," visitors who interacted with an enactor felt significantly ($t(86)=-2.798$, $p=0.006$) more familiar than those visitors who had no enactor interaction.

Though all but two visitors surveyed did not expect to see enactors in the Museum, many were affected by their interactions with the enactors and commented on their experiences. Below are quotes taken from the survey responses, where visitors

were asked how their/their group's interaction with the enactor in the diorama halls affected their experience and what any children or teens in the group thought about the interaction.

- Awesome! We loved all the information and learning from the actor!
- Excellent! She was delightful and VERY informative.
- I enjoyed it. He was very good & I learned more about the museum itself than I expected.
- I loved it-if it weren't for the little ones I would have stayed longer!
- It made me & my daughter want to spend more time looking at the detail of the dioramas.
- It was fun and unique. We learned some things we wouldn't have noticed on our own. He was also good at interacting with young children.
- My children were more curious and inquisitive. I enjoyed the interaction myself. Made it more lifelike.
- That is the very best way to learn history. She is passionate about the period that she represents.
- [The children] love the actors. They want to come back every day to look and talk with them. They and I learn something new every day.
- Wonderful addition to diorama experience-helps one to consider diorama from new perspectives. Good learning experience. I hope the "actors" continue to interact with public.
- [My child] wanted to bring the actor to every exhibit!
- [My child] was involved and you can tell he understood
- If the actors weren't there the students would have just looked & left.
- [The children] loved him. They will probably talk about him for a long time.

Though anecdotal, these responses are indicative of the successful implementation of many of the enactor program goals. **All fifty-four of the visitors who interacted with the enactors wrote in positive comments about their interactions—stressing in particular the uniqueness, educational value, interactive element, and personal relevance/connection that the interaction brought to their Museum experience. Additionally, the visitors spoke to the ability of the enactors to interact effectively with children**.

Over two-thirds of those visitors surveyed who had interacted with an enactor indicated that they felt using enactors in the Museum was a "fantastic" idea; the remaining visitors felt it was a "good" idea. When asked why enactors are part of the diorama halls, most visitors surveyed felt that the enactors were there to provide information about the dioramas (i.e. the wildlife, habitats, etc.). More than half of visitors also cited that the enactors were part of the diorama halls to show visitors history (i.e. what life was like in the early 1900s), to entertain, to make the dioramas feel more real (like you're there), and to help visitors find their way through the dioramas. It was not commonly thought that the enactors were there to surprise and/or shock the visitors. Table 17.1 outlines these reasons.

Finally, visitors surveyed were asked a variety of demographic questions. Due to the limited sample size, the following demographics apply to the full sample ($n=92$) rather than addressing groups of visitors who did or did not interact with

Table 17.1 : Reason for enactors

Reason for enactors	# of visitors	% of visitors
Give information re: dioramas	51	94.4
Show history	43	79.6
Entertain	38	70.4
Make dioramas feel "real"	33	61.1
Help visitors wayfind	32	59.3
Teach about conservation, etc.	26	48.2
Surprise/shock visitors	18	33.3

enactors separately. Approximately 70 % of visitors sampled had been to the Museum before and approximately one-third were members. One-fifth of the sample had seen actors utilized either at DMNS or another Museum before. Examples included at the *Titanic* temporary exhibition at DMNS, within DMNS' permanent space science hall (*Space Odyssey*), and at historical sites such as civil war battlefields. Most of the sample was female (approximately 73 %), fell between the ages of 25–54 (76 %), and self-identified as Anglo/White (84 %). (These statistics are comparable with most of the Museum's evaluations.) The majority of visitor groups had 1–2 adults and 0–2 children.

4 Observation

Forty-two ($n=42$) visitor groups (126 visitors total) were ***observed interacting with the enactors in the diorama halls*** over a three day period. Each enactor was observed for 4 h (10:30AM–2:30PM, which included a lunch break). The observation component of this study was conducted primarily to gather qualitative data, however several key elements were identified and tracked throughout the sample of visitor groups to address the goals and objectives of the enactor program (as outlined in the Introduction).

Almost Three-Quarters of the Sample (n = 31/42; 73.8 %) Demonstrated Close Examination of the Dioramas This included elements such as pointing out animals/plants and discussing elements of the dioramas. This may be linked to Goal 1: To bring attention to the richness of the dioramas and to the individual objects/specimens within them; Goal 2: To connect the visitors to those dioramas and objects through discussion and participatory activities; and Goal 5: To enrich visitors' understanding of the themes, concepts, and content of the exhibit and of the Museum. The following are examples from the observations:

- Two boys and their father spoke about the grasslands in a diorama in relation to a topographical map that was in front of the diorama.

- A family group closely examined a diorama's grass after the enactor explained that keeping the grass short is better for grazing (i.e. more nutritious).
- The enactor pointed out nocturnal animals to a group of adult visitors. They examined the diorama closely and noted that the watering hole was muddy and that the aardvarks could feed on the termites.
- The enactor encouraged a young visitor to look closely at the diorama to find a very well camouflaged frog. The child successfully found the frog after close examination.

Approximately One-Third of the Sample (n = 15/42; 35.7 %) Demonstrated a Personal Connection to the Dioramas This included a visitor relating the interaction they had with the enactor or the diorama to themselves or their group. This may be linked to Goal 4: To make the experience personally relevant to the visitors by putting them at the center of the interaction, having them participate rather than just observe. The following are examples from the observations:

- An adult visitor commented that his brother lived in Alaska and hunts/mounts animals; he pointed out the similarities and difference with taxidermy.
- A family group noted that their house was built in 1908—the same time the enactor was from.
- A mom at the Museum with her husband and three children related a story about symbiosis that they had seen with a tree and a bird.

Just Under Half of the Sample (n = 20/42; 47.6 %) Travelled While Interacting with the Enactor in the Diorama Halls This means that a visitor group went to more than one diorama or hall with an enactor as part of their interaction. This may be linked to Goal 2: To connect the visitors to those dioramas and objects through discussion and participatory activities; Goal 3: To allow visitors to choose their level of involvement and to have the opportunity to drive the direction of the discussion content; and Goal 4: To make the experience personally relevant to the visitors by putting them at the center of the interaction, having them participate rather than just observe. The following is an example from the observations:

- A group started their interaction for 2 min with the enactor at the front-entrance to the diorama hall, and then continued inside the hall—spending 11 min at a grasslands diorama and then four more minutes at a river diorama.

About a Quarter of the Sample (n = 10/42; 23.8 %) Addressed Conservation or the Human Effect This included a comment or question connected to conservation or the human effect on habitat or wildlife. This may be linked to Goal 1: To enrich visitors' understanding of the themes, concepts, and content of the exhibit and of the Museum; Goal 2: To connect the visitors to those dioramas and objects through discussion and participatory activities; and Goal 5: To enrich visitors' understanding of the themes, concepts, and content of the exhibit and of the Museum. The following are examples from the observations:

- A family group talked about the effect poaching elephants for exhibits and dioramas might have had on the elephant population.

- A family group discussed how human's created dioramas as a form of conservation—at one time it was the only way to be exposed to other parts of the world and certain animal species.

Over Two-Thirds of the Sample (n = 28/42; 66.7 %) Addressed Museum History Museum history included a comment or question related to the historical context of their experience, the diorama, or visiting the Museum when the visitor was younger. This may be linked to Goal 2: To connect the visitors to those dioramas and objects through discussion and participatory activities; and Goal 4: To make the experience personally relevant to the visitors by putting them at the center of the interaction, having them participate rather than just observe. The following are examples from the observations:

- A little boy was very excited to see old photographs of the Museum from 100 years ago and noted that some of the old architectural features could still be seen today at the Museum.
- Another young boy wanted to know about the Museum's atrium and asked if the Museum was two separate building that they joined together.
- A family group compared an old floor plan to the Museum's current layout.

Three-Fifths of the Sample (n = 25/42; 59.5 %) Demonstrated Critical Thinking Within Their Interaction With Enactors in the Diorama Halls This included any comments, questions, or conclusions demonstrating assessment or analysis; it also included debating with the enactors. This may be linked to Goal 2: To connect the visitors to those dioramas and objects through discussion and participatory activities; Goal 3: To allow visitors to choose their level of involvement and to have the opportunity to drive the direction of the discussion content; Goal 4: To make the experience personally relevant to the visitors by putting them at the center of the interaction, having them participate rather than just observe; and Goal 5: To enrich visitors' understanding of the themes, concepts, and content of the exhibit and of the Museum. The following are examples from the observations:

- A young boy used the enactor's old-fashioned binoculars to find prairie dogs in the diorama. He found baby birds in the grass and deduced that they must nest there because there was no tree nearby. He also asked, "How old are these binoculars? I think you need to polish them!"
- A young girl deduced that the watering hole in a diorama must be clean and safe to drink from, as the animals within were drinking from it.

Three-Fifths of the Sample (n = 24/42; 57.1 %) Demonstrated Enthusiasm This included enjoyment or enthusiasm shown during the visitor groups' interaction with the enactor, or a comment made following the interaction. This may be linked to Goal 2: To connect the visitors to those dioramas and objects through discussion and participatory activities; Goal 3: To allow visitors to choose their level of involvement and to have the opportunity to drive the direction of the discussion content; and Goal 4: To make the experience personally relevant to the visitors by putting them at the center of the interaction, having them participate rather than just observe. The following are examples from the observations:

Table 17.2 Interaction with the enactors

Element demonstrated	# of visitor groups	% of visitor groups
Close examination	31	73.8
Museum history	28	66.7
Critical thinking	25	59.5
Enthusiasm	24	57.1
Past/present connection	22	52.4
Travel	20	47.6
Personal connection	15	35.7
Conservation/human effect	10	23.8

- A little boy followed an enactor around eagerly, even after the interaction had ended, and continued to ask the enactor questions.
- A young girl wanted to show the enactor all the different animals she could find and identify in a diorama.
- A dad commented that he would be bringing his children back the following week to find the enactors again. He commented, "This is very educational."

Over Half of the Sample (n = 22/42; 52.4 %) Demonstrated a Past-to-Present Connection Past-present connections included connecting a past, historical issue with a present, current issue, or a future, similar issue. This may be linked to Goal 2: To connect the visitors to those dioramas and objects through discussion and participatory activities; Goal 4: To make the experience personally relevant to the visitors by putting them at the center of the interaction, having them participate rather than just observe; and Goal 5: To enrich visitors' understanding of the themes, concepts, and content of the exhibit and of the Museum. The following are examples from the observations:

- A family group discussed with the enactor how taxidermy methods had changed in the last 100 years, including how some things used then (I.e., arsenic) were considered safe and now are not.
- When asked by the enactor if they arrived at the Museum by train, a family group explained, "No, by Chevrolet." They then talked about changes to travel and transportation over the years.
- The enactor explained to a family group that gold mined in Colorado 100 years ago was now in the Museum's Gems and Minerals hall; the family decided they would head there next to see it.

Table 17.2 provides an overview of the number and percentage of visitor groups in the observed sample ($n = 42$) who demonstrating the above elements within their interaction with the enactors in the diorama halls.

Forty-two visitors groups is a relatively small sample size. It is notable, however, that five out of eight highlighted elements linked to programmatic goals were observed at rates over 50 %, and none were observed in less than 20 % of the visitor groups.

In addition to the specific elements identified in the visitor group observations, demographic collection was collected. Over two-thirds ($n = 28/42$; 66.7%) of the observed visitor groups had children as part of the group and these children were part of the enactor interaction. Many of these children were young (under 5 years old). The enactor program may provide a way for young children (including those who do not yet read) to have an educational, meaningful, and interactive experience in the dioramas without relying entirely on verbal and written language (i.e. signage).

Nineteen percent ($n = 8/42$) of the visitor groups included non-Anglo visitors. Three (7%) of these groups spoke English as a second language, or were monolingual, non-English speakers. This percentage is similar to that of the Museum's visitation overall, however the enactor program may provide a way for visitors with limited English language to, as above, interact in a way that is less reliant on verbal and written language (i.e. signage).

5 Timing

A random sample of 50 visitor groups in the diorama halls were tracked and timed to establish how long, on average, Museum visitors spend in diorama hall/area when enactors are not present. None of the visitors observed saw enactors or interacted with them. While the time visitors spent in a diorama hall varied greatly (from 37 s to just over 20 min), on average visitors spent about 4 ½ min (4:36). As a comparison, 42 visitor groups who *did* interact with an enactor in the diorama halls were tracked and timed. Again, while the time visitors spent in a hall varied (from just over 1 min to just under a half an hour), on average visitors with enactor interaction stayed in a diorama hall for almost 8 min (7:50). While a 3 ½ min difference may not seem substantial, **time spent in the dioramas almost doubles when visitors interact with the enactors.**

Equal variances in both groups assumed, the time spent by those who interacted with an enactor is a significantly greater amount of time ($t(90) = -3.073$, $p = 0.003$) than that spent by those who did not interact with an enactor, indicating a **statistically increased likelihood of visitors spending longer in the diorama halls if there was enactor interaction**. This result may have several implications, including that identified as Goal 5 of the enactor program within the dioramas: To enrich visitors' understanding of the themes, concepts, and content of the exhibit and of the Museum. This idea has been noted by the enactors themselves since the inception of the enactor program; those who have a personal interaction with an enactor may connect at a deeper level, perhaps due to the enriched powerful, personal, and unique opportunities intrinsic to the experience. This may lead to greater time spent inside the exhibition (*dwelltime*). The reverse hypothesis was examined; I.e., Were those who spent longer in the diorama halls more likely to speak with an enactor? The results were not statistically significant, indicating that it is the interaction that leads to greater time spent in the diorama halls, rather than greater time in the halls leading to interaction with an enactor.

6 Enactor Focus Group

In order to supplement the data collected from and interactions observed with visitors, the three enactors who worked within the diorama halls during the study participated in a focus group. Several key themes came out of the focus group**: (1) enactment as unique; (2) enactment as educational; (3) enactment as empowering; and (4) enactment as limitless.** Examples of each theme are provided below, in the enactors' own words. Additionally, the enactors provided insight on potential ways the program could evolve.

6.1 Unique

"Not only are you unique as the enactor in the diorama hall … each person coming to visit with you, to see you, is having a specific and unique experience in themselves…. The enactor program is specified towards each individual, each new family, and each new school-group. It is all specified toward them. That is unique in itself. No other program can be as specific with each single person that you see in a day."

"Last week I had a little boy who was deaf…. He was 7 years old, so he was young, and goes to school for the hearing impaired but his little eyes would just light up. And there was a barrier there of language because he couldn't hear me so he had to have a translator and yet she would translate for him and he would give me answers and things and I just found myself completely fascinated that with that one barrier between us we could still connect with the story and what you could see."

"I have had many experiences like that with people who speak Spanish and had the translating and I had a Japanese girl who had a translator. I use Swahili and I learned Japanese and Spanish and teach them the Swahili and it was fascinating how that hook, that uniqueness about it, allowed for us to teach each other; not only with language but also with seeing differently."

6.2 Educational

"For me the hook is the fact that that group then gets to be an expert to be. They get to teach you. And most of the time when you come to the museum you don't get to teach people."

"If you give a person a chance to be the expert they learn so much and I think that that is what really makes my interactions with the visitors unique."

"We can, as characters, come without being condescending—down to a 3 year old's level because it's new and different to us too. Everything is new and different to us."

"What is great is the ability that they can teach you which then allows then for you in turn to teach them."

"I personally know that I teach the young ones how to look for things in the dioramas and how to use what I call their 'scientific eye.' 'Use your scientific, discerning eye to find things now.' And sometimes I start them with the little elves and gnomes in [the dioramas]; but then I say, 'I will show you where the gnomes are but then we must have some scientific inquiry about the diorama.' And they are willing to play that game and then I teach them how to sit there and really enjoy and look and really know what they are looking for."

"I can go and say the exact same thing that is on that sign in a different way and then they are interested and it becomes interactive and their eyes are open and their ears are open."

"One of my favorite stories … is this little girl, Ella. We were talking about the Acacia tree and I was talking about the properties of the gum and how it has its great healing properties. And she was so excited because she had this new gum she just got at the store and it was Bubble Tape and she rolled the gum out and asked, 'what tree is this from?' It was a great teaching lesson because I had told her that that gum was from a tree and we talked about where the gum came from and I had to taste it and … she asked, 'does yours taste this good?' And the next week, the very next week, she is charging down the hall … I mean you could hear the little pitter-patter of feet running down and … here comes Ella, running like I've never seen anyone and she's holding a York Peppermint Patty and she yelled … 'I brought another one! What tree is this from?' And it was so wonderful; we had this whole conversation about cocoa and mint …"

6.3 Empowering

"There was this group of probably 15 middle school girls and they just wanted to know everything. They wanted to know my whole back-story they wanted to know everything about me because I was an explorer. And they wanted to know about my father and how I got to Africa. I was a young girl travelling the world and none of them had ever been outside the U.S. It just sparked an interest that I want to do that, I want to be there; I want to be there and do that."

"We started talking about … the Democratic National Convention and mentioned that women were allowed in and isn't that amazing. And they started to talk about Barack Obama and the ability to have a black president …. We had a great discussion…. And they were engaging me and telling me about the sisters who walked the streets of Denver to get the women's right to vote—the suffrage sisters—and how important they were. And they stayed with me, and that was one of those really unique experiences, where these young ladies were telling me … empowering themselves as women…. And just seeing how empowered they became talking about the past. It was pretty cool."

6.4 Limitless

"And with the diorama hall it's everything. It's everywhere, everything—you have no idea of where your conversation is going that day. You have your character, you have your time, you have your props but you don't know where it's going to lead you."

"I think there's a lot of opportunity for enactors. This shows the diversity of where you can go. If you are talking politics and social issues one minute and you are teaching geography the next there is such a vast range that sort of generic but defined character can cover depending on where people want to go."

6.5 Program Development

The enactors spoke extensively about what they felt would be important and, in some cases, necessary to further the development of the program. In particular, having an area or space within the Museum where visitors could locate the enactors was highlighted, as was setting up set times for programming (i.e. storytelling) and increasing the number of enactors per day. Below are examples of the enactors' perspectives on program development.

"I think it is very effective for us to be in the diorama halls … and the history and science of it. But there is something … I don't know if it is space that needs to be created in the Museum; I don't know if it's a historical cabin or what it is … but some type of location where it is a 'stage.' I hate to use that word in this form, but a room that is more open. If you are wanting to enhance a program and make it larger and stronger, I think having a location that you can go to, to hear the stories, is important."

"Say you came in and you are on the floor for a little bit saying, 'I am going to be telling these stories would you come and visit me at my cabin.' Then you go do that and say, 'if you want to come with me I can show you; I am telling you a naturalist story.' I think in the course of the day we could come out in the hall."

"I do think it's important that we do remember that we are a part of the visitor program team because otherwise I think we become separate. I would hate to see it become separate from the regular programming. So that's why I think if we can go in other areas of the museum we can do storytelling or just infiltrating other areas I think it becomes part of the program of the DMNS. And if you can work your way to doing shows in those other areas that would make the program stronger as well."

"The hard part would be to have someone cover you because literally there is only one person per day."

"We are kind of coming up with a template. I think anybody in this program has got to be a uniquely motivated person. The books by my bedside are six-deep on natural history and that is all not on the clock."

"It is a different job. In a sense it is very much what like visitor research programs does now. They are hired on to learn the astronaut section and learn what the

effect on Mars is and that is a part of your job description. To say that that's where this program is unique … you could give a script to anyone on the visitor program staff to do a storytelling of Gertrude Bell up in the mummy hall. And that would be part of their programming. That is where the enactor program is completely different because we each have our own characters that are chosen. We know how to engage people specifically, make unique choices, and have them have unique experiences. And it's all different. It is free flowing and it allows for that."

7 Four Years Later: Changes from 2008 to 2012

Four years later, in 2012, I wondered how much had changed in the enactor program as a result of (or in spite of) the evaluation findings. I caught up with Mary Jane Bradbury, who portrayed Miss Margaret Winters when the study took place, and Michael Parker, who portrayed Mr. A.J. Rappaport.

Bradbury told me, "the findings about the enactors at DMNS hold true; changes that have occurred have been a result of trying techniques and tweaking them to be more effective with the work." She explains, "the goals of the program—connecting people with objects and making meaningful experiences—are the same; they deepen as we experiment with more ways of being who we are as characters." In Bradbury's words, "the opportunity to talk with someone in a provocative and interesting way still trumps pushing buttons on interactive video screens." Parker agrees. "Although we have changed the characters several times," he explains, "the methods utilized have, for me at least, remained consistent. The visitor interactions are of a high quality and continue to inspire me as an enactor to increase my knowledge about whatever subject the particular character is concerned with and I believe it is the same for the visitors."

The diorama halls have been particularly inspiring for Parker:

> I have developed a character, Jack Tar, who sailed on the HMS Beagle with Charles Darwin. He tends to stay in the dioramas of: South America, and the South Pacific Islands. Jack talks about the hardships of nineteenth century sailors, as well as the science of evolution, Mr. Darwin, and the fauna and flora in the dioramas. After one encounter a visitor sent an email telling us how his young daughter was enamored with Jack; moreover the encounter inspired him to go back and reread *On the Origin of Species by Means of Natural Selection*. Here is an indication of how the program meets the goals set, not only by the program, but also those stated in the Museum's mission statement.

Though the study is now several years old, the findings and relevance are not. "One goal of the enactor program," Parker prompts, "is to help the learner increase his or her knowledge and understanding of the world around them. There is no doubt that we meet that goal for hundreds of visitors to the Museum every year. Another goal is to bring the diorama halls to life, and again, this goal is met day in and day out."

One example of how the program has continued to expand and evolve is bringing the enactors into Crane Hall, the Native American collection at DMNS. Bradbury

explains, "Dispensing of information can be done by a facilitator without the trappings of costume and character development. A true enactment experience is achieved when the character sticks to his/her story and lets that drive the conversation." Not wanting to be, as she states, "yet another white person attempting to interpret native people history," Bradbury was committed to having a historically accurate, plausible story and sticking to it. That story ("I was one of the well-documented white women of means at the turn of the twentieth century that the new science of anthropology recruited to go into the field and get the stories of the native cultures") allowed Bradbury a unique entry point with visitors:

> Instead of, 'Here's a turtle shell with 13 divisions on its back. Turtle shells reflected for native cultures the connection to the 13 moons of the year, etc., etc.' through story I instead can say 'Ah, I remember when I was living with the Seneca people in New York State and Arthur– a boy about your age, the son of the family I came to know well– he took me with him when he walked along the river one day. There, sunning itself on a rock by the bank was a turtle. Arthur picked it up and explained to me…. well, look here, I have a turtle shell' (here I take a shell from my bag of items, unwrap it, and hand it to the visitor) 'and see these sections? Why, I didn't know it but I have since learned that every turtle has the same number of sections and how that corresponds to the moons….' This allows visitors to question, if they wish, why I was with the people in New York, what I learned there, some natural science about the turtle, and the telling of some of the many native stories about turtles and beliefs around them. All this from the standpoint of Alice – a 1908 white woman learning about the then-new science of anthropology.

Bradbury has incredible stories, including one unhappy, restless young boy with his parents who, through listening to her tell native tales of the turtle shell in Crane Hall, was calmed and so engrossed he did not want to leave. He ran back and asked to see the shell again. Bradbury told another native story about turtles and the boy's father said, "You are the best thing we have experienced all day. I wish there were more like you in the museum."

She recognizes that, "If there is one thing that this craft suffers from it is the reputation that talking to 'people dressed in costume' can be cheesy and silly." Her advice to those who may want to bring enacting into their museums? "Invest in accurate clothing and props. Invest in professionals who are skilled and committed to delivering what your program desires to achieve. Don't try to cut corners. Think the program through and take it seriously, and the results will be outstanding."

Parker recognizes that "spending six hours a day, three days a week" in the diorama halls has made him quite an expert on many aspects of DMNS' dioramas. He tells me, "I can show people the little things that they may have missed, like how to find a certain flower or animal. I often spend ten to 15 min with kids hunting for the hidden treasures." Opportunities like this with visitors can lead to conversations about anything from taxidermy and animal behavior to conservation and climate change. It can also lead to repeat visits. "I had one mother say to Jack, 'I don't care who you are as long as you keep coming back.' She and her teenage daughter had met another one of my characters on a previous visit and came looking for him, but found Jack instead. I have seen this couple many times in the six years I have been wondering the halls, and they are never disappointed with who they meet."

Kate Tinworth is the founder and Principal of ExposeYourMuseum LLC—a boutique consultancy delivering the tools and data you require to better understand current and potential visitors, teams, communities, and audiences. Kate's approach prioritizes making connections, facilitating conversations, elevating voices, engaging creatively, and strong, clear communication to inspire innovation, inform strategy, and drive decision-making. From 2007–2013, she was the Director of the Audience Insights department at the Denver Museum of Nature & Science.

Chapter 18
Storytelling and Performance in Diorama Galleries

Keith Dunmall

Performance and museums are natural partners for educational and interpretive activity. Performance and dioramas both owe a great deal to the theatre and are of the same family, all be it of a different order and species. The wealth of a display can be unlocked either through stories both intrinsic and extrinsic to the artefacts; more direct narrative tours; or conversations in front of and through the diorama. Bringing together diorama, actor and audience creates a space for a new interpretation and understanding of what might at first seem a very still, very quiet, very alien vista. The narratives within the diorama, along with the narratives brought by the audience and any structures supplied by the performers create a new type of museum experience. This is more than standing in front of a diorama talking about it.

Gardner's theory of multiple intelligences has for almost thirty years held open the door for the consideration of different requirements for learners in an educational environment (Gardner and Hatch 1989). Barnes in turn has taken these requirements and applied them to a cross-curricular or interdisciplinarity model of teaching (2007). In museums these theories and models can be brought together in order to appeal to the broad range of leaning styles preferred by their users. With an expectation of museums to be both educative and interesting, performance is used to make the space meet these expectations through being informative and entertaining.

The Powell-Cotton Museum uses performance to provide interaction for our audiences. Rather than the quasi-religious silent or whispered exploration some undertake in the 'temple of the muses' these activities are intended to bring noise and conversation to the space, sometimes to the consternation of the visitor looking for a more contemplative experience. To accommodate our full range of visitors the performances are always part of a day rather than the sole or dominant form of interaction and each is targeted at a specific group. Sometimes the themes are approached separately, sometimes they are mixed. Each approach has specific objectives described below. However each also have the shared objectives of bringing a new vision of the dioramas to our audience and developing new types of interac-

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tions within the museum. The three broad categories of performance are storytelling, diorama narratives and natural history talks.

Storytelling is aimed at a mixed aged audience, under the guise of a children's activity. It takes often familiar tales from a mix of genre including folk and fairy tales, myths and legends and more recent 'children's stories' and links them to the diorama. Remaking the dioramas in the eyes of the visitor into a story offers the possibility for each and any visitor to then go into the spaces and reinterpret what they see. Intergenerational interpretation based around a story permits and encourages adults accompanied by children to frame their conversations in an imaginative and playful way. Facts become less central to the experience and the pressure to provide answers can be redirected into an imaginative response from the child. Children are adept at creating stories from the interactions and hierarchies they perceive in the dioramas. The objective of this type of storytelling is to allow both adults and children to take an imaginative journey through the space, either during the tour or on subsequent visits and use it to answer and stimulate further enquiry either through written interpretation or their own 'research' post visit. The structure of a storytelling tour frequently include dramatized narrative, audience acting out, call and response games, object handling, questions and answers, and craft activity.

On first impression diorama narratives cover topics similar to the traditional arts and history type interpretation familiar from museums, galleries and country houses. The artistic, social, political and economic context of the diorama is explored though describing what can be seen and drawing on source material specific to the diorama, from other primary sources and also secondary research. Two broad categories become evident: stories from the dioramas, and stories of the dioramas. The objectives are to contextualise the diorama. For some audiences this is an essential activity as there is a resistance to taxidermy and an impression among many that the diorama is simply and solely an extension of the trophy cabinet. The approach is to take these events and represent them through performance. These might be quite traditional ticketed events with a stage and paying seated audience that takes place outside of usual museum hours, or within what might otherwise be anticipated by a visitor as a 'tour'. These performances are flexible in both their format and their audiences having been performed for primary school groups, mixed audiences and university students.

Natural history talks tend to link to topic specific subjects for formal groups, or are short public talks to highlight an animal or type of behaviour on display. Although predominantly factual in content they can include both playful and serious techniques for interaction depending on the circumstances of the visit.

1 Storytelling

The Museum has been working with Scandalmongers, a local theatre company, for four years. Initially they introduced site generic storytelling events with linked children's activities. From these we decided to develop museum tours that provided linked storytelling and activities that related more closely to the museum collection.

For one event we took folk and fairy stories and adapted them to link to the diorama. Described to our audience as tours they are in fact promenade performances with the storytellers staying in character.

Another storytelling tour was written with the intention of telling the stories of the objects in the display. They were a mix of factual, traditional and contemporary stories aimed at bringing unusual and possibly unconsidered aspects of the dioramas into focus.

1.1 Fisherman and the Magical Fish

Pushkin's story of the fisherman and the golden fish (1833) is a morality tale around greed. The fisherman catches and releases a fish which as a reward grants him three wishes. In our retelling each wish has a series of consequences and linked environmental themes which escalate negatively until eventually with a final wish things are returned to normal. This story was one that the theatre troop particularly wanted to do as it has a strong visual quality. However with large diorama of African and Asian mammals the fish was a difficult creature to find. From the museum perspective there is so much detail in the dioramas that an opportunity to focus on one of the less obvious specimens presented itself. A land-crab in the savannah and rainforest diorama provided the connection and the story was narrated by one performer while the other mimed the story.

The objectives were to draw people's attention to the detail of the diorama and in particular to one of the more unusual creatures. This heightened 'looking' would hopefully be continued by visitors after the performance. The morality aspect of linking greed to environmental change was also a significant aspect of the activity.

1.2 The Tar Baby

The southern United States stories of Brer Rabbit provide a useful vehicle for telling animal tales and also in linking different storytelling traditions. Originating from the West African Anansi stories Brer Rabbit embodies the trickster character familiar in many folk and legendary traditions. His crossing of the Atlantic and transformation from spider god into a rabbit among a cast of other familiar animals enabled a tradition to be carried on among the slave populations of plantation workers in the United States. After some discussion we decided upon the story of the tar baby and presented it as a narrative from the perspective of the briar patch.

The story begins with Brer Fox creating a person made of Star in order to catch Brer Rabbit. Setting his creation at the side of the road Brer Fox uses the social norms of greeting to trap Brer Rabbit. Once trapped Brer Rabbit pleads with Brer Fox for his own good not to throw him into the briar patch. He points out that it is full of thorns able to tear the flesh and cause pain and suffering. The Fox who has repeatedly suffered at the hands of the cunning rabbit decides that such suffering is what the rabbit deserves and throws him into the patch. The result is that the rabbit's

warning was good as he was familiar with the patch as it was where he grew up and the fox injures himself through trying to recapture the rabbit. The story concludes with a brief retelling of the history of Brer Rabbit's origins in Africa.

The approach of retelling this story from the perspective of the briar patch is key to this particular tale. The diorama contains plants collected from Africa in order to help achieve the 'realism' in the display. By introducing the 'character' of the Briar the objective is to draw attention to the flora within the display. The plants are either from the habitat presented or chosen to provide the sense of the type of plant that might be found. Shifting the perspective of the story shifts the perspective on the diorama. Also the cross cultural aspect identifies the potential for other hidden stories and characters to be identified in the museum and the everyday.

1.3 Naughty Little Monkeys

Naughty Little Monkeys takes characters children might be familiar with from Jim Aylesworth, Henry Cole's alphabet teaching storybook of the same name and puts three of the monkeys into the museum's long diorama of gallery one which displays animals of the savannah and forest. As the monkeys encounter each animal they play little tricks on them until they move from this cabinet to the primate cabinet. Here they encounter the gorilla who tells them to be quiet so his grandchild can sleep. The monkeys then see a tiger (from the next diorama) approaching and throw sticks and stones at it, while making a lot of noise to scare it away from the sleeping infant. The grandfather gorilla comes back and scolds them for making noise again. They tell him about the tiger and he says that there are no tigers in Africa and they are being naughty. They point out the paw print and the gorilla says they have been very brave and for a short while only can make as much noise as they wish.

This format is aimed at younger children either with parents or in a school group. Objectives include naming animals and identifying their habitats and teaching social skills. It applies a story to the space but it is through questioning and call and return that the learning objectives are met. The story provides the framework for the activity.

1.4 Anansi and all the Stories

The Anansi stories draw directly on the traditions and environment of West Africa. The story is adapted slightly so that the key protaganists are animals that are represented in the dioramas. In this tale Anansi approaches Sky God who is the keeper of all the stories and asks for them. His is initially refuse them but after some persistence is set three tasks to perform. Each task is to capture a creature and present it to sky god. The tasks are set because Sky God does not think they can be achieved and therefore he will be left in peace. Anansi successfully captures the Queen of the Termites, The Lord of all Snakes, and the King of the Cheetahs. As a result every story told since has Anansi in it, either as a character or making an appearance in

some way, even if that means making an appearance as a spider in a web in the corner of a room.

The story of how Anansi gets all the stories brings the audience into the narrative process. They get to choose which order Anansi will undertake his tasks and are invited to provide solutions to the challenges he faces. As the story develops there are repetitions, Anansi calling to Sky God and Sky Gods dismissal of Anansi, which enable the audience to join in some of the narration. The characterisation of the animals of the story is used to reflect real aspects of natural history. The voices of the leopard and the snake are respectively growling and sibilant. The response of the termites to rain and their mud home represents the response of termites to this type of environmental hazard.

2 Diaroma Narratives

The next group of performances fall into the two part category of storytelling from the displays. The first group are stories from the diorama. These relate to either the collecting of the specimens by Major Powell-Cotton or to their method of display.

2.1 Stories From the Diorama

Snake and Duiker

While in Africa in 1905 Powell-Cotton recorded in his diary how he observed a group of duiker fighting behind a bush. He shot and went to collect one when he heard the fighting continuing. On arrival he was confronted with a group of Duiker fighting with a Rock Python that was coiled around one of their number. He observed their drama before dispatching the lot and bring them back to recreate the incident in one of his displays.

The story has a dual narrative. The first brings the audience attention to the meticulous collecting and recording done by Powell-Cotton and the second highlighting a type of behaviour generally unknown and unrecorded elsewhere in the museum.

Lion and Buffalo

The Lion and the Buffalo are the centre piece of the second oldest gallery in the museum. Dating from 1907 these two animals are locked in combat. It is a life and death struggle. The buffalo halted mid-charge with its head down while the lion is suspended all four paws off the ground. Forepaw claws and teeth buried into the nose back and shoulder of the buffalo while the rear paws are in the air below the buffalos neck between its lowered head and chest. The buffalo is fixed mid-turn and

has one horn piercing the side of the lion. This taxidermy display is viewable from all sides and as such allows a different impression of the action taking place depending on the location of the viewer.

The accompanying story is layered and threefold. The first examines an African tale of a hungry lion that attacks to eat the first thing to arrive at the waterhole at which it is waiting for its prey. The second layer is of how the animals were collected and that the lion almost killed the collector. The third story investigates the meaning of the display explaining that the buffalo is a type specimen (an animal identified to science for the first time). Bringing together the type specimen that bears the Powell-Cotton name within its scientific name and the lion that almost killed Powell-Cotton locked in a death struggle with the beast exposes an understanding of the dramatic power of diorama.

The stories that surround the Lion and the Buffalo display in the museum present a complex web of linked stories that reach beyond storytelling and provide a full dialogue to develop. Questions of the veracity of this representation of Lion behaviour can be raised and it provides a great example of how people bring their own narratives to museums. Dioramas are an opportunity for museum educators to consider how objects and locations might be open to this type of audience self-expression. Examples of the broader interpretation of the symbolic potential of the Lion and Buffalo range through geopolitical, religious and gender based readings.

The Lion and the Buffalo is a two animal diorama that can be easily adapted to all three interpretive methods, storytelling, diorama narratives and natural history.

2.2 Stories of the Diorama

Stories of the diorama are the contextualising method that explain the specimens not as live creatures or representations of natural history process, but as objects that have undergone a series of collecting processes.

Collecting Mime

We occasionally use mime in order to explain the shooting, recording, skinning, preserving, transporting, taxidermy, and placing of the animal specimen in the museum to school groups. The technique drives the students to generate the narrative and find the vocabulary for what they observe. As they develop confidence they begin to predict next actions and vie to create the best narrative.

Elephant in the Room

This narrative tracks the fate of the largest elephant taken out of Africa. On his return to England Powell-Cotton took it to the taxidermist Rowland Ward of Piccadilly intending to have a half mount made. Once Ward took the measurements it

became clear that the elephant was exceptional and as such should have a full mount to show its size. Once this animal was brought to the museum the display had to be reorganised and walls knocked down to accommodate its size. It is then compared to the elephant on display in the American Museum of Natural History in New York. They have both in their time been the largest elephant in a museum display. Then for scale the viewers are directed to examine their height to that of the leg bones of the elephant on display in another part of the gallery.

Giant Sable Antelope

Through the Giant Sable Antelope the DNA work of the museum can be discussed. It brings the research that takes place at the museum to the attention of the audience through a story that encompasses war, exploration dung and DNA. The important museum conservation message is expressed through the work undertaken both at the time of the collection and the contemporary work that continues on the site.

3 Natural History

Natural History narratives tend to be factually based. Again they provide an excellent method to draw out knowledge from the audience and share the process of discovery.

3.1 Weaver Birds

Weaver birds nests look rather like socks hanging from the branches of a tree and using this as the answer for questions about them bring humour and audience knowledge as the story develops. Labelling them "Giraffe socks" and explaining how they are knitted with sticks held between their cloven hooves and worn only at night, hence never seen on natural history programmes. This misdescription allows for identification of some physiological features of giraffes and enables wrong and absurd answers to be put forward during the theorising phase leading to the correct information.

3.2 Giraffe

The Giraffe also presents an example of increased knowledge through the mistakes made in the past. Simply put, the tongue of the Giraffe is the wrong colour. Other aspects of the physical appearance and activity of giraffe are then explored by acting out. Drinking, walking running and how a giraffe maintains its posture are all assessed through the group taking on various poses to emulate the process they are trying to understand.

3.3 White Rhino

The story of the Northern White Rhino completes the cycle of museum tales presented in this chapter. It begins with basic taxonomic ideas, Why is it called a Rhino, why white? Why northern? It tells the tale of change once Africa was opened up through exploration and colonisation. Animals hidden or unknown to science were identified, in the case of the Northern White Rhino by Percy Powell-Cotton at the turn of the twentieth century, and then either threatened through habitat destruction for farming and industry or poached for food or decorative or medicinal body parts. This dual listing of identifying features brings together different thought systems based around a single subject which has through the museum been transformed into a third system of description: That of the object. The final poignant note being that it seems very soon this animal will only exist in museum and zoo collections.

Conclusion

Stories about dioramas, their specimens and their derivation are effective means of delivering information both biological and cultural to audiences from a diverse range of backgrounds. Delivering the stories through both dioramas and museum theatre, which are natural partners as both have a story to impart in their particular way, provides visitors with more ways of making sense of exhibits. This powerful combination forms a new type of museum experience, much more than standing in front of a diorama looking and commenting.

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Chapter 19
The Diorama as a Means for Biodiversity Education

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1 The Genesis of the Diorama

Museums are, among other things, places of education and communication. Exhibitions serve as the primary communicative link between the museum's collections of objects and specimens and its audience. However, the nature of this relationship has been subject to significant changes over time. As a result, the exhibition as an interface between museum and audience has undergone many transformations and continues to do so.

Historically, natural science exhibitions have mirrored the prevailing science epistemology of the time (Fortin-Debart 2003) (Fig. 19.1). Until the seventeenth century, natural science was characterized by explorations and expeditions, and curiosity cabinets were the physical manifestation of this attempt to inventory the wealth of the world (Van Praët 1996). In this period, there was a one-to-one relationship between what was collected, and what was exhibited. The natural sciences were essentially an exploratory inventory of the diversity and richness of the world, and the exhibition space was simultaneously the storage space of the collected objects (Van Praët 1989).

Later, in the eighteenth century, Linné introduced the new scientific concept of systematic classification. For the first time, his binary and hierarchical system of classification provided a universal basis for botany and later, zoology, with a systematic method guided by precise rules (Delicado 2010). This new epistemology

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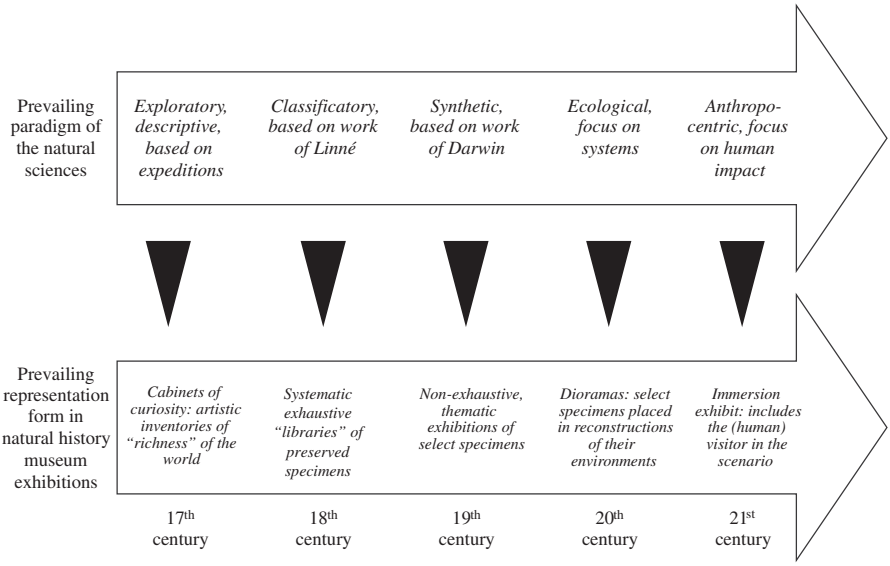

Fig. 19.1 The relationship between the prevailing contemporary paradigm of the natural sciences and the prevailing representation form in natural history museums from the seventeenth century to today

was reflected in contemporary exhibits, where natural objects were now arranged according to taxonomic principles and comprised a general inventory of living beings (Delicado 2010; Van Praët 1996).

In the nineteenth century, the natural sciences underwent another transformation. Disciplines such as botany, zoology, geology and mineralogy arose, and within each discipline, further specialisation resulted in sub-disciplines such as mammalogy, herpetology, and ornithology. Darwin and his theory of evolution through natural selection had perhaps the largest impact on the prevailing epistemology, but other advances were also made which changed the way geological time and dynamics were perceived (Delicado 2010). Processes and interactions became the objects of study, and as a result, exhibitions became reflections of evolutionary succession. The visitors' pathway through the museum became a walk through evolutionary time (Bennett 1995). It is worth noting that the advent of thematic exhibitions marked the first dissociation between the museum collection and the exhibition. The exhibition was no longer an exhaustive inventory of collected objects and specimens, but rather, a spatial organisation of carefully selected items arranged to illustrate certain scientific principles.

Up until this time, the natural sciences and natural history exhibitions had been governed by a principle of *bio-centrism* in which nature was simply understood as the biotic and abiotic components that existed within it (Fortin-Debart 2003). However, in the twentieth century, a rising awareness of systems theory began to influence the epistemology of the natural sciences. As a result, conceptions of ecology and ecological communities appeared in the scientific discourse and were con-

sequently reflected in exhibition themes. A new *eco-centric* exhibit genre, the diorama, appeared as a means to embody the natural interactions between the plants, animals and climate of a given environment (Fortin-Debart 2003). A three-dimensional, life-sized, simulated environment in which models or taxidermied animals were placed in an ecological context, the diorama was intended as a means for the audience to appreciate the relationships between the flora and fauna of an environment, and to consider their historical and ethical heritage by observing fragile environments and endangered ecologies. The diorama was thus based on a principle of analogy where the exhibited objects were arranged in a visual representation of a real reference world (Montpetit 1996), and the modality of visitors' responses was mainly one of observation and contemplation.

With the diorama, the dissociation between the museum collection and the exhibition became stronger. Rather than a displaying a selection of objects from the collections, as in the earlier thematic exhibitions, dioramas featured specimens prepared exclusively for the artistic and educational qualities of the diorama. Van Praët (1989) points out that although the diorama was originally conceived as a way for the audience to interact with a presented ecosystem in the same way that a naturalist observes a new environment, visitors may not always have responded to the diorama in this fashion. In fact, Van Praët argues, the careful staging of the contents took away from the visitors the opportunity to observe the authenticity of objects in a way similar to the scientific approach of researchers, and instead simply provided visitors with the ecology-related conclusions of the exhibit's designers (Van Praët 1989). We will return to the question of the diorama's educational affordances in the following.

Meanwhile, the development of the exhibition as an interface between museum and audience continued to take place. At the end of the twentieth century and the beginning of the twenty-first, an *anthropocentric* perspective began to influence the ways in which scientists thought about the world (Fortin-Debart 2003). Issues related to human beings and our impact on the natural world became important, and concerns related to human-induced loss of biodiversity, climate change and conservation became focal points for much scientific research. Just as in earlier decades, this change was reflected in the ways museums staged their objects, specimens and knowledge in exhibitions. The first efforts to include human beings in natural history exhibitions were the incorporation of models of humans in dioramas (Insley 2008; see Fig. 19.3 for an example). Subsequently, the notion of *immersion* emerged as a way of extending the diorama to include the visitor as an actor within the displayed scene, and thus of including the human as an agent in nature. In immersion exhibitions, the visitor is no longer removed from the exhibited objects, but becomes included in the staged environment and plays a specific role. Science knowledge is no longer presented as fact, but becomes a discourse or interaction between the visitor and the exhibited objects (Belaën 2003).

Immersion exhibits are arguably the natural development of the diorama (Mortensen 2010a)—but are immersion exhibits well suited as the defining contemporary form of representation in natural history museums? Girault and Guichard (2000) argue that the natural history museum environment is unsuitable for interac-

tive exhibits such as, for example, immersion exhibits. They argue that many biological processes take place over extended time periods making them incompatible with the more "here-and-now" experiential nature of interactive exhibits. Science centres, they argue, with their focus on physics and technology, can more unproblematically select dramatic manipulations that result in instantaneous phenomena (Girault and Guichard 2000). Additionally, visitors to natural history museums do not expect interactive devices (Falk et al. 2004), and thus may be unsure how to use them to their best effect.

1.1 The Current Status of Dioramas and Immersion Exhibits

Although dioramas are not the latest invention of the museum community, they continue to be popular with museum visitors today. The consensus among proponents of dioramas seems to be that they can successfully represent many aspects of biological phenomena, including dimensions of time and space:

> Good dioramas can be constructed to convey many messages about ecological context, habitat, behaviour, structure and movement, whereas a photograph is limited by what is actually happening in the frame at an instant in time. This is rarely as rich in messages as it is possible to create in a diorama. (Morris 2009)

The contemplation and observation prompted by dioramas seems to occur in visitors to immersion exhibits as well (Mortensen 2010a). Immersive milieux promote a sensorial interaction (Harvey et al. 1998) requiring the use of a larger number of senses (visual, olfactory, auditory and tactile) than is usually the case in interactive science centre exhibits. If the visitor invests the time and effort, dioramas and immersion exhibits allow for a more extended experience regarding biological phenomena such as animal and plant behaviour, for example. As Morris (2009) points out, in dioramas, animals are grouped together in less space than they would be in nature, and thus dioramas can show various forms of animal interactions simultaneously. In addition, they can include the big and the small as well as cheating the hours and the seasons.

Although the first dioramas specifically excluded humans from their narratives by framing visitors as observers of nature or voyeurs rather than as participants in nature (Reiss and Tunnicliffe 2011), later humans became included as models within the dioramas. While Wonders (1993) argues that dioramas including humans:

> …are not of equal interest as illusory exhibitions. This is because attempts to create the human form fail to arouse the trompe l'oeuil effect that is the aim of the habitat diorama. No matter how realistic a human model may be, there is always an intuitive sense of its falseness, perhaps due to a deep biological recognition of likeness within a species, that prevents a real illusion from occurring in the mind of the viewer. (Wonders 1993, p. 17)

Insley (2008) makes the counter-argument that dioramas containing human subjects have no intentions of constructing an illusion of reality, but rather, of convincing. She affirms that dioramas showing human activity can be as affective and effective for visitors as traditional dioramas, and goes on to suggest that dioramas including

human activity have great potential as a means of disseminating current and future concerns such as, for example, climate change.

Accordingly, we observe that dioramas (and their offspring, immersion exhibits) are objects that can represent the temporal and spatial dimensions of biological phenomena. They can include models and taxidermied animals as well as living elements, and they can incorporate human beings as part of the constructed scenario, although in different ways. These characteristics offer many possibilities (but also pose challenges) with regards to the educational role of dioramas and immersion exhibits. Indeed, the expositive discourse associated with dioramas and immersion exhibits contain conceptions of the relation between humans and nature that are important to consider when discussing the educational dimension of museums. In particular, the concept of biodiversity seems to be a compelling candidate for representation in dioramas and immersion exhibits since in addition to its scientific definition, the concept of biodiversity has strong anthropocentric components related to conservation and economy.

In the following we discuss a number of investigations carried out with regard to dioramas related to biodiversity, delving into the educational role of these types of exhibits. Due to their close relationship with each other, we inform the discussion of dioramas with research on immersion exhibits when appropriate.

2 Dioramas as Educational Devices

Dioramas were originally conceived of as a means for visitors to explore and discover 'authentic' environments much in the same way as a naturalist explores and discovers unknown natural areas. However, rather than going through this intended individual inquiry process, there is evidence to suggest that visitors to dioramas instead uncritically take up the ecology-related conclusions of the exhibit developer (Van Praët 1989). In the following, we will examine the educational affordances of dioramas; for now we merely observe that dioramas are based on educational intentions when presented in exhibitions, and that they attempt to illustrate aspects of ecology in ways that non-specialist visitors can interact with.

Understanding dioramas as devices imbued with educational intentions allows us to consider them as products of *museographic transposition*, a transformation process in which content from the domain of scientific research is transformed and adapted to become embodied in the final installation of the physical exhibit in a museum (Mortensen 2010b). The resulting exhibit with its objects, texts, specimens and other items is thus an expression of the adaptations and selections that scientific knowledge and practices undergo, and comprises the *expositive discourse* (Marandino 2001). The expositive discourse of a diorama is the narrative that emerges from the staging of the content: a scenario that uses models of plants, taxidermied animals, and other items to embody aspects of the life and behaviour of the organisms, their relation with other organisms, and their relationship with the environment.

Due to the process of museographic transposition, the 'version' of ecology embodied in the expositive discourse is different from the 'version' of ecology found in

the scientific discourse (Mortensen 2010b). In this light it is interesting to pose the questions: What aspects of ecology—in particular those related to biodiversity—are dioramas in fact presenting to the public? And what kinds of biodiversity-related knowledge do visitors in fact acquire when they are contemplating dioramas and immersion exhibits in museums? In the following we will present some examples of research that sheds light on the processes of disseminating and learning biodiversity at dioramas.

2.1 Disseminating Biodiversity with Dioramas

Since their origin, natural history museums have worked to establish a relationship with the diversity of life by housing and studying it. Furthermore, they often provide the first contact between people and all of nature's wealth (Bragança Gil 1988; Marandino 2001). According to Mehrhoff (1997), museum spaces are important documents of the diversity that exists and which has existed on Earth; indeed, part of what we know about biodiversity today was discovered by research developed in museums. Mehrhoff (1997) also points out that in addition to seeking all knowledge about the richness of life on this planet, museums should, through their exhibitions, stimulate people's interest in biodiversity. This is one of the main challenges of natural history museums in the twenty-first century.

The definition of biodiversity has long been a focus of discussion, and as a result of the *Rio—92* meeting held in Brazil in 1992, its meaning has been intensified. During this meeting, the Convention of Biological Diversity was created as the first global agreement pertaining to the sustainable use of different elements of biodiversity. The convention emphasizes the maintenance of life as well as human society and its economic aspects (Gross et al. 2006). Some research (Motokane 2005; Wilson 1997) argues that subsequent to this event, the notion of biodiversity became a central issue in scientific as well as in political arenas.

Although biodiversity is considered a poorly defined concept to many authors (Van Weelie and Wals 2002), there is general agreement that it acquires its meaning in terms of *levels* (Gaston 1996; Lévêque 1999; Raven 1992; Wilson 1997). In this perspective, biodiversity is defined by considering the *genetic* level, which considers any and all kind of genetic and chromosome variation present between different species or in the same species; the *variety of species* level, which considers both diversity of organisms (number of species in the same region) and taxonomic diversity (the relationship between species); and the *ecosystems diversity* level which considers the relationship between organisms and the environment both in terms of habitats and ecological processes. In addition, today the biodiversity concept in a scientific perspective is also related to evolution, because evolution by natural selection is implied in the variation, relative to the ancestral form, that arises in groups of organisms over a long period of time.

Additionally, the present discussion of biodiversity also deals with its interface with human phenomena, i.e. its cultural dimensions. These include include economic issues such as those connected with agriculture or other industries, social

Table 19.1 The elements of biodiversity

Domain	Elements of biodiversity
Biological	*Genetic diversity*
	Species diversity
	Ecosystem diversity
	Evolution
Cultural	*Economic issues*
	Social issues
	Conservational issues

issues such as health concerns or leisure values, and conservational issues such as sustainability and safeguarding of biodiversity at each level (Table 19.1).

Clearly, the different aspects of biodiversity may be present to varying degrees in dioramas in museums. Several studies are under way to analyse the aspects of biodiversity that are disseminated by exhibits, and although the results are related to relatively few cases, these studies allow us to discuss the potential and the challenges of disseminating biodiversity in museums.

For example, a study carried out in two Brazilian museums—the Natural History Museum of Capão da Imbuia at Paraná and the Science and Technology Museum of Catholic University at Rio Grande do Sul—shows that the dioramas here depict biodiversity in similar ways (Oliveira 2010). The levels of *species diversity* and *ecosystem diversity* were identified, confirming the typical relation between the conception of the natural sciences in the twentieth century and its representation in natural history museums. Recall that in this period, dioramas arose as an effective way to display ecology concepts in the exhibition. Thus, the *eco-centric* exhibit genre that dioramas represent (Fortin-Debart 2003) continues to be emphasized in museum exhibitions and even in science centres such as the Science and Technology Museum of Catholic University at Rio Grande do Sul (which, in spite of its name, is in fact a science centre). Generally speaking, these dioramas use a variety of means to express the relation between living organisms and between them and the environment (Fig. 19.2).

The *genetic diversity* level is rarely mentioned in exhibit texts or explicitly represented by objects in the studied dioramas (Oliveira 2010). Since ecology emerged as a macroscopic domain of research in the nineteenth century before the advent of genetics, the concomitant development of the diorama had no way of depicting or even being aware of the sub microscopic aspects of biodiversity. Presumably, this cultural link between the diorama and the perception of ecology as a macro science still implicitly exists; thus today, dioramas still seem to favour macro levels of biodiversity such as species and ecosystem over micro levels, such as the genetic level.

The absence of the *evolution* dimension of biodiversity in the objects and texts in the studied dioramas may be explained by a parallel phenomenon. Unlike the case of genetics, the mechanisms of evolution were known when the diorama emerged as the primary exhibition form in natural history museums. However, even though dioramas can "cheat" time (Morris 2009), the time scale of evolution by natural selection is presumably too large to be captured within the realistic scene or event

Fig. 19.2 The ecological relations depicted in the diorama 'Pampas' at the Science and Technology Museum of the Catholic University, Rio Grande do Sul: parental care of the rhea with its nest and eggs; parent and offspring opossums. Taxidermied and painted rheas (*Rhea americana*) and taxidermied opossums (*Didelphis albiventris*). (Photo courtesy of M. Marandino)

that is the hallmark of the diorama. However, evolution may be present in series of dioramas that depict scenarios occurring at successive points in time such as in the exhibition 'Danish Fauna: From Mammoth Steppe to Cultural Steppe' at the Zoology Museum of the University of Copenhagen in Denmark. Such exhibitions require the visitor to construct a narrative that spans multiple exhibits; while interesting, we shall limit ourselves here to a discussion of interactions with single exhibits.

The Natural History Museum of Capão da Imbuia, Brazil, provides an example of a diorama which shows cultural aspects of biodiversity. Here, the relation between a social issue—poverty—is related to biodiversity in a representation of the garbage problematique in a poor neighbourhood (cf. Marandino et al. 2009). Another case that shows the cultural aspect of biodiversity is the Amazon Forest diorama in the Science and Technology Museum of the Catholic University, which shows a man extracting rubber from a tree to depict sustainability and economic value (Fig. 19.3) (Oliveira 2010). The cultural aspects of biodiversity presented in these examples is evidence of the presence of the anthropocentric perspective in dioramas. Thus, we observe that the cultural dimension of biodiversity, which includes the economic, social, and conservational issues related to the term, is a perspective may be present in dioramas but is probably rarely explored.

In a study of two immersion exhibitions: the Zoobotanic Foundation in Belo Horizonte, Brazil and the Biodôme in Montreal, Canada, Marandino and Diaz Rocha (2011) underlined the centrality of the human being in the constructed narrative. The levels of biodiversity were frequently represented in the studied exhibitions, with an emphasis on the species and ecosystem levels. As the expositive discourse of these exhibitions took a macroscopic approach, using texts as well as live and taxidermied objects to create the narrative, the genetic aspect was rarely present.

Fig. 19.3 Representation of a human extracting rubber in the Amazon Forest diorama in the Science and Technology Museum of the Catholic University, Rio Grande do Sul. (Photo courtesy of A. D. Oliveira)

Similarly, in the Zoobotanic Foundation, the evolutionary perspective of biodiversity was only present in a space that recreated the evolutionary history of plants.

Just as it is the case in the studied dioramas, eco-centric representations are more prevalent than bio-centric representations in immersion exhibits (Marandino and Diaz Rocha 2011). In addition, the anthropocentric perspective is almost always present here, given the nature of the immersion exhibit as a means to include the visitor as an actor within a displayed scene and by inference, as an agent in nature. In the studied immersion exhibits, visitors are converted into actors who contemplate a recreated nature in order to conserve it. By converting nature into a common good, a natural heritage, and a place that must be studied and preserved through scientific, cultural, social and political actions, a certain relationship between man and nature is established (Marandino and Diaz Rocha 2011). Here, the human being is the centre of exchanges and control of the surrounding world. These are the kinds of educational impacts immersion exhibits can promote.

In sum, the aspects of biodiversity most commonly represented in studied dioramas are those of species and ecosystem diversity, while genetic diversity and evolution are less well suited for representation in (individual) dioramas. Additionally, the cultural aspects of economy and conservation are often represented. Immersion exhibits, due to their close relationship with dioramas, are able to represent much the same aspects as dioramas; however, they are probably stronger mediators of anthropocentric aspects of biodiversity such as conservational and economic issues.

2.2 Visitors' Meaning-Making of Biodiversity at Dioramas

When visitors observe biological exhibits, they frequently identify and name the animals (Allen 2002; Garcia 2006; Tunnicliffe 2009). In addition, drawings made by children after their visit show evidence that they also perceive details of the habitat shown in the exhibits. The fact that children can observe and recognize patterns when looking at animals is a key aspect of biological inquiry (Tunnicliffe 2009).

Considering that identifying and naming organisms and habitats is an important aspect of the inquiry learning process, these results encourage us to consider the potential of the dioramas in promoting learning. As we have seen, in the bio-centric era of natural history museums, natural objects were arranged according to taxonomic principles and comprised a general inventory of living beings. In a different way, dioramas took an eco-centric perspective on nature, emphasizing the relations between organisms. In this light, it is important to ask: What is expected from the encounter of the visitor with the diorama? Does the embodied scenario sufficiently communicate to the visitor elements that let them recognize and describe the ecological relations between the living beings and between them and the environment, not just naming them? Can visitors identify the aspects of biodiversity presented in the dioramas? What characterizes the process of visiting dioramas? In other words: are dioramas more successful in promoting the learning process of certain aspects of biodiversity rather than others?

A series of studies have explored the learning potential of dioramas and immersion exhibits as educational activities in museums. Findings from these results emphasise the potential for such exhibits as a means to promote understanding about biodiversity and aspects of conservation through a first-hand contact with environments that many of the visitors may never have experienced before (Ash 2004; Breslof 2001).

One first observation we can make from some of these studies is the relation between what people say during or after visits to dioramas in museums and their previous experience or mental models (Piqueras et al. 2008; Tunnicliffe and Scheersoi 2009). The results are consistent with the general constructivist idea that people, when exploring objects and concepts in school or museums, are involved in a learning process that corresponds to their experiences and previous knowledge. When a museum visitor observes a diorama that shows an ecosystem and its elements and interactions, they construct a particular narrative that fits what they see with their previous knowledge of the environment and the organisms, the memories or experiences directly or remotely related to the objects, and the aesthetic and affective impressions of the milieu (Piqueras et al. 2008; Tunnicliffe 2009). These inclusive narratives may especially be a feature of intergenerational groups of visitors (Ash 2004; Stern 2009).

Furthermore, visitors to dioramas utilise and build upon their prior knowledge to establish biological themes such as alive/dead, feeding and life cycles and form/function reasoning to grasp the diorama's narrative. These processes may be seen as

'necessary antecedents' for acquiring more scientific ways of reasoning (Ash 2004). A similar finding was reported by Tunnicliffe and Tomkins, who state:

> If pupils are provided with the opportunity and encouraged to observe for a period of time rather than just look, they make relevant biological observations, raise questions and form hypotheses (Tomkins and Tunnicliffe 2001) and relate what they see to what they already know (Tunnicliffe and Tomkins 2005).

Piqueras et al. (2008) also noted the presence of biological themes such as feeding behaviour and environment in a study of student teachers' discussions at dioramas in a museum. Here, student teachers used different *practical epistemologies* to link the unfamiliar aspects of the dioramas with their prior knowledge, thereby questioning and establishing the themes at stake in the dioramas. Findings such as these could indicate that visitors to dioramas do engage in the inquiry processes necessary for them to grasp important aspects of biodiversity.

Such questions, among others, have allowed us to develop a program of research with dioramas as a central object of the dissemination and learning process in museums. Part of this program is developed in a partnership between the University of São Paulo in Brazil and the University of Copenhagen in Denmark. The project studied the perceptions of biodiversity from a group of fifteen adults invited to visit dioramas in two museums—the Zoology Museum of the University of São Paulo, in São Paulo, Brazil and the Zoology Museum of the University of Copenhagen, in Copenhagen, Denmark.

The study had two moments of data collection. In the first part, invited subjects filled in a questionnaire that identified their conceptions of biodiversity (Marandino et al. 2012). In the second moment, we audio and video recorded their interactions with two dioramas from each museum using the think aloud method (van Someren et al. 1994), followed by an interview. Both interventions were organized in order to identify the ideas of biodiversity that they observed in the dioramas. The survey data is still undergoing analysis, but there are some general results that can be discussed here.

The first finding is that most of the adults recognized the educational potential in the dioramas at first contact with them. They underlined how the organisms, the scenario and the text together created a powerful milieu to access ecological and environmental aspects of biodiversity, as well as conservation of biodiversity. However, some of them suggested that the 'old-fashioned' way of presenting objects in museums does not correspond to what visitors expect from a contemporary museum experience. We will return to this issue in the final considerations.

The building of relationships between the elements of the diorama and the prior experiences of the visitors appeared in the utterances they made while observing the dioramas. Some subjects described the place they lived and the animals they recognized from their childhood. A common occurrence was the identification and naming of the animals and a description of what they thought the animals were doing in the scenario. Another frequent occurrence was questioning or hypothesizing the reasons for the animals' positioning or presence. Our findings are thus similar to those reported in the literature, but additionally, we were able to distinguish between

two particular observation strategies among visitors. The first may be described as a *focal approach* (cf. Chua et al. 2005), where the visitor began by identifying an individual object (usually an animal) in the diorama and then widened their focus to include the entire ecology on display. The second, complementary approach may be described as a *contextual approach* (cf. Chua et al. 2005), wherein the visitor began by observing the entire ecological context on display and then zoomed in on particulars such as individual animals.

Visitors did not necessarily subscribe to just one of the strategies; some used the two strategies interchangeably in their interactions with dioramas. In either case, the visitors' observations were accompanied by identification and description of what they were observing and hypothesising about how the various objects were related to each other and to the visitor's prior knowledge and experience. While our data do not allow for a more thorough analysis of this phenomenon, the strategies adopted by the public when perceiving the scenes displayed in dioramas seems an interesting area for future investigation. Even within shared environments, we humans see different aspects of the world in different ways (Chua et al. 2005); this phenomenon holds interesting potential for the work of exhibit designers and developers

Another thought-provoking aspect of our findings is the dichotomy between visitors' perceptions of the diorama as, on one hand, an analogous representation of a fragment of reality and on the other, as a more symbolic *reconstitution* of that reality (Montpetit 1996): some visitors took the relations between organisms at face value, describing behaviours such as an animal holding a fruit to eat, or a hunting scene; others commented how they found the dioramas to be an 'unrealistic' representation of the environment, as they did not show 'how nature really is'. For example, some of the adult visitors felt conflicted by the idea that a predatory animal could be unproblematically placed together with typical prey animals within the same scenario without some illustration of the tension between them.

As underlined by Morris (2009), in a diorama, animals can be grouped together in less space than is natural. This potential of dioramas of juxtaposing organisms as well as certain biological phenomena to show various forms of animal behaviour simultaneously is their advantage and, at the same time, their challenge. This challenge, however, is related to any kind of educational situation resulting from a transposition process; when synthesizing scientific ideas in order to promote their comprehension by visitors during a brief visit to a museum, exhibit designers may sometimes be tempted to overreach the potential of the tools at their disposal. Clearly, careful consideration of the opportunities and limitations of both the chosen content and the chosen media is important in the museographic transposition process (Achiam 2012).

Finally, in our research we found that some participants expressed negative feelings of the display of 'dead' animals. This lets us consider another educational potential of dioramas, namely in discussions of the contemporary role of collections in museums. The dissociation between the museum's collections and its exhibitions that took place in the twentieth century means that today, museums can no longer completely justify the practice of taking animals and preserving them as the

collection of scientific specimens; rather, this practice must at times be considered as serving other objectives, including those of education and perhaps entertainment. This is an interesting ethical problematique within the anthropocentric perspective that could be further developed in the educational programmes of modern natural history museums.

3 Final Considerations

Together with the findings from the literature, our data allow us to think about the contemporary role of dioramas. From one perspective, dioramas continue to be an important means of representing aspects of the natural world. Dioramas make places and things accessible that would otherwise be beyond the experience of most visitors:

> [Dioramas] offer the viewer an opportunity to see details of the wildlife of six continents, juxtaposed and in close up, without discomfort, difficulty or the expense of long-distance travel. The most dangerous situations can thus be experienced by proxy, in complete safety. (Morris 2009, p. 27)

In addition to their role in promoting biological inquiry processes in general, they provide ideal settings for the construction of biodiversity-related knowledge, especially at the levels of species and ecosystem diversity. This is probably due to their origin in an era where the prevailing natural science paradigm was one of ecological relationships and communities. The anthropocentric elements of biodiversity: social, conservational, and economical can also be represented in dioramas, although we would hypothesise that immersion exhibits are better suited to filling this particular role. Indeed, immersive exhibits promote a special interaction between the visitor and the exhibited objects, addressing in a more explicit way the interactions between humans and nature. On the other hand, immersion exhibits by their nature require a certain suspension of reality on behalf of the visitor (Belaën 2005; Bitgood 1990), and studies show that not all visitors are able to suspend reality to the extent that they can construct the intended meaning from their immersion experience (Mortensen 2011).

As pointed out in the preceding, data from the literature indicates that visitors to natural history museums do not expect interactive devices, but rather the more contemplative experience typically promoted by those types of museums. However, in our research, we found that visitors were interested in interactive and technological experiences when visiting museums; hence, dioramas with their static appearance do not meet those visitors' agendas. A means to make dioramas more active without fundamentally changing them is the inclusion of soundtracks, interactive lighting or interactive text panels seen in many dioramas today. Alternatively, these visitors' expectations can be met with immersion exhibits, which as the natural extension of the diorama with their added sensory stimulation and more interactive and varied aesthetical experiences include the visitor as an agent in nature.

As educational objects derived from a careful process of museographical transposition, dioramas—and immersion exhibits—seem to be valuable media for representing the biological levels of biodiversity and, at the same time, its cultural values. On the other hand, it seems that representing aspects of biodiversity that are submicroscopic (such as as the genetic level), or macrotemporal (such as evolution) using dioramas and immersion exhibits is challenging or even impossible. In sum, the relationship between humans and nature mediated by dioramas and immersion exhibits provokes many questions about their potential and limits, and cause us to observe that the process of biodiversity dissemination and learning in such exhibits deserves more research. We agree with Tunnicliffe (2009) that dioramas are an underused educational resource and deserve serious consideration from the perspectives of both visitor and designer.

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Chapter 20
Interpreting Through Drawings

Edward Mifsud

1 Introduction

The concept of nature conservation is relatively recent. Historically, nature has been viewed by some as forbidden wilderness. Those who considered nature as powerful and dangerous wilderness thought of it as a phenomenon to be tamed. Our present disposition to value wilderness is a consequence of its rapid disappearance and the desire to have those areas available to us along with those areas we have tamed all too well (Moran 2006, p. 59). Economic growth onslaught on the natural reserves is seriously threatening the biodiversity (Harding 2006, p. 231). The young generations are engrained in consumerism and they need a greater appreciation of nature to try and balance their consumerist drive with nature conservation.

In his best seller, *Last Child in the Woods,* Richard Louv (2008) calls the lack of nature in the lives of today's 'wired' generation as 'nature-deficit' and links it to some of the modern negative childhood trends, such as the rises in obesity, attention disorders, and depression. Emerging body of scientific evidence indicates that direct exposure to nature is essential for physical and emotional health (Louv 2008, p. 35). North Carolina State University professor, Robin Moore holds that primary experience of nature is being replaced "by the secondary, vicarious, often distorted, dual sensory (vision/sound only), one-way experience of television and other electronic media" (cited in Louv 2008, p. 66). Natural settings are essential for healthy child development because they stimulate all senses and integrate informal play with formal learning (Louv 2008, p. 86).

There are no zoos or animal parks in Malta, and the only places where live animals can be seen on display are farms or isolated public places that house one or two specimens such as a lama or kangaroo and two small aviaries. In such a situation, dioramas are particularly valuable for the urban community to be able to see and possibly understand the diverse habitats with the various indigenous organisms that live within (Tunnicliffe 2005, p. 30).

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2 Theoretical Framework

Quite recently, the educational potential and role in biological learning of dioramas has been, quite recently, documented by various researchers (Peart and Kool 1988; Ash 2004; Insley 2007, 2008; Pipueras et al. 2008; Reiss and Tunnicliffe 2007; Scheersoi 2009; Tunnicliffe 2002, 2005, 2007). The term constructivism currently features in a wide range of educational literature and it has been given an array of different interpretations. In summary, constructivism is based on the notion that each individual constructs a unique picture of the world based on previous knowledge. A person goes through a mental process to be able to interpret and make sense of surroundings (Gatt and Vella 2003, p. 4). Educational constructivism has two aspects; the personal and cognitive dimension as given by Piaget and the social dimension as explained by Vygotsky and the late Driver (Sjøberg 2007, pp. 485–490).

As a constructivist one could set out to see how the child constructs knowledge about animals and plants through interactions with wildlife dioramas. Children are allowed to interact with the dioramas. They stop to observe the exhibits, notice the different forms of animals and plants, the anatomical features of each organism and possible relationships between animals and plants or animals and animals. The child forms his or her concept of wildlife in general and more specifically a concept of the particular wildlife in the exhibit. The constructivist approach would be to elicit the concept formed. At dioramas, children construct their own personal knowledge, but they also construct knowledge as they interact with the exhibits in groups.

Children's learning about animals may be investigated by examining the mental models revealed through their talk and drawing when they come face to face with live or preserved animals. The mental model is the person's personal knowledge of the phenomenon. This knowledge will in certain aspects bear similarities and in others differences to scientifically accepted knowledge, which in the case of this thesis is the appearance of the organisms and their ecological habitat (Reiss and Tunnicliffe 1999, p. 142). The features that capture children's attention may be revealed from the child's representations of the authentic specimens as constructed through the interrelation between the real object, mental model and the representation (Fig. 20.1) (ibid).

The representations may be written descriptions, verbal descriptions, drawings or three-dimensional models. In this context, observation emerges as an essential skill for scientific learning, which is here understood to mean active looking in search of understanding (Tomkins and Tunnicliffe 2006, p. 9). Tomkins and Tunnicliffe are particularly concerned that present day science education is lacking observation skills in biological sciences and stress the importance of the skill.

Most of the methods employed for gathering information on pupils' understanding of scientific phenomena rely mainly on speech and writing. Very few empirical studies have made use and evaluated the potential of drawings in elucidating scientific understanding. This is not to state that drawing is necessarily superior to other means, but it does have advantages. One is the relative ease of obtaining a rich mass of data that related to the children's mental models. Another is the

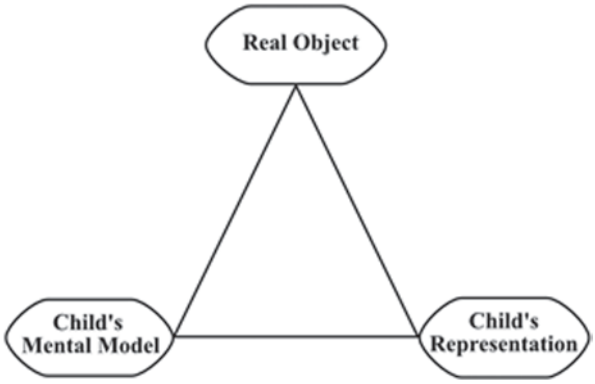

Fig. 20.1 Interaction between object, mental model and representation

international suitability of drawing that transcends the huge diversity of languages (Reiss et al. 2002, p. 59). Drawings may be as rich a source of evidence as language and open a window on children's thinking in all curricular areas. It may also serve as an alternative to verbal expression for children that are often able, through drawing, to show things that they cannot put into words (Lewis and Green in Bowker 2007, p. 79). However, finished drawings cannot portray the thinking, talking, social interaction and mark-making sequences that form a fundamental part of the process (Coates and Coates 2006, p. 222). Drawings may also provide insights into children's cognitive, affective and social development (Bowker 2007, p. 79). Unfortunately, schools tend to suffocate children's natural inclination to use drawing as a mode of thinking and learning. Many teachers consider drawing a minor communicative tool, secondary to writing and speech (Anning 1997, p. 219).

Children possess great capabilities in communicating through drawing that enable them to overcome language barriers (Mavers 2003). Drawings together with interviews can efficiently and effectively reveal what children have acquired from the exhibit through their mental model. Most children will draw when encourage to, but there will always be individuals who will find it hard to do so. Some will need to be assured that we are not after high quality artistic or design artefacts. Normally, people like to draw and children are less inhibited than adults when asked to draw something. Adults are more likely to say that they have never been able to draw. However, drawing is not a problem free activity. Piaget and Inhelder shown that there are performance problems associated with drawing (Piaget 1967, p. 71). According to Goodnow drawing comprises a problem-solving process for children, rather than a test of their knowledge (Goodnow 1977, p. 85).

Different forms may represent objects equally well if representation really deals with the creation of equivalences for objects and events. This could account for the wide range of individual variations that are observed in children's drawings.

> There are, however, distinct limits to the representational equivalences children create, and their drawings are constrained by their as yet limited exploration of the medium and of the objects they wish to portray (Golomb 2004, p. 360).

3 Methodology

Most of the methods employed for gathering information on pupils' understanding of scientific phenomena rely mainly on speech and writing. Very few empirical studies have made use and evaluated the potential of drawings in elucidating scientific understanding (Haney et al. 2004, p. 248). Drawings may be as rich a source of evidence as language and open a window on children's thinking in all curricular areas. It may also serve as an alternative to verbal expression for children that are often able, through drawing, to show things that they cannot put into words (Lewis and Green in Bowker 2007, p. 79).

Three grade 5 classes (63 pupils) composed of 9–10 year old primary students visited the Natural History Museum of Malta. Following a short briefing, children we allowed into the diorama area in groups of four to observe each of the five dioramas always in the same order. They were asked to look carefully and discover as many animals and plants as they could. After the diorama observation, the pupils were given boards to produce a drawing of their favourite diorama on A4 paper using HB and coloured pencils. This drawing was done in the bird hall just outside the diorama area. Each pupil had the opportunity to explain the content of his or her drawing during an interview help at school a week after the visit. During the interview, the children were asked to explain the content of their drawing. They were asked to mention influences on their choice of drawing and any other features they wished to include. Pupils were also encouraged to comment on features they felt were important to them. Each answer or comment made by pupils was attached to the respective drawing as a memo (short note in Altas.ti).

Drawings were analysed using Altas.ti based on the NCT model of qualitative data analysis, where the three basic components are noticing things, collecting and thinking about things (Friese 2012, p. 92). Drawings were very carefully and repeatedly examined to identify relevant features that were subsequently tagged with codes and memos added to record explanations given by the author of the drawing. A coding method was developed for analysing the drawing, in principle similar to emergent analytic coding developed by Haney et al (2004, p. 252). A list of features that the drawings contain was drawn; each feature was assigned a specific code. The checklist was used to mark codes in each drawing generating a cumulative count. Main code categories, such as animal and plant, were assigned. In the case of animals, taxonomic sub-categories were added to better classify the organisms included. Each animal included in the drawing was linked in the appropriate taxonomic sub-category for example mammal, insect or bird. Sub-categories were not added to the diorama drawings since the organisms presented are pre-selected by the museum setting constructor and children were not free to include any organism they could recall. A feature in a drawing was coded by first selecting it using the PC mouse and than tagging the selected area with the relevant codes.

The selected area could include several codes and also memos. Memos contain information, which cannot be presented in drawing or is not evident in the graphical composition. This information provides relevant details such as what influenced the

child to draw that particular scene or the reasons for choosing to draw a particular diorama or for not drawing another one. Memos are also useful to recount the sequential process of analysis.

A diorama drawing is regarded as an expression of the children's mental model of the particular diorama observed. It was thus important to analyze the drawings in relation to the diorama they are representing. This has important implications in relation to ideas about perception. The diorama drawings are scored on the number of animals, plants and physical features present in the diorama and included in the drawing. The score was given by expressing the number of animals or plants drawn as a percentage of the total number present in that particular diorama. Features in drawings were also scored in comparison to their position in the diorama and also recorded as a percentage. The number of drawings in which all the features were sketched in the same place or in a similar position as that found in the actual diorama was also noted and recorded.

ATLAS.ti offers the possibility of creating graphical networks. An ATLAS.ti network is the set of all objects and their links inside the Hermeneutic Unit (HU) and it is actually the logical structure of the HU's objects. In contrast with linear, sequential representations such as text, presentations of knowledge in networks resemble more closely the way human memory and thought is structured. Cognitive "load" in handling complex relationships is reduced with the aid of spatial representation techniques. ATLAS.ti uses networks to help conceptualize the structure by connecting sets of similar elements together in a visual diagram. In the network view it is possible to express relationships between the elements (codes, quotations and memos) that form the network. The elements become nodes, which are any object that is displayed in a network view. It is possible to construct concepts and theories based on relationships between codes and memos. This process may uncover other relations in the data that may not be previously obvious and still allows the researcher to instantly revert to his notes or primary data.

4 Results

The purpose of diorama drawings was to find out how the children perceived the diorama, what captures their attention and what they did not notice. The Diorama hermeneutic unit (HU) included the 51 drawings created during the museum visit, meaning that the *Diorama* HU comprised 51 PDs (primary documents). Analysis of these PDs generated 107 different codes, which were classified into the following categories: *animal, diorama, ex-diorama, human construct, meteorological, non-diorama, physical, plant, agrifield, bastion, rural yard and sand dune*.

From the 51 drawings produced only three did not show an animal, but 13 did not include a plant. Five drawings did not show a diorama setting, but something else. Human constructions featured more frequently in drawings than plants. Half the drawings show abiotic features and objects not present in the diorama settings. Of the 46 drawings (90%) showing a diorama, 17 show the Rural Yard, 12 the

Agrifield, 12 the Sand Dune and 5 the Bastion. The valley floor setting did not appear in any drawing. The rural yard was most effective in gaining the children's attention with the largest number of features noted belonging to this setting. The agrifield and sand dune were quite effective too, but least appealing were the bastion and the valley floor settings. The trend of observing animals in preference to plants is also noted. Children's drawings also contained animals (15), plants (eight), meteorological (four), physical (two) and a human construct feature not present in any of the dioramas. This is evidence of the tendency to insert organisms or objects from outside the diorama (Ex-diorama) into the diorama drawing.

All drawings were also analysed for content in relation to the animals, plants and physical (abiotic) features as placed inside the diorama. Drawings were scored on a scale from one to ten (1–10) expressing the number of drawn features compared to the actual number in the diorama and also their position in it. Animal and plants scored rather low on quantity, physical scored higher while composition score was highest. Few children (12%) include more than half the animals and plants in the diorama, while they tend to draw more of the physical features of the setting. Notably, 32 (70%) of the drawings (showing a diorama) display all items in the same place as they occur in the diorama.

The interviews revealed some interesting points. Over half the pupils (53%) expressed difficulty in drawing features of the selected diorama, while a fifth (20%) said they required more time to conclude the job adequately. Some children erased items from the drawing and drew few items since they did not have the confidence to produce a complete picture. Two thirds (67%) drew their favourite diorama, 22% drew another diorama and the rest drew no diorama even though they had a favourite. The reason for not drawing the favourite diorama was that the children considered it too complicated and difficult to draw and so they settled for a diorama that was easier to draw.

Conclusions

The local habitat dioramas at the NHM in Malta are relatively small, placed in a narrow corridor with dim lighting and no panels. In comparison to Natural History dioramas in Europe and North America, those in Malta would seem quite unimpressive. Yet these dioramas attracted the attention of the visiting pupils who interacted with the exhibits actively. The boys and girls shifted from one diorama to the adjacent ones, while noting and commenting on what they were observing. Certain features in the dioramas grab the children's attention who stop and interpret what they see. In this context, the dioramas may be considered a museum object described as an artefact containing animal and plant specimens in an ecological relationship. To Hooper-Greenhill (2000) objects do not exist outside interpretations of their meaning and significance. Their interpretation is rooted in existing experience and knowledge, while always being targets for feelings and actions (pg. 104). Person-object interaction leads to 'situational interest' that emerges in response to

situational cues. In non-formal, free learning environments this situational interest is vital to learning. A more profound form of 'individual interest', that develops over time and exists within the person, may ensue from situational interest (Scheersoi 2009, p. 11).

Most of the pupils (90%) managed to draw a diorama, while only two did not have a favourite, which indicates that pupils were positively influenced by the exhibits. The diorama as the object created the situational interest for the visit. A familiar place with children is internal yard of traditional Maltese houses and this could explain why the Rural Yard featured most frequently (33%) in the drawings. Children seem to notice most features (22) in the rural yard diorama. However, the Agrifield and the Sand Dune were also commonly selected and represent two sites frequently encountered in the countryside and at the sea-side. This is another indication that interest arises from recognition of the familiar. It must be noted that choice of diorama was also affected by actual or perceived difficulty in drawing. It is crucial not to overlook the question of discrepancy between (cognitive) competence and (drawing) performance. Piaget and Inhelder have shown that there are performance problems associated with drawing (Piaget 1967, p. 71). We also need to consider children's growing control over visual resources and their feeling of confidence in the situation (Hopperstad 2010, p. 432).

The predominance of animals is clear with almost half the number of items in drawings coded as animals. The general trend showing that animals are the most noticed and plants appreciably less was observed in each diorama type. A good number (75%) of drawings featured a least one plant, but the total number of plants (19%) was half that of animals (46%). The apparent child disregard for plants has been previously reported in literature. Human artefacts (man made structures) seem to be more important to children than plants. The man made structures are quite prominent in the dioramas and so easily noticeable by the visitor. Also most of these items are familiar to children such as the colourful Maltese fishing boat or the rubble wall.

An interesting observation was that almost half (47%) the drawings contained a feature not present in the dioramas. That is evidence of the tendency to insert organisms or objects from outside the diorama. For example, the beach diorama (showing the colourful boat) ***does not*** have a painted background of a blue sky with the sun and the palm trees, but the children drew them anyway. This study was conducted in Malta, an island where children are used to the predominant sunny weather with blue skies all year round and very limited cloud. It seems that the children produced a representation of a typical Maltese beach from their memory with the usual blue sky and the sun.

Apart from content, the drawings were also analyzed in relation to diorama composition. Composition refers to the degree of graphical closeness between the drawing and the actual diorama setting. Most drawings contained a low number of animals and plants present in the diorama. Few children included more than half the animals and plants in the diorama, while they tend to draw more of the physical features of the setting. Children missed the less conspicuous biota or omitted what they could not draw. There is a tendency to notice the larger animals or the unusual or unexpected.

Notably, most drawings (70%) display all items in the same place as they occur in the diorama indicating an accurate spatial perception. The viewing of the dioramas acts as a trigger for children to assemble their related memories about the topic and compile a personal representation of the topic. In drawing, children record selective features that they find most relevant. These are generally connected with their personal experiences of everyday observations of animals around, media representations and narratives. Dioramas enhance situational interest when they induce emotional reactions and offer reference to allow different visitors to relate to prior experiences to the object observed.

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Part IV
Conclusion

Chapter 21
The Cultural History and Learning Affordances of Natural History Dioramas

Michael J. Reiss

A diorama is a careful positioning of a number of museum objects in a naturalistic setting. Natural history dioramas come in a variety of forms but typically contain skilfully positioned taxidermy specimens and other objects before a painted backdrop. While time-consuming and expensive to design and construct, dioramas offer tremendous potential as educational tools and are often very popular with museum visitors (Insley 2007; other chapters in this volume).

While objects are at the heart of museums (cf. Dudley 2010), curators and other museum professionals typically have a range of responses to dioramas (Paddon 2009). Dioramas periodically go in and out of fashion (Tirrell 2000), but then so does taxidermy, which is currently undergoing something of a resurgence in interest (Turner 2013). Consider, for instance, the use of preserved animals in the work of such artists as Damien Hirst (of pickled shark fame) and taxidermy artist Polly Morgan, whose *To Every Seed his own Body* features a stuffed blue songbird atop a prayer book under a miniature chandelier (Morgan 2006).

The education literature on dioramas, while growing, is still meagre (Reiss and Tunnicliffe 2011). Dioramas do not feature in the indices of such major texts as Hein (1998), Falk and Dierking (2000), Paris (2002) and Black (2005). What has been published on dioramas mostly consists of studies that examine what visitors learn from them (e.g. Peart and Kool 1988; Ash 2004) and a few publications that trace the history of those who were responsible for them (Wonders 1993; Morris 2003; Quinn 2006). This volume does much to add to and extend the literature in its examination both of the characteristics of dioramas and of their educational capacities and potentials.

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1 History and Features of Natural History Dioramas

Dioramas have had a longer history than is sometimes supposed as Kamcke and Hutterer (Chap. 2) review. Their origins go back at least to the panoramas that took parts of Europe by storm at the beginning of the nineteenth Century; arguably, they have prior antecedents in the careful arrangements of objects found in Renaissance cabinets of curiosities. Nowadays we are used to dioramas capturing a moment but the early dioramas were the centrepiece of shows in which almost every moment contained action and change. In an *Alice in Wonderland* inversion of reality, Daguerre painted the real objects in his early dioramas to help conform them to the image he was creating.

Within natural history dioramas a useful distinction is made by Kamcke and Hutterer between artificial groups (that show an unnatural large number and diversity of individuals and species in a particular landscape), geographical groups (that present animals or plants from a specific geographical region), biological groups (that show a piece of nature with a natural combination of habitat, plants and animals but lack a painted background and the illusion of space) and habitat dioramas (that present convincing 'windows on nature' (Quinn 2006) and are characterised by a near-perfect combination of scientific accuracy, art and technology).

Certain works of art are routinely accorded less protection than others. Murals, for instance, seem peculiarly ephemeral even when painted by recognised artists (Powers 2013). Dioramas too are all too infrequently accorded the protection they deserve. As Hutterer (Chap. 3) points out, nowadays early panoramas, photographs and technical optical equipment are valued as highly priced collectors' items and may be displayed in art exhibitions whereas habitat dioramas in natural history museums are too often threatened by dismantling. Focusing on the European bison and moose in the oak-birch swamp forest diorama in the Museum Alexander Koenig in Bonn, Hutterer researches its origins and cultural significance in a manner reminiscent of the various contributions in Alberti (2011), remarkably succeeding in linking the male moose to none other than Hermann Göring.

The Bonn diorama is illustrative of the care frequently taken in the construction of major natural history dioramas. It was planned as one of a series of 12 by Alexander Koenig (1858–1940), a private scholar with a doctorate in natural history, for his eponymous zoology museum. Koenig saw his dioramas in the tradition of the great Swedish artists Gustav Kolthoff (1845–1913) and Bruno Liljefors (1860–1939), who both worked together on early habitat dioramas. Yet, as Hutterer shows, whatever Koenig's intentions, he, his dioramas and his museum became caught up in the maelstrom that engulfed Europe in the 1930s. Koenig died in 1940; it's a wonder his dioramas survived both the Second World War and subsequent 'renovations' at the museum.

Dioramas, as Morris (Chap. 4) points out, make accessible objects and places that would otherwise be beyond the direct experience of most people. Today, they seem, to some viewers, to provide less than the moving image. Yet in their time before the advent of television they were seen as being more realistic than still photography. Whatever the arguments about realism, a diorama can be constructed

to convey precise messages about ecological context, habitat, behaviour, structure and movement, whereas a photograph is more or less limited by what is actually happening in the frame at a particular instant in time. In this respect dioramas have a similarity with those mediaeval paintings of the lives of the saints that present several asynchronous events in a single painting, to be read sequentially as the eye moves across the picture's surface.

Morris' argument about the similarities and differences between dioramas and photography is taken up by Howie (Chap. 5) in her study of the dioramas of the Powell-Cotton Museum. On entering the museum, the visitor, like Pip calling on Miss Haversham, is swept back to an earlier period as Gallery 2, in particular, is virtually unchanged from its 1896 construction. The visitor is overwhelmed by a profusion of specimens in a beautiful and carefully constructed setting. Powell-Cotton seems to have used the exhibits in his museum to recreate a memory of his extensive travels on over 28 exhibitions to many countries in Asia and Africa.

Drawing on Wonders' own tremendous doctoral thesis (Wonders 1993), Howie considers the natural habitat diorama as an ecological theatre. Plato, of course, was deeply suspicious of the theatre. He saw it as a dangerous place since philosophers were concerned with truth whereas actors and orators persuaded the public through the use of rhetoric. Nor was that true only of the theatre. In Book X of *The Republic*, Plato relates Socrates' metaphor of three beds: one (the Platonic ideal) exists as an idea made by God; one is made by a carpenter; and one is made by the artist in imitation of the carpenter's. The artist bed is therefore twice removed from the truth (the Platonic ideal).

As Powell-Cotton aged, he became sensitised to conservation issues and his dioramas can be read in that light, as well as being the product of a colonial hunter. As Howie argues, his diorama present an idyll, one in which birth and death, the sick and the old, the need for food and shelter are edited out. What therefore results is a distinctive fiction in which the craft of the taxidermist and artist combine to construct a particular fabrication, a deceptive reality.

Remarkably little is known of many of the artists who helped turn drastically foreshortened dioramas into convincing three-dimensional spaces. Michael Anderson (Chap. 6) describes how James Perry Wilson, one of a number of painters of dioramas in the American Museum of Natural History in the mid-twentieth Century, developed and refined his technique. Painting a diorama is painting using anamorphic perspective (such as the famous example in Holbein's *The Ambassadors*)—it's not easy! What Wilson did was to look at the problem of distortion analytically. Using his architecture training, he devised distinctive projection grids, relying less on 'the artist's eye' than did other painters of dioramas.

The result was that Wilson produced, using his science-based techniques, more convincing backgrounds than any other diorama painter of his time. Eschewing the then advice to avoid relying too much on nature but be artistic, Wilson produce a series of stunning and realistic backgrounds. Critics of the time alleged that his backgrounds lacked creative inspiration but, as Anderson shows, Wilson realised that the more 'artistic' the background, the less effective the illusion. Wilson simply painted what he could see. Time has proved him right.

2 Modern Dioramas

In 2004 the National Museum of Natural History in Mdina, Malta embarked on an educational programme by building and presenting a set of dioramas that highlighted local ecosystems. Borg (Chap. 7) describes how the resulting dioramas can function as educational tools for wildlife conservation and appreciation. The intention is to overturn the common misconception that Malta is largely devoid of wildlife. In general, dioramas are often accompanied by less written information than is the case for many museum exhibits. In the case of the Maltese National Museum of Natural History, the dioramas lack *any* labels or information panels. What happens instead is that during organised visits, viewers are invited to note the animals and plants they observe in the displays and then, with the help of museum staff, they go through each display again and see which additional species were not noted.

Loveland, Buckley and Quellmalz (Chap. 8) examine the affordances of computer-based technologies to help visitors step into a richer understanding of ecosystems. A sceptic might presume that computer-based technologies simply position the museum visitor as being even further removed from museum objects. However, research shows that computer-enhanced exhibits can deepen visitors' engagement with real objects. Furthermore, we are still in the early days of realising how to use the potential of these new technologies to enhance visitor engagement, learning and wonder. Used appropriately, such technologies can develop skills of argumentation, collaboration, model-based thinking and innovation.

Loveland, Buckley and Quellmalz compare how two very different museums deal with ecosystems. One is the internationally renowned American Museum of Natural History that opened in 1869 and currently has 32 million specimens and 500,000 square feet; the other is the Marian Koshland Science Museum of the National Academy of Sciences that opened in 2004 and has just a handful of physical artifacts and 6000 square feet of floor space. While the Mammal Halls at the American Museum of Natural History provide a precise and apparently timeless recreation of ecosystems from the past, the Earth Lab in Marian Koshland Science Museum uses up-to-date data, simulations and multimedia visualisations to present how ecosystems across the globe are impacted by various manifestations of global climate change: drought, heat waves, rising sea levels, receding glaciers and increasing ocean salinity. Visitors can explore how their own choices might or might not impact climate change and compare the effects of their choices in real time with those of choices made by other visitors. More generally, digital technologies can help visitors build more complete, dynamic models of the system interactions and changing population levels portrayed in dioramas and other displays across time and changes in environmental conditions.

Natural history dioramas are often very popular with visitors. Ximin (Chap. 9) describes how the new diorama exhibition in the Zhejiang Museum of Natural History increased visitor numbers by a factor of ten. What is less clear, though, is the long-term effect of visiting such dioramas. In particular, can dioramas such as these inspire visitors to love nature and cherish life and the natural environment in which they live?

Dioramas are amongst the most complex of museum exhibit constructions, natural history dioramas particularly so with their combination of taxidermy specimens, background scenery and other objects. In the case of the historical dioramas in the Hessisches Landesmuseum Darmstadt, Munsch, Schmiese, Angelov, Riedel and Köhler (Chap. 10) summarise how damage over the last 100 years has resulted from UV radiation, climatic fluctuation, the original techniques used to preserve biological specimens, occasional treading on the dioramas, dust, insect infestation and vibrations caused by construction and restoration works on the building. The resulting restoration has allowed these dioramas to be viewed anew in something close to their original full glory.

3 Learning at Dioramas

Museums typically juggle a multitude of roles, one of which, as Tunnicliffe and Scheersoi (Chap. 11) point out, is for them to be sites for informal learning about values, norms and technical knowledge. Museums are now more aware that visitors bring their own understandings of meaning with them, so that exhibits need to connect with these if a visit is to appreciated by the visitor and result in some sort of learning. Dioramas can be fruitful in this regard as they offer a range of possible hooks onto which visitors can latch. Of course, learning can be as transient at a diorama as at any other museum exhibit if the thread that connects it to a visitor is a thin one. However, there are a number of features of dioramas, including natural history dioramas, that can serve to grab and hold the attention of visitors. Indeed, dioramas provide particular opportunities, as Tunnicliffe and Scheersoi discuss, for museums to act as sites of socialisation. Children, in particular, can engage in dialogue, expressing their own thoughts and developing their own ideas while listening to those of others and co-constructing their understandings with them.

Certain dioramas catch the attention of visitors more than others but what causes some dioramas to be more successful in this regard? Scheersoi (Chap. 12) addresses this question, drawing on data collected at natural history dioramas in three German museums with diorama galleries. Interest was determined using a range of methods: observation of visitors, notes made of visitor conversations at dioramas, audio-taped interviews with visitors after they had viewed a diorama and children's drawings after they had viewed a diorama. As one might expect, certain dioramas tended to be more interesting than others though interest is a function of the visitor too, not only of the exhibit.

Scheersoi found that visitors are especially likely to stop at dioramas with big, young or rare animals. The resulting 'animals encounters' were particularly appreciated, given the fact that few visitors ever come face to face with such animals in the wild. However, personal significance could trump considerations of size or rarity as in the visitor who stated: "My interest was caught by the tick, because we have a cat that often brings these ticks at home". Local animals, too, were often particularly appreciated as parents sought to point them out to their children or simply wanted

to know more about them for themselves. Other well designed features of the dioramas were important in attracting attention; ice, a stream, the background painting, plants, a fence, tyre tracks and a puddle were all commented on positively in this regard. As with a musical tune, the trick is for a diorama to be neither too familiar and predictable nor too unfamiliar and unpredictable. Indeed, the data show that the dioramas varied hugely in how successful they were in arresting and holding the attention of visitors.

The importance of the experience, knowledge and expectations that visitors bring to dioramas is emphasized further by Tunnicliffe (Chap. 13). Visitors often identify and name objects, particularly animals, within natural history dioramas. This initial identification catches their interest and they may go on to interpret what they see, even to investigate it further. Realisation of these various phases of a visit has been aided by a trend for research on dioramas to incorporate more qualitative methods than used to be the case. Indeed, if anything, there now seems to be a bewildering range of research methods in use with apparently little attempt to produce some sort of analytical frame to indicate which methods might best be used for which purposes.

The importance of storytelling for us—for how we make sense of the world and for why we learn—is increasingly recognised. Cotumaggio (Chap. 14) explores the power of narratives for learning about natural history, noting that storytelling is widely used for teaching about literature and history, but rarely for teaching about science. And yet, many learners of science find much of the subject to be boring, to have no connection to the things in their lives that matter and so to be irrelevant; perhaps storytelling could help.

The American Museum of Natural History provides a fine research site to study these issues. In its Museum Education and Employment Program (MEEP), college-aged youth are given training on the content of the museum's exhibit halls and in pedagogy. They develop their own distinctive tours set in the form of a narrative and infused with inquiry to engage visitors, mostly camp groups. The tours are designed to draw on the visitors' prior knowledge and encourage observations, questions and a desire to learn more.

The outcomes of Cotumaggio's study show that the more inquiry-driven the tour, the more the narratives, and in particular the conversations at each diorama, change with each group. Visitors come to the museum with pre-existing ideas about how the world works. By using inquiry techniques, the facilitators are able to draw on this prior knowledge and allow it, and the observations and interests of the audience, to drive the direction of the narrative.

A challenge to any simplistic idea that dioramas present objective truth is provided by Livingstone (Chap. 15) who draws on the approaches to understanding dioramas used by Haraway (2004), Haraway being one of the small number of authors to employ critical theory when attempting to understand how dioramas are viewed. However, what remains unclear is whether visitors see dioramas in the way that cultural theorists like Haraway do. Livingstone addresses this question in her visitor study on the African Savannah diorama at the Royal Ontario Museum. This diorama has five prominent lions arranged—at least in the eyes of a cultural theo-

rist—in the manner of a conventional human nuclear family, with a standing adult male as the focal point. Data were collected by means of observations, intercept interviews and visitor-employed photography.

Quite a number of visitors did, without prompting, state that the lions were a family, thus applying an anthropocentric and gendered analogy to make sense of the diorama. However, some visitors were more than capable of deconstructing what they saw and questioning its presumed intended message. For instance, one visitor (a student in her twenties) critiqued the presentation, resisted a focus on the lions as the most important element of the drama and found her own significance in the diorama:

> Well, it looks like it's supposed to be reflecting a typical day in the life of a lion. I don't know how realistic the picture its, but I've never been to Africa before. I get distracted by the background because it doesn't look like something that would actually be a prairie in real life. It just doesn't seem like there would be giraffes right there and lions right there. But I think what they're trying to go for is looking at something that looks nice, not really realistic. And I guess, yeah like I said, it's supposed to be representing a typical day … like if you look at the birds that are over there—they actually looked like they were doing something instead of just sitting and standing around … look like they're actually kind of foraging around and pecking at things. And I think that's interesting. And you've got the snakes right there, and that bird right there. It's the little things that just mean a lot more than the actual bigger parts of it. And those birds, they look like they're going to eat something. You know? The lions just look like they're standing around and waiting for something to happen.

The staging required by natural history dioramas suggests that they can contribute to visitors' development of a sense of place, yet little research on this possibility has been undertaken. Such research is needed, not least because a number of studies suggest that developing a strong sense of place can lead to environmentally responsible behaviours. Garibay and Gyllenhaal (Chap. 16) note the richness of 'place'—with its biophysical, psychological, sociocultural and political economic dimensions. They developed an instrument to measure 'place bondedness', aspects and potential outcomes of the diorama experience and a range of possible contributing factors such as familiarity with the place, personal connectedness to nature and preferences for outdoor experiences. Data were collected from some 300 individuals at each of two sites: the *Nature Walk* diorama exhibition in the Field Museum and the *Explore Colorado* dioramas at the Denver Museum of Nature and Science.

In both museums the dioramas evoked memories that connected to people in respondents' lives and to events such as vacations, childhood explorations in nature and encounters with animals. More generally, these connections to place could be represented as concentric rings from places of individual significance through places shared with particular others to community places and, finally, iconic places—such as the Amazon or the Grand Canyon—that the visitor might not actually have visited. Interestingly though, many visitors didn't vocalise these thoughts to those with whom they visited—only to the researchers.

The Denver Museum of Nature and Science boasts fully 104 wildlife dioramas. Many of these are loved by visitors yet many are now tired after decades of use. Since 2007 the museum has introduce an enactor programme in an attempt to en-

hance visitor experience. The enactors act (fictitious) historical figures. For example, Miss Florence Epp is a young adventurer who grew up in Africa. She draws inspiration from her late 1800s' (genuine) counterparts, Mary Kingsley, Isabelle Eberhardt and Gertrude Bell, women who explored foreign lands and studied indigenous cultures. Miss Epp is most at home in the Botswana Hall, telling stories and teaching games from Africa and showing her collection of 'money cowries'. Tinworth (Chap. 17) describes the effect the programme is having.

The response of visitors to the enactor programme has been positive. Indeed, all 54 of the sampled visitors who interacted with the enactors commented positively about their interactions, stressing the uniqueness, educational value, interactive element and personal relevance/connection that the interaction brought to their museum experience. Additionally, they spoke to the ability of the enactors to interact effectively with children. Observations of the enactors at work confirmed these reports. Furthermore, visitors spent almost twice as long at exhibits when enactors were present. The enactors too were positive about the educational benefits of the programme.

Other museums have developed interactive programmes to get more from their dioramas. In the Powell-Cotton Museum, Dunmall (Chap. 18) describes the introduction of storytelling tours that frequently include dramatised narrative, audience acting out, call and response games, object handling, questions and answers and craft activity. The storytelling is aimed at a mixed-aged audience, under the guise of a children's activity. It takes often familiar tales from a mix of genres including folk and fairy tales, myths, legends and more recent 'children's stories' (e.g. Brer Rabbit) and links them to the diorama. One of the stories features Powell-Cotton himself. On his 2-year honeymoon cum expedition he may only have survived the maulings of a lion that now features in one of the dioramas because of the presence of a copy of *Punch* in his breast pocket.

Over the centuries museums have changed in terms of how they present biodiversity. Marandino, Achiam and Oliveira (Chap. 19) discuss how nowadays, just as science is more sensitive to anthropogenic effects so museums are using the notion of *immersion* as a way of extending dioramas to include the visitor as an actor within the displayed scene, thus recognising humans as agents in nature. However, due to museographic transposition, the ecology embodied in the expositive discourse (the diorama) differs from the ecology found in the scientific discourse from which, in part, it derives. Furthermore, visitors to natural history museums generally do not expect interactive devices, but the more contemplative experience typically promoted by such museums. Nevertheless, the research reported by Marandino, Achiam and Oliveira, in agreement with that reported elsewhere, shows that interactive and technological experiences can be effective.

In the final chapter in this volume, before this concluding one, Mifsud (Chap. 20) uses drawings to investigate what primary children learn when visiting the dioramas in the Natural History Museum of Malta. Malta is a small archipelago that lacks zoos or animals parks. Accordingly, the dioramas in the Natural History Museum are an important educational resource. One interesting finding was that almost half the drawings showed a feature not present in the dioramas. An initial reaction might

be one of surprise. However, if we think of representations (drawings) as attempts by individuals to make sense of what they see in the light of what they already know, this becomes less surprising.

4 Coda

Dioramas are usually snapshots: they are a moment frozen in action, so visitors can view, ponder and look again. In this way they are unlike live animal exhibits in zoos, which perform a different function for their visitors (Reiss and Tunnicliffe 2011). Moreover, in contrast with the single taxidermically prepared animal typically found in other natural history museum displays, the specimens in natural history dioramas are usually shown in clusters in a representation of their natural context, which conveys many messages for visitors to interpret. If visitors look carefully and thoughtfully, they may develop their observational and interpretative skills.

Dioramas also stimulate the construction of visitor narratives and inquiry. Inquiry is both the art and science of asking questions about a phenomenon or object, in this case a natural history diorama portraying an aspect of the natural world, and finding answers to those questions. It involves careful observations and measurements, hypothesising with reasons, interpreting and theorising. Inquiry-based learning is a way of acquiring further knowledge and understanding through the very process of questioning. Learners may raise the questions themselves spontaneously from their own first-hand observations connected with their mental model of the subject of the dioramas or the question may be put to them by a significant other, such as a facilitator or adult in charge of the child (Vygotsky 1962), to scaffold their thinking and develop concepts that may be required by formal, school curricula.

Whereas a single museum object is an *instance* of reality, a diorama is a *depiction* of reality. Of course, it might immediately be objected that even a single object involves the creation of a reality: which particular object is selected (for instance, crystals more often than ores in earth science exhibits), its aspect (terrestrial mammals are rarely shown asleep) and so on. Nevertheless, dioramas take the depiction of reality much further than a single object does. They require the designer to think about things like the numbers of objects, their positioning and staging, to indicate their inter-relationships and often a scenic background or surround. What might be termed the realist perspective—the notion that a diorama should depict reality—is illustrated by the work of James Perry Wilson (Chap. 6).

Yet, as has been argued, the situation is more complicated, not least because the attention to detail and the search for objectivity pursued by many who construct dioramas may lull the viewer into believing that they are indeed being presented with a picture of reality (Reiss and Tunnicliffe 2011). Furthermore, animals are shown doing interesting things more often than would actually be the case in nature. Male gorillas beats their chests, a leopard mauls a child, large number of different species mingle in a small area, a hippopotamus is found out of water in broad daylight and so on—the examples could continue and apply to a high proportion of

natural history dioramas. My point in noting this is not to complain but to note the slippage from 'actual reality' to 'interesting presented reality'. Dioramas are therefore a bit like soap operas. Things happen in them everyday that in reality happen only occasionally (cf. Crayford et al. 1997). Indeed, even granted the unrealistically frequent acts of predation they sometimes present, natural history dioramas often have a Garden of Eden feel to them. There is no disease or malnutrition; animals are inevitably shown in the prime of health and physical fitness, the same features that are sometimes found in children's drawings of ecosystems (Reiss et al. 2007). I suspect this reflects by viewers an idealistic view of museum reality, a view that the museum should be presenting what *should be* as much or more as *what is*.

Again, this is not to criticise natural history dioramas—it is good for us to consider what life might consist of as well as what it does. But these points mean that there is particular value, when such dioramas are used for educational purposes, in encouraging viewers to reflect on what they see and conclude. A diorama is a metaphor for reality not a faithful depiction of it. Metaphors can illuminate but they need to be examined and talked through, otherwise they can seduce unwittingly.

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