GLASS BEAD DETERIORATION OF ETHNOGRAPHIC OBJECTS: IDENTIFICATION, PREVENTION, AND TREATMENT

by

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July 18, 2006

Submitted in Partial Fulfillment

of the Requirements for the Degree of

Master of Arts

in

Museum Studies

in the

School of Education and Liberal Arts

at

John F. Kennedy University

Approved:

________________________________  _________
Department Chair      Date
TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>Purpose of Study</td>
<td>3</td>
</tr>
<tr>
<td>Research Questions and Objectives</td>
<td>4</td>
</tr>
<tr>
<td>Methodology</td>
<td>6</td>
</tr>
<tr>
<td>Limitations</td>
<td>10</td>
</tr>
<tr>
<td>Product Description</td>
<td>12</td>
</tr>
<tr>
<td>Background</td>
<td>16</td>
</tr>
<tr>
<td>History of Glass</td>
<td>17</td>
</tr>
<tr>
<td>Glass Manufacturing</td>
<td>20</td>
</tr>
<tr>
<td>Glass Bead Manufacturing</td>
<td>24</td>
</tr>
<tr>
<td>Trade and Use</td>
<td>27</td>
</tr>
<tr>
<td>Glass Disease</td>
<td>28</td>
</tr>
<tr>
<td>Glass Bead Deterioration</td>
<td>31</td>
</tr>
<tr>
<td>Treatment</td>
<td>38</td>
</tr>
<tr>
<td>Museum Literature</td>
<td>42</td>
</tr>
<tr>
<td>Conservation Literature</td>
<td>44</td>
</tr>
<tr>
<td>Conclusion</td>
<td>53</td>
</tr>
<tr>
<td>Findings and Conclusions</td>
<td>54</td>
</tr>
<tr>
<td>Surveys</td>
<td>54</td>
</tr>
<tr>
<td>Interviews</td>
<td>64</td>
</tr>
<tr>
<td>Online Discussion Groups</td>
<td>79</td>
</tr>
<tr>
<td>Conclusion</td>
<td>83</td>
</tr>
</tbody>
</table>
Recommendations 85

Bibliography 94

Appendix 99
  A: Photos 99
  B: Sample Survey 105
  C: List of Interviews 108
  D: Product 111
INTRODUCTION

Nearly every culture around the world has used beads to decorate clothing, religious objects, and functional tools for thousands of years. While beads have been made from a number of natural materials including wood, bone, shell, and stone, beads made from glass have become one of the most popular and colorful types in recent centuries. The indigenous people of North America have been well known for their intricate and unique style of work with glass beads imported from Europe. However, over the years these beads used to decorate everyday as well as sacred objects have become susceptible to a devastating type of deterioration changing the appearance and meaning of the object forever.

Glass is one of many materials commonly found in museum collections that can be potentially problematic when it comes to conservation issues. While objects such as fine historic dishes, stained glass window panes, and shimmering art sculptures are easily recognized and categorized as glass, American Indian moccasins, Indonesian baby carriers, and African ceremonial masks can easily be omitted from a museum’s list of objects that contain glass. These ethnographic objects, and many others, contain glass beads which are vulnerable to the same problems and concerns as more common glass objects—and more.
The most common and obvious concern with glass objects is breakage. The fragility of most glass objects prompts most museum professionals and volunteers to take caution when handling, storing, or displaying glass objects. A more serious concern that conservators recognize with glass is the possibility of the glass becoming chemically unstable, a process that can eventually lead to total deterioration. The problem of unstable glass is well researched and is discussed in publications by professional conservators, yet little is being done to inform the general museum community about glass disease and how it relates to ethnographic beadwork. As a result numerous cultural objects are permanently affected by the loss and deterioration of glass beads.

This master’s project focuses on glass deterioration on ethnographic objects containing glass beads and the ways in which collections management staff can identify, prevent, and care for these objects. The best strategy for preserving ethnographic beadwork is to engage both conservators and collections staff in an open discussion of the issue. This project draws heavily on the knowledge and expertise of the conservation community to make practical recommendations to collections management staff on how to deal with the problem of glass bead deterioration in museum collections.
PURPOSE OF STUDY

The purpose of this study is to bring awareness to museum professionals about how to identify, prevent, and care for ethnographic objects suffering from glass bead deterioration. These objects appear in several different types of museums, including: history museums, art museums, natural history museums, tribal museums, and anthropology museums. I also located glass beads and beaded objects in collections at a children’s museum, bead museums, textile museums, and a glass museum. Because of the wide range of museums that hold ethnographic beadwork, I included a broad range of museums in my research. This project is intended for collections managers and registrars who deal with ethnographic collections.
RESEARCH QUESTIONS & OBJECTIVES

Throughout this project I had some underlying questions and objectives that drove my research efforts and provided a framework for my findings and end product. I began my project by asking, what is glass disease and what are its causes? Furthermore I wanted to know how glass disease specifically affects glass beads on ethnographic objects and what additional problems are presented to the other materials on these same objects. With these technical and scientific questions answered, I began to investigate how wide-spread this problem was in U.S. museums by asking how many museums had object in this condition and what museum professionals knew about recognizing and dealing with this problem. Finally, I wanted to know what treatments and preventive measures can be taken to deal specifically with glass bead deterioration.

In addition to the above research questions, I developed a set of objectives that I used to guide my efforts in this project. The first objective was to research the history and manufacturing process of glass beads and how they became so popular among American Indian groups. With this information in hand I was prepared to learn the causes and properties of glass disease. After a thorough review of the literature and several interviews with museum professionals, I determined that there was a definite need to inform the museum community about glass bead deterioration on ethnographic
objects. Finally, I wanted to make practical recommendations to collections managers and registrars about the treatment and prevention of glass bead deterioration.
METHODOLOGY

For this masters project I employed several different methodologies to conduct my research. The bulk of my background material was supplied by an extensive review of past and current literature in the areas of glass history and manufacture, the production and use of glass beads, museum collections practices, and conservation. I also spoke with fourteen individuals about various issues related to glass bead deterioration; these individuals consisted of conservators, collections managers, registrars, and bead researchers. Finally, I conducted a survey of sixty-three U.S. museums to learn what was known about glass bead deterioration and how it was being dealt with by collections staff.

Literature Review

I reviewed a number of articles and book references about the production of early glass and the problems with deterioration. The problem of glass disease has been known about for some time by glass manufacturers and conservators, but the association of glass disease with beaded ethnographic objects has only begun to be recognized on its own. I sought out and reviewed as many sources as I could find that specifically addressed glass bead deterioration. Many of these references were written for
professional conservators and it was difficult to single out important details at times. I also consulted books and manuals that dealt with current practices and standards in the museum and conservation field.

**Interviews**

I conducted fourteen interviews with three groups of people: professional conservators, collections managers and registrars, and bead researchers. The conservators I interviewed were all knowledgeable about glass disease or ethnographic objects. Some conservators had previously published or presented on these topics to the professional community. I asked these conservators about the specifics of glass bead deterioration and how serious the problem was in museums. Many of these professionals I spoke with had personal stories to tell about dealing with glass disease and what they had done to treat and prevent the problem on beaded objects. I relied heavily on conservators to simplify the scientific jargon that was present in many of the written works I reviewed for this project.

The collections managers and registrars I interviewed were all currently employed in a museum with collections that housed ethnographic objects with glass beads—mostly American Indian beadwork. I asked these museum professionals about what they knew about glass bead deterioration and how they dealt with the issue in their museum. These interviews proved
particularly helpful in discovering the relationship and effectiveness of communication between conservators and collections staff. As with the conservators, the collections managers I interviewed related personal stories about glass bead deterioration and how they dealt with the issues. These particular stories provide the strongest evidence of the misunderstanding of how glass disease develops on ethnographic beadwork and how it should be dealt with. I also conducted five interviews with individuals who provided insight into cultural issues surrounding glass bead deterioration on ethnographic objects.

The next group of interviewees I am classifying as bead researchers. These individuals range from passionate enthusiasts to authors and curators at bead museums and are knowledgeable in areas of bead manufacture and use. The information obtained in these interviews was used mostly for background information and in gathering references; however, I did obtain some insightful personal stories relating to glass bead deterioration.

Lastly, I searched three separate online discussion groups for posts that relate to glass bead deterioration. I uncovered several such posts and the responses by other members of the group. The questions asked in these discussion groups showed how professionals today seek to find quick solutions to problems in their museum collections and also showed how unreliable online postings can be. The answers provided online by peers are frequently brief and sometimes grossly inaccurate.
Surveys

As part of this project, I mailed surveys to 170 U.S. museums asking questions about glass bead deterioration in April of 2005. Of these 170, sixty-three, or thirty-seven percent, were returned. In order to target museums that most likely had beaded objects in their collection, I selected museums from a broad range of disciplines, size, and geographic location. These included history museums, natural history museums, art museums, and tribal museums. During the early stages of my research I discovered three bead museums in the U.S. and decided to include these museums in my survey.
LIMITATIONS

My research on the topic of glass bead deterioration on ethnographic objects was limited by several factors. My greatest limitation was not being a professional conservator. My background in history and the arts left me poorly prepared to tackle an issue with such a strong scientific base in chemistry and physics. As a result I relied heavily on conservators and members of the scientific community to translate many of the technical and scientific terms into layman’s terms so that I could understand the processes being discussed. Nevertheless, there are still concepts and properties that I may never fully understand on the same level as a conservator or chemist. Glass disease in general has been well studied and known about in the conservation community for some time. This project is not a regeneration of glass conservation research, but is a review of the literature available today and how it applies specifically to glass bead deterioration.

Aside from knowledge limitations, my research was bound by my availability of time and money. Additional surveys, a more complete review of the literature, site visits, and actual experimentation with treatment options were not possible due to the added time and money needed to complete such tasks. While I believe that my research has been thorough and accurate, I believe that more research and information would have produced a similar conclusion with a somewhat stronger argument.
My recommendations for recognizing, preventing, and treating glass bead deterioration are directed toward collections managers and registrars, not professional conservators. Since collections staff are usually the first line of defense in preventive conservation, it is imperative that they have the proper knowledge and skills to handle a variety of situations. My recommendations and product are meant only as guidelines for collections staff and not as definitive solutions for preventing or stopping glass bead deterioration.
PRODUCT DESCRIPTION

The final product for this master’s project is an informational web site about glass bead deterioration. My research finding for this project show that in the age of “Google” people first look to the internet for quick and easy answers to questions about collections issues. My research specifically reveals several posts in online discussion groups about how to deal with cleaning and other problems with ethnographic beadwork. The answers to these questions are brief at best and sometimes inaccurate. For this reason I have produced a web site with information and resources about how to deal with glass bead deterioration. This web site is available to museum staff when searching for keywords and topics relating to beadwork conservation on the web. The medium of a web site also allows for continuous updating of information and images as well as there being no cost to view the information. The web site can be accessed at http://bead-disease.122mb.com or at http://bead-disease.com.

The web page is composed of five main parts: an introduction, history of glass beads, overview of glass disease, glass bead deterioration, and resources. The introduction briefly outlines the remaining four sections and explains how the web site came about. A menu bar placed on the left hand side of the screen remains visible on every page, allowing users to quickly jump to any of the five main sections of the site.
The history section of the web site contains four separate pages: history, glass making, bead manufacturing, and trade and use. The story of glass bead production is essential to understanding how and why glass from certain time periods is more susceptible to becoming unstable in the future. A short overview of the materials and processes used in making glass prepares the reader to understand the deterioration process. The final manufacturing process is what makes glass beads different from other glass objects, for that reason the techniques and processes of finalizing glass into beads is discussed. The last page in the history section is trade and use. This section discusses the introduction of beads to North America and the multiple uses of beads by American Indian people for centuries.

The second section of the web site describes the problem of glass disease in general. This section has the largest amount of scientific terms and contains a link to a glossary of terms used throughout the site. The information about how glass disease develops is essential to understanding how the condition works specifically with glass beads.

The third section is the most important part of the web site. This section deals directly with glass bead deterioration on ethnographic objects. This section has three parts: symptoms and stages, prevention, and treatment. The first part, symptoms and stages, describes the various physical aspects seen on the beads at each stage of the deterioration process. The full color photos clearly illustrate each stage—a characteristic that is lacking in many
publications about bead deterioration. The photos and text are the tools that collections managers need to identify glass disease on beaded objects.

The other two parts of the glass bead deterioration section discuss prevention measures and treatment options. This is where the reader will find the most practical information about dealing with glass bead deterioration. The preventive measures are suggestions and actual practices that conservators and collections managers use to effectively slow or prevent the affects of glass disease on ethnographic beadwork. Treatment options are few, but they are listed to inform the reader about the available options. A warning is included at the bottom of this page about consulting a professional conservator before attempting any cleaning or treatment on an object.

The fifth and final section of this web site is a list of resources for further research and help. The full bibliography of this master’s thesis is contained in the section. Also included is a list of museums with conservators from across the country that specialize in ethnographic objects and glass conservation. Finally there is a link to send an email to me for questions or comments about the web site.

One of the advantages of a web site over a printed medium is that the information can be changed or updated with ease. This site will be maintained to the best of my ability and updated with new resources and photos when available. When posters to online discussion groups ask
questions in the future about glass bead conservation, the web address can be given instead of a brief and general response by another group member.
BACKGROUND

Some of the most beautiful and recognizable objects from American Indian culture have been decorated with a multitude of brightly colored glass beads. These beads were manufactured in Europe and obtained through trade beginning more than five centuries ago. Poor glass manufacturing practices and unfavorable environmental conditions have caused some of these glass beads to deteriorate over time. In most cases only one type of bead or glass color has deteriorated on a single object. In the most severe cases, the deterioration can leave a blank space in the beadwork design. When the deterioration reaches this point it has not only caused physical damage to the object, but it has also affected the meaning and interpretation intended by the artist.

All glass objects, including glass beads, have the potential to succumb to deterioration under the right conditions. Once the deterioration process has started it is impossible to reverse and difficult to stop. Proper storage, display, and environmental monitoring can prevent or lessen the deterioration process and preserve the magnificent beadwork tradition of native North America.

The root of the problem with deteriorating beadwork lies in the manufacturing process of the glass beads themselves. While any glass object can deteriorate under certain conditions, beads were often made from poor
quality glass in order to save time and money. Once the beads are made they are transported, traded or sold, and then used by American Indian people to embellish both sacred and secular objects. The materials and techniques used in beadwork bring an added level of conservation concern to beaded objects. Trade cloth, thread, and tanned animal skins react with the deteriorating glass and create problems unique only to glass beads. To fully understand the deterioration process, we must first look at the manufacturing process that produced glass beads and the history of the glass industry in Europe.

**History of Glass**

It has been commonly accepted by scholars that glass was first discovered around 1700 BC in the Middle East. Most likely fire pits were dug in sandy areas and the immense heat from the fire accidentally melted the sand. As a result the silica in the sand—the main ingredient for making glass—cooled to form a hard, glossy mass that held its shape. After centuries of experimentation, various cultures throughout the Mediterranean region, including the Egyptians, learned to control and form molten glass to produce a variety of colors and shapes. These talented people created functional glass containers as well as decorative art and adornment pieces. Primitive glassworks were reserved for the wealthy and powerful elite class. To prevent lower classes from gaining access to these highly sought after items,
only a select group of individuals possessed the secrets to the manufacturing processes of early glass, and great care was taken to preserve and protect these secrets.¹

The most influential breakthrough in the history of glass making technology occurred in Syria around 200 BC. Craftsmen in this region discovered that a lump of molten glass placed on the end of a metal pipe could be blown into a bubble and manipulated to form an infinite number of shapes and sizes. This process—known as glass blowing—allowed glassmakers to mass produce objects of identical size and shape. The invention of glassblowing has been the single most important discovery in the history of glass making.²

During the thirteenth century A.D., the Islamic and Byzantine Empires of the Near East were developing stained, enameled, and colored glass. Italian craftsmen learned this art form through their extensive trade colonies in the Eastern Mediterranean and brought the knowledge back to the coastal city of Venice. Venetian glassmakers quickly excelled in the production of a variety of glass goods, including bottles, containers, sculptures, and beads. The public’s reception to the introduction of glass in southern Europe was not unlike that of the earlier Egyptians. Glassmakers

² Mentasti, 38-44.
were regarded as the most skilled and talented of the craftsmen. The Italian
glassmakers set high standards of manufacturing to ensure that their
glassworks were of superior quality. Their insistence on perfection made the
finished products become some of the most expensive commodities in
Europe.\(^3\)

In 1292, the entire Venetian glass making industry was relocated to
the nearby island of Murano. This move was a two-fold strategy to protect
the secrecy of the advanced Venetian glass technology from spreading to
other countries as well as to buffer the mainland from the constant threat of
fire that could easily escape the immense furnaces. Once relocated to
Murano, glassmakers and their families were forbidden, by penalty of
imprisonment or even death, to share their trade secrets with craftsmen in
other countries. Although glass manufacturing was active throughout
Europe, Venice held the monopoly on glass.\(^4\)

Venice remained the powerhouse in glassmaking for nearly 300 years.
By the sixteenth century, information and trade secrets slowly leaked from
Venice as the power and control of the local government declined. France,
Britain, Germany, and Bohemia—now the Czech Republic—began to
produce glass at and above the quality of Venice. With glass factories now
spread throughout Europe, trade schools and craftsmen’s guilds began to

\(^4\) Ibid., 83.
form allowing young apprentices a place to go and learn the once secret formulas and techniques of fine glassmaking. Many of these artists who began working in the Northern region of Bohemia, between the German and Polish borders, specialized in the production of glass beads.\(^5\)

**Glass Manufacturing**

Glass manufacturing is a complicated and precise art requires patience, skill, and knowledge. The essential ingredient for making glass is silicon dioxide (SiO\(_2\)), or silica, obtained from sand. While nearly half of the earth’s surface is covered with silicon dioxide sand, only a few select areas have the purity needed to produce high quality glass. The finest sand for making glass is found naturally throughout the South Pacific region. Sand from most other areas must be processed and refined to remove elements and impurities that can cause structural flaws and discoloration in the glass.\(^6\)

To make glass, silicon dioxide is melted at a very high temperature of more than 1700 degrees Celsius. The molten glass is then formed into a desired shape and finally cooled to produce the finished product. The melting temperature, however, can be lowered by the introduction of fluxes. Fluxes are elements that mix with the silicon dioxide allowing the particles to move easier and liquefy at a lower temperature, thus requiring less fuel to

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\(^5\) Mentasti, 112-113.  
\(^6\) Ibid., 12-34; Davison, 73.
heat the furnace. While several fluxes are known to be used, sodium carbonate ($\text{Na}_2\text{CO}_3$) and potassium carbonate ($\text{K}_2\text{CO}_3$) are the two most commonly used when making glass beads. During the melting process, the flux releases carbon dioxide gas from the glass mixture leaving sodium oxide or potassium oxide in the glass. Sodium carbonate and potassium carbonate—commonly known as soda ash and potash—are easily and inexpensively obtained from plant ashes.\(^7\)

The desired finished glass product determines the chemical formula for the glass mixture. Most glass objects require a stabilizer to produce chemical or physical properties essential to the function of the glass, such as increased hardness or resistance to chemicals or extreme temperatures. These stabilizers are commonly found in the form of oxides derived from metals such as aluminum, zinc, magnesium, and lead—used in the production of lead crystal. The glass most commonly used for making beads contains calcium carbonate ($\text{CaCO}_3$) to improve hardness and chemical resistance. As with fluxes carbon dioxide is released from the mixture during the melting process, leaving calcium oxide ($\text{CaO}$) in the glass. Calcium carbonate, also known as lime, is found naturally in limestone, marble, and chalk. Glass made using lime as a stabilizer and soda ash as the primary flux is called

\(^7\) Davison, 73.
soda-lime glass, and is the most common type of glass used for making beads.\(^8\)

The single most important factor for beads is color. Glass can be colored by adding oxides of pure chemical elements such as copper, chromium, manganese, iron, cobalt, nickel, vanadium, titanium, and even uranium.\(^9\) Coloring formulas are among the most highly kept secrets, as the same element in different glass mixtures or different oxides of the same metal can produce different colors. Occasionally, materials containing fluorine, such as fluorspar and certain phosphates, are added to produce small crystalline particles in the glass. These crystals give the finished piece a cloudy or milky appearance commonly known as lattimo or milk glass.\(^10\)

The final ingredient that is often added to a glass mixture is small bits of ground glass called cullet. Cullet is typically made up of pieces of broken or discarded glass. Glass factories always save their cullet for use in future mixtures. The cullet acts as a fluxing agent, helping the silicon dioxide melt faster. Color can also be added by introducing cullet of colored glass. Coloring with cullet typically produces a translucent glass opposed to an opaque glass. Adding cullet to the mixture strengthens the glass as well as conserves costly raw materials.\(^11\)

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\(^8\) Ibid., 73-75.  
\(^10\) Gable, 31.  
\(^11\) Mentasti, 16.
Gathering the raw materials to make glass is only the first step to producing a finished piece. The materials must be ground to a powder or granular form and free of any impurities in order to ensure consistency and prevent undesired results. Often times it is difficult to determine the exact color and appearance of the glass until after it is cooled. The ingredients are added at various stages of the melting process when the ideal temperature is reached. Ingredients must also be mixed in precise proportions to make glass with the necessary physical and chemical properties. A typical soda-lime glass formula would be approximately seventy-four percent sand, sixteen percent soda ash, five percent lime, one-half percent potash, three percent magnesium, and one percent aluminum.\(^{12}\)

Once the glass mixture has reached its molten form, it can be formed into an infinite number of sizes and shapes. Glass blowing is the most common technique used to form objects out of molten glass. This technique employs the use of a tool known as a *canna de soffio*, or blowpipe. The glassmaker gathers a clump of molten glass mixture at one end of the blowpipe. Air is blown through the pipe creating a bubble in the glass. This bubble can be blown into a mold or hand worked to form a custom shape. Modern glass objects are blown by machines making it possible for

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\(^{12}\) Ibid., 19.
thousands of glass pieces to be produced with incredible accuracy and consistency.\textsuperscript{13}

When the molten glass has reached its finished form, the glass is hardened by allowing it to cool. Glass must be cooled at a slow rate to reduce strain and prevent breakage. The process of controlled cooling over an extended period of time is known as annealing. Thicker glass objects require longer annealing times to ensure consistent temperature on the surface as well as the interior of the glass.\textsuperscript{14}

\textbf{Glass Bead Manufacturing}

Some of the earliest glass objects produced in the factories at Venice and Murano were glass beads. As the popularity of the Roman Catholic Church spread throughout Europe, the increased demand for prayer beads and Rosaries drove the glass bead industry into mass production.\textsuperscript{15} The global explorations beginning in the fifteenth century resulted in an additional outlet for glass beads as trade items with natives from Africa, the Far East, and the New World—North America. Beads were among the simplest glass objects manufactured in the Murano factories because they had minimal functional specifications and some level of inconsistency and error was overlooked.

\textsuperscript{13} Gable, 45-48.
\textsuperscript{14} Ibid., 48; Mentasti, 33-35.
Glass beads were not expected to withstand extreme temperatures nor were they expected to undergo unusual levels of stress. The only necessary functional aspect of beads was to have a hole and retain a vibrant color. For these reasons the glass making standards and quality for making beads was not as good as other glass objects. Glass mixtures were often made with an unusually large percentage of flux to reduce the overall melting temperature and conserving valuable furnace fuel.  

Beads are made in a wide variety of sizes, shapes, finishes, and colors. Modern technology and machinery has only increased the range of possibilities for making glass beads. Beads are generally grouped into two major categories based on their method of manufacture: drawn beads and wound beads. Drawn beads comprise the types commonly known as seed beads, pony or pound beads, basket beads, tile beads, and chevrons. Mellon beads, mulberry beads, eye beads, and most other fancy beads are all made using the wound technique.  

Drawn beads are made with the glass blowing process described above. Once the molten glass mixture is blown into a bubble, the blowpipe is plugged and a metal rod is attached to the opposite end of the bubble. The rod and blowpipe are immediately passed on to two runners who stretch the bubble into a long hollow tube up to 300 feet long. The air inside the bubble

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16 Ibid., 39, 93, 98; Peter Francis, Jr., *Beads of the World* (Atglen, PA: Schiffer, 1999), 54.
17 Mary Elizabeth Good, “Glass Bead Manufacturing Techniques,” in *Beads: Their Use By Upper Great Lakes Indians* (Grand Rapids: Michigan Indian Press, 1977), 29; Dubin, 93.
retains its pressure to keep the glass tube from collapsing on itself and closing the hole. The walls of the glass are very thin, so little to no annealing is needed to cool the glass. The long tube is then cut into shorter tubes and grouped by size. The short tubes are then scored and cut into uniform sized pieces. Additional heating and polishing rounds off the rough edges producing uniform sized glass beads.\textsuperscript{18}

Several variations are possible when making drawn beads. If the glass bubble is pressed onto a flat surface on several sides, the flat edges will stretch when the glass is drawn creating square or faceted beads. Before being drawn the bubble can be dipped into another color of glass resulting in a bead with a different colored center. Opaque white glass is frequently used for these types of beads, commonly referred to as “white hearts.” In some occasions the finished beads undergo an additional polishing or grinding process to produce fancy finishes or flat edges known as cuts.\textsuperscript{19}

Unlike mass produced drawn beads, wound beads are made one at a time by wrapping molten glass cane around a metal rod called a mandrel. The glass cane is similar to drawn glass used for making beads except the glass is not blown so it forms a solid cane opposed to a hollow tube. The cane is melted by a torch-like instrument and is removed from the glass quickly to allow the bead to cool and take shape. Color variations and patterns are added by introducing different colored canes to the bead. When

\textsuperscript{18} Good, 29-30; Francis, 56-57.  
\textsuperscript{19} Good, 30.
finished the hole is created as the mandrel is removed from the bead. In addition to color and design variations in wound beads, shapes are created by pressing the semi-ductile glass into a mold or by rolling it across a flat slab with the design carved in relief.\textsuperscript{20}

\textbf{Trade and Use}

Beads quickly became a highly prized trade commodity as European explorers began to penetrate the African and North American continents and the islands of the South Pacific starting in the fifteenth century. Glass beads gradually replaced many of the decorative arts practiced by the native people in these areas. Large beads were strung as necklaces and used as fringe on large objects, while the smaller seed beads were sewn onto tanned animal skin and trade cloth or woven into intricate bands. A variety of cordage materials were used to string beads of all sizes, including leather, plant fiber, sinew, and commercially spun cotton and linen thread obtained through trade.\textsuperscript{21}

American Indians adapted techniques of earlier porcupine quillwork or fiber weaving into their beadwork tradition. Many of the design elements remained the same in both native fiber arts and beadwork; although, the

\textsuperscript{20} Ibid., 30-32; Francis, 54-56.

increased availability of beads augmented the color palette for many tribes. Beadwork quickly became the dominant art form for most of native North America. A unique tradition of beadwork began as women created crafting societies and established distinct tribal styles to identify their work. Everyday objects, as well as sacred or ceremonial objects, were decorated with beads. Each color and design was carefully and meaningfully chosen by the artist for a specific reason. Some of these objects have existed for more than 200 years and have started to show signs of deterioration. Once the affected beads have totally disintegrated the intended appearance and meaning of the object has been changed forever.

**Glass Disease**

Most glass objects remain relatively stable for hundreds of years; however, some problems exist in certain types of glass rendering an object chemically unstable. Conservators and chemists have researched this problem and in true conservation fashion have coined the term “glass disease” to refer to this condition. Essentially, glass disease is caused by poor or inconsistent manufacturing techniques—specifically the ratio of flux

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and stabilizer in the glass. The visible symptoms of glass disease are weeping or sweating, cloudy appearance, white powdery substance on the surface, small cracks or crizzling, and breakage. Other symptoms, such as tiny cracks and fissures, are visible only with the aid of a microscope or other instruments. Aside from assessing visual symptoms, certain tests measuring acidity and chemical composition can be performed to determine if an object is in fact suffering from glass disease.\(^\text{25}\)

Glass disease occurs when alkaline salts in the glass are drawn to the surface by water or humidity. These alkaline salts are mostly composed of sodium and potassium, common fluxing agents in glass. These alkaline salts are drawn to the surface by hydrogen ions in water causing them to fluoresce. The solution that comes to the surface during this process is a mixture of sodium hydroxide and potassium hydroxide which can be seen on the surface of the glass in the form of moisture spots, commonly referred to as weeping or sweating. Once this alkaline hydroxide solution is exposed to the dry outside air the sodium and potassium crystallize in low humidity creating white powdery substances known as sodium carbonate and potassium carbonate. These alkaline carbonates usually have a high pH of nine or ten.\(^\text{26}\)

The alkaline environment attracts more moisture causing the glass


\(^{26}\) The pH scale (potential of hydrogen) measures the acidity of a substance. A low pH of zero to six means a substance is an acid, while a high pH of eight to fourteen is a base. Solutions with a pH of seven are neutral.
the deterioration process to escalate. The scientific and conservation communities refer to this process of deterioration by several terms, such as: de-alkinization, leaching, alkali-deficient, silica-rich, hydrogen glass, or the gel layer.

As more and more alkaline salts are removed from the glass, small pores form on the surface. These pores increase the surface area allowing for more moisture to come in contact with the glass. Over time the pores grow and form tiny cracks. Small networks of cracks are known as crizzling. Eventually, the crizzling leads to larger cracks making objects brittle. In extreme situations the glass becomes so cracked that the object can break or even shatter.

As stated above, the factor that is most damaging to unstable glass is water, especially in the form of relative humidity. Consistently low humidity levels will stabilize the glass preventing further deterioration. Consistently high or fluctuating humidity levels will continue to cause the alkaline salts to surface and continue the deterioration process. For this reason conservators

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27 Susan M. Bradley, *Do Objects have a Finite Lifetime*, in *Care of Collection*, (London: Routledge, 1994), 55-56 states that glass that contains lead has been shown to prevent the introduction of moisture and stabilize glass objects thus preventing deterioration; Davison, 175.
28 Davison, 174-175
recommend low humidity levels of forty to forty-five percent RH as the best environment to prevent glass disease.\(^30\)

**Glass Bead Deterioration**

Not all glass beads suffer from glass disease; in fact very few beads currently show signs of deterioration. However, beads can be more susceptible to glass disease due to the nature of their manufacture. Beads are among the smallest and most mass produced glass objects manufactured in Europe. Beads have the simple purpose of being aesthetically pleasing; they are not subject to extreme temperatures and high levels of stress like other more functional glass objects. For this reason beads are made from glass with an incredibly large amount of flux—sodium and potassium—to lower the melting temperature and reduce the amount of costly fuel needed to heat the furnace. The unusually large amount of alkaline metals used in the glass greatly increases the possibility of glass disease occurring in the future.\(^31\) Chemical analysis of glass beads shows a flux to silica ratio as high as one-to-one. To correct this problem of instability calcium oxide is frequently added to stabilize the glass. Calcium oxide is commonly found in the form of lime or chalk which gives the beads a white or opaque appearance. To obtain


\(^{31}\) Lougheed, 109.
certain colors or transparent affects to the beads, calcium oxide is occasionally excluded from the glass mixture, thus making these bead colors more susceptible to glass disease.\footnote{Davison, 118, 177.}

Although the deterioration process is the same in all glass, glass disease develops in a unique way on beaded objects. Most glass objects are comprised of only glass, such as bottles, stemware, sculptures, and windowpanes. American Indian beadwork consists of glass beads along with various cordage materials and support fabric such as leather or cloth. It is also not uncommon for natural pigments or plant particles to be present on a beaded object for ceremonial purposes. All these elements create added difficulties when dealing with glass bead deterioration on ethnographic objects.\footnote{Ann Howard-Krahn, “Conservation: Beadwork,” \textit{American Indian Art Magazine}, 1986, 11(4), 24-29.}

The early signs of glass bead deterioration occur during the sweating or weeping stage of glass disease. The alkaline solution that surfaces on the beads is sticky and attracts dirt and dust. This clear solution may be difficult to recognize on small beads suffering from glass disease, but they will often have a dirty or grimy build-up not present on nearby stable beads contained on the same object.\footnote{Lougheed, 110.}

When the early stage of sweating or weeping occurs in beads attached to animal hide, an additional chemical reaction can take place. The alkaline
solution reacts with fatty material in the leather creating an oil or soapy residue. This process is known as saponification. The first record of this condition is by June Hosford, objects conservator at the South African Museum of Natural History. Hosford reported this unique reaction on a Ndebele—African—beaded apron. She observed that the soapy mixture attracts high amounts of dust and dirt that can spread to adjacent beads.

Saponification is observed on a wide range of beaded objects from cultures around the world with different bead types, animal skin species, and tanning methods. To date there is no explanation as to why saponification occurs on some beaded objects suffering from glass disease and not on others.

The next stage of glass bead deterioration occurs when the sweating or weeping alkaline solution crystallizes on the surface forming a white powdery substance. This powdery material is composed of sodium carbonate and potassium carbonate. When the alkaline hydroxide solutions, formed during the sweating or weeping stage, is introduced into a dry or low humidity environment it dries and turns into an alkaline carbonate solution. The alkaline carbonate attracts moisture to the glass surface causing more sweating or weeping and the deterioration process accelerates. The alkaline carbonate solutions can weaken or break the threading material in the

36 Ibid.
beadwork. The substrate, or supporting fabric to which the beads are attached, can also be affected by this process.  

Sandra Lougheed identifies two unique visual signs of glass bead deterioration on ethnographic objects: bleached image on cloth and darkening of leather. Both of these conditions refer to the substrate material to which the beads are attached. Bleached image refers to a white or ghost image of the beads on dark wool, cotton, or silk cloth. The image is the result of the powdery alkaline carbonate rubbing off of the beads onto the substrate material. A similar condition occurs when affected beads are in direct contact with leather. Alkaline hydroxide from the glass is absorbed by the leather causing dark discolored areas. Bleached image and darkening of leather are both glass disease symptoms but on their own can indicate other problems as well.  

As more sodium and potassium migrate to the glass surface, the beads become more fragile and unstable. The next stage of the deterioration process is marked by an intricate network of tiny cracks on the surface known as crazing or crizzling. Crizzling is often difficult to recognize, especially on opaque beads, yet microscopic examination reveals the symptoms quite clearly. In transparent and translucent beads, crizzling often produces a dull finish or opaque appearance.

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37 Lougheed, 111-112.  
38 Ibid., 111.  
39 Brill, 121-131.
Glass bead deterioration most often occurs on the surface and works inward. In rare occasions interior cracks or cracks radiating from the threading hole appear on glass beads. Ann Frisina, Textile Conservator at the Minnesota Historical Society, suggests that moisture can travel through the threading material like a wick to start the deterioration process from the hole of the bead rather than the exterior surface.\textsuperscript{40} Interior cracks, or cracks that form within the walls of the bead, are frequently the result of improper annealing when the glass is cooled, incorrect proportions of raw materials, or poor mixing of the molten glass.\textsuperscript{41} Internal cracks are very difficult to identify, even with a powerful microscope. One way to identify internal cracks is to look for color change during light scattering tests.\textsuperscript{42}

The final and most severe stage of glass bead deterioration results in broken and missing beads. Crizzling and cracking continue until the bead is so weak and so much of the sodium and potassium have been removed from the glass that it simply falls apart. This stage of glass disease on beads is relatively easy to recognize as bead fragments may be present on the object or on storage and display lining near the object. A key characteristic of affected beads in this stage is for only one type or color of bead to be missing when surrounding beads remain intact. Beads broken or missing from the

\textsuperscript{41}Lougheed, 111.
\textsuperscript{42}Ibid.
deterioration process often create an area that is void of a particular color in the overall design scheme. Deterioration should not be confused with beads missing as a result of broken threading material, which can cause all bead types and colors in a particular area to fall off. When threading material breaks whole beads will fall from the object as opposed to bead fragments due to deterioration. When glass disease is the cause of missing or broken beads, it is common for the threading material to remain in place after the beads have deteriorated. Glass disease can cause threading material to become weak and break allowing non-affected beads to fall off, but this is uncommon and should not be considered as a symptom of deterioration.43

In rare occasions the visual symptoms of glass bead deterioration are mistaken for other problems in ethnographic beadwork. A form of white clay, called kaolin, is commonly used by American Indian people to clean white buckskin decorated with glass beads. Over time kaolin becomes powdery and may transfer to the surface of the beads creating a white powdery substance similar in appearance to the efflorescence of alkaline carbonates. When kaolin residue is present glass disease can usually be ruled out when the white powdery substance appears on all beads in a given area as opposed to only one color or type of bead.44 A simple pH test will also

43 Ibid., 110.
determine if a powdery substance is in fact glass disease as kaolin is a mild acid while alkaline carbonate is a base.

It is commonly known among bead researchers and others that certain colors of beads—namely blues, reds, and black—tend to be more susceptible to glass disease. One researcher in Florida described a milky-blue bead referred to by local artisans as “bursting blue” because of its tendency to deteriorate on historic objects. Other researchers have called the same color “pony trader blue” in reference to the early European-American traders who transported goods by pony pack trains. The overwhelming occurrence of this specific color to deteriorate has caused many museum professionals and researchers to look for answers to the deterioration problem in the coloring elements of the glass. It is possible that to obtain bead colors such as “bursting blue” the glass formula may have required high amounts of flux and low amounts of stabilizer, but in general the coloring elements have not been directly responsible for deterioration.

Visual examination of beaded objects is the easiest and most efficient way of identifying glass bead deterioration in a large collection. Professional conservators use chemical tests and precise scientific equipment to examine beads and accurately determine whether or not an object is suffering from glass disease. Some tests allow an object to completely remain intact during testing while others require samples of crystals or broken beads from the

45 Jason Wolz, personal conversations with author, Indiana University, Bloomington, August 2, 2002.
object in order to be analyzed in a laboratory. Carbonates, chlorides, oils, and specific metals are detected by tests using only small sample sizes. Beads are also subjected to scanning electron microscopy and electron beam x-ray micro-analysis to positively identify the presence of potassium carbonate on deteriorating beads. While these tests are accurate and thorough, the high costs of materials, equipment, and time do not prove to be much more effective than visual diagnosis when identifying glass bead deterioration.

Treatment

Conservators experiment with a variety of preventive conservation methods and treatments to control and counter the effects of glass disease on beaded objects. Preventive measures deal mostly with safe cleaning and strict control of environmental conditions in storage and exhibit spaces. Current treatment options are confined to the application of consolidants and coatings. Once glass beads have started to deteriorate the process is irreversible. For this reason most of the proactive measures to counter glass bead deterioration focus on preventive measures.

So far conservators have not been successful in treating the advanced stages of glass disease. One approach they have taken is to apply a surface

46 Lougheed, 112.
47 Carrol and McHugh, 31-37.
coating to the beads. This process serves partly to block out any moisture that can cause efflorescence of alkaline salts. The application of surface coatings has an adverse affect by create an alkaline micro-environment around the beads that increases deterioration of the glass. Other surface coatings are applied to severely cracked glass beads as a consolidant. The idea behind consolidants is to hold the beads together with special glue-like chemicals to prevent further fragmenting and bead loss. Experiments conducted using polyvinyl butyral in ethanol and Acryloid B-72 in toluene as well as other chemicals produce mildly acceptable results. Fracturing beads are shown to hold together for a period of time, but the long term effects of this treatment are still unknown. The largest drawback to consolidants is the time consuming task and the difficulty of coating the entire surface of the bead while it is still on the threading material.\footnote{Lougheed, 113; Ruth Norton, telephone interview with author, May 17, 2005.}

While treatment with coatings and consolidants remain largely unsuccessful and unlikely to correct the later stages or deterioration, conservators demonstrate great success at slowing or even halting the early stages of glass disease by employing strict preventive conservation measures. The two most damaging factors for affected beads are fluctuations in relative humidity and an alkaline environment. Routine and proper cleaning with alcohol or saliva—not water—along with accurate monitoring and adjusting...
of the environment are essential to preventing or slowing the deterioration process on glass beads.

Moisture, in the form of water or humidity, increases the process of glass bead deterioration. Current conservation and collections management literature vary as to the desired level of relative humidity for storing glass objects; most sources recommend a range of forty to forty-five percent RH. However, all sources agree that extreme humidity levels or fluctuations in relative humidity can be detrimental to glass beads. The alkaline salts that appear on deteriorating beads are hygroscopic, meaning they attract moisture from the air. These salts come to the surface when humidity is high and crystallizes when the humidity is low. When these solutions attract more moisture to the glass surface the deterioration process is repeated at an increased rate. If affected beads come into direct contact with water, such as during cleaning, the process is accelerated even more.\textsuperscript{49}

One rare example of how alkaline environments affect glass bead is revealed by Scott Carrlee, conservator at the Alaska State Museum. Carrlee’s examination of a glass bead on an Inuit harpoon in the collection of the National Museum of the American Indian reveals the presence of sodium chloride (NaCl), most likely acquired from used in sea water. Sodium chloride acts in a similar way to the alkaline carbonate solutions efflorescing from deteriorating glass beads by introducing moisture to the bead and

\textsuperscript{49} Werner, 45-48; Barbara Lang Rottenberg, “Care and Display of Glass Collections,” \textit{American Association for State and Local History Technical Leaflet}, 1980, 127.
causing further deterioration. This example shows that other outside factors, in this case salt water, can produce unpredictable characteristics on deteriorating beads.

In addition to humidity fluctuation, a high alkaline environment accelerates the deterioration process by attacking the silica network in the glass, which occurs at a pH of nine or higher. When sodium or potassium carbonates or hydroxide—all alkaline solutions—are present on the surface of glass beads the pH level of the environment around the object elevates. Removing these alkaline solutions lowers the pH level of the surrounding environment and helps slow or, in some cases, stop the deterioration process all together. Conservators typically use stiff brushes and solutions of diluted alcohol to remove the carbonate buildup on deteriorating beads. Cleaning with water or soap is discouraged in most instances as it attracts moisture to the beads and causes the deterioration to progress.

Other environmental factors contribute to the deterioration of glass. Organic air pollutants, such as acetic acid and formic acid—formaldehyde—can influence the alkaline salts on the surface of deteriorating glass. These chemicals are produced from off-gassing of wooden storage or display cabinets and furnishings. Glass objects also require adequate air circulation to prevent moisture in the air from collecting on the surface of the glass.

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51 Frisina, 139-142. 
52 L. Robert et al, Understanding Glass Deterioration in Museum Collections through SIMS Analysis, unpublished paper.
Lastly, extreme temperatures have been shown to destroy unstable objects already affected by glass disease. Such temperatures are encountered as a result of a building fire or freezing.\textsuperscript{53}

**Museum Literature**

Specific literature addressing glass disease and ethnographic beadwork has been scarce in the past. Scott Carrlee—formerly Scott Carrol—and Kelly McHugh conducted an extensive literature search for glass bead deterioration in preparation for their presentation at the Conservators of Ethnographic Artifacts Seminar in 1999. As a result they found few specific references to glass bead deterioration and treatment options.\textsuperscript{54} A comprehensive bibliography obtained from the Rakow Research Library at the Corning Museum of Glass in Corning, New York, added little to the already thin body of literature on the subject.\textsuperscript{55} For this project I conducted a broader search of the general museum literature and added little to the definitive bibliographies amassed by Carrlee, McHugh and the Corning Glass Museum.

General collections management texts vary as to how glass disease is discussed and the recommendations giver to prevent and treat the problem.

\textsuperscript{53} Stephen Koob, telephone interview with author, June 14, 2005.
\textsuperscript{54} Carrlee interview, 2005.
\textsuperscript{55} Unpublished bibliography from Rakow Research Library, Corning Museum of Glass.
The New Museum Registration Methods is a standard publication used by professionals in museums of all sizes as a basic resource for collections management and care. Although the main focus of this book is not conservation, some basic guidelines are given for storage and identifying potential problems for many object types. Glass is given only a short three line passage in the section labeled “Specific Collections Needs.” The entire section reads: “Glass (e.g., archaeological glass, art glass): 40-50% RH. Pad storage shelves or drawers with microfoam or polyester batting.” The relative humidity recommendation is slightly outside the forty to forty-five percent suggested by conservators. In addition, no mention is given on how to recognize the symptoms and stages of glass disease or how to deal with the problem.56

Susan Bradley writes a decent description of glass disease and even identifies ethnographic beadwork as a potentially problematic object type in her article Do Objects Have a Finite Lifetime, published in Care of Collections. Bradley points to previously published sources that vary on issues such as relative humidity recommendations, suggesting that further study and collaboration is needed in the field.57 Glass bead deterioration is mentioned by Carolyn Rose in Preserving Ethnographic Objects, suggesting that beads may be affected if they feel soapy, become cloudy or crizzled, or

57 Bradley, 55-56.
show signs of crystalline deposits on the surface. Rose also makes a valid point in saying that “the ideally dry storage conditions recommended for unstable glass may be overly dry for adjacent organic material.” This is especially true for beadwork adornment on leather garments or beads that have sinew as a threading material.\footnote{Carolyn L. Rose, “Preserving Ethnographic Objects,” \textit{Conservation Concerns: A Guide for Collectors and Curators} (Washington D.C.: Smithsonian Institution Press, 1992), 119-120.}

\begin{center}
\textbf{Conservation Literature}
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Unlike the general museum literature, the international conservation community has discussed glass disease—and to a lesser extent deterioration of glass beads—quite extensively. Glass disease became a relevant topic in conservation circles beginning in the 1950s. R. M. Organ was one of the early conservators to study glass disease and publish his research findings. Organ’s 1957 article in \textit{Museum Journal} brought the problem of glass disease out from behind the conservation curtain and introduced it to the general museum community. The article outlined problems encountered at the British Museum in London, and provided details for constructing a special storage cabinet developed to lower the humidity of a small storage area. The wooden cabinets employed the use of electric fans to circulate air and silica
gel to absorb excess moisture.\textsuperscript{59} The basic design of Organ’s storage cabinet has changed very little over the past fifty years and the concept is still used by museums today.

Another publication of the same era as Organ’s article was published in 1966 as a Technical Supplement in \textit{Museum News} by A. E. Werner. Werner’s article built upon Organ’s work by including pictures and a more detailed description of glass disease. Werner presented the causes and signs of glass disease and described the steps needed to reduce further deterioration. Organ’s diagram for a storage cabinet for glass objects was reprinted in Werner’s article, and practical advice for cleaning and handling glassworks was added.\textsuperscript{60} The vast majority of early references to glass disease appeared almost exclusively in European journals; Werner’s article was the first museum publication to address glass disease in the United States. While these early publications introduced the concept of unstable glass to museum professionals, all of them fail to mention glass beads as an object type that can suffer from the condition.

An earlier \textit{Museum News} Technical Supplement offered practical advice for managers of ethnographic collections. Stephen A. Gyermek authored “Conservation of Ethnographic Materials” in 1964, two years before Werner’s supplement on glass care. The information provided in Gyermek’s supplement adequately represented the standards for museum practices of the

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\textsuperscript{60} Werner, 45-49.
day. In addition to the application of toxic pesticides and ethically questionable repair techniques, Gyermek recommended cleaning glass and beaded objects with water and soap suds—a practice now known to have accelerated the deterioration process in glass.\(^{61}\)

After the publications of the 1960s, the museum community remained relatively void of newly published information about glass deterioration for nearly two decades. During the 1970s a small number of scientific articles were published. These articles targeted professionals in the glass making industry and were unlikely to be seen by collections managers. Robert Brill’s 1975 article in Conservation in Archaeology and the Applied Arts, specifically addressed the problem of crizzling in glass objects. While crizzling was a major problem in deteriorating glass beads, Brill failed to acknowledge the issue.\(^{62}\)

Interest in glass disease resurfaced in the museum community during the 1980s. For the first time glass beads were added to the list of potentially problematic objects. In contrast to earlier references in Museum News and Museum Journal, many of the later articles that dealt specifically with glass beads were published in relatively obscure journals and magazines, and had limited circulation among museum professionals at the time. The first of these later publications was the 1980 Technical Leaflet for the American

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\(^{62}\) Brill, 121-131.
Association of State and Local History, “Care and Display of Glass Collections” by Barbara Lang Rottenberg. Rottenberg detailed the problems associated with glass objects, including breakage, repair, display, storage, and deterioration. Nevertheless, Rottenberg makes no mention of glass beads or ethnographic objects and the special concerns associated with them.63

The first mention of glass disease in beadwork appears in Sandra Lougheed and Jane Shaw’s 1985 article “The Deterioration of Glass Beads on Ethnographic Objects” published in The Bead Forum, the newsletter of the Society of Bead Researchers. This brief three page article provided basic information about the causes and symptoms of glass bead deterioration. Three preventive conservation recommendations were given at the conclusion of the article: avoid cleaning with water, stabilize objects to prevent excessive movement, and store objects in a stable humidity of thirty to forty percent relative humidity.64 While Lougheed and Shaw’s article was far from a definitive work on the subject, it brought glass bead deterioration and conservation concerns to the professional community.

A significant addition to the study of glass bead deterioration occurred when Sandra Lougheed presented her research findings at the 1986 Symposium for the Care and Preservation of Ethnological Materials in Ottawa. A more detailed account of glass bead deterioration appeared in the

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63 Rottenberg, 1980.
proceedings of that symposium. In this paper Lougheed offered the most comprehensive and detailed account of glass bead deterioration to date. Nearly all subsequent publications sited Lougheed’s 1987 article as a noteworthy source. In addition to the detailed written description of glass bead deterioration, Lougheed included several photographs that adequately illustrate the various stages of deterioration on beaded works.65

One of the most comprehensive and often noted references on glass conservation is Sandra Davison’s Conservation and Restoration of Glass. Davison’s work steers away from the usual topics of Medieval window glass and focuses on archaeological and historic glass vessels. The information in Davison’s book is highly specialized and technical, with a number of scientific terms and concepts fully explained. Additionally, the book contains a number of color photographs that clearly illustrate a wide range of glass conservation problems. Since this work is meant to be a comprehensive approach to glass conservation, Davison devotes only a moderate portion of the book to chemical deterioration of soda lime glass. However, the information about glass deterioration contained in this book is accurate, thorough, and descriptive.66

The issue of glass bead deterioration was brought to the museum community as well as to private collectors and researchers in a conservation article by Ann Howatt-Krahn entitled “Beadwork,” appearing in American

Indian Art Magazine. Of all the specific references to glass bead deterioration, this article may have received the widest distribution to professionals in the museum community. Howatt-Krahn addressed many aspects of the care and preservation of beadwork, including deterioration in which she drew heavily from Lougheed’s work. The information on deterioration was brief yet sufficient enough to convey the importance of the proper care of beaded objects. While the written descriptions of deterioration symptoms were somewhat vague, the article contained wonderful color photographs that brilliantly illustrated the most common characteristics of glass disease in beadwork.\(^{67}\)

Prior to 1987 the body of literature about glass bead deterioration centered solely on cause, treatment, and prevention; little was being done to look at how glass disease specifically affected ethnographic beadwork. These unique aspects began to be explored when Julia Fenn, Conservator at the Royal Ontario Museum in Toronto, presented a paper at the Eighth Triennial Meeting of the International Committee for Conservation. The paper was entitled “Deterioration of Glass Trade Beads in Contact with Skin and Leather,” or more simply put, “Glass Beads in Soapy Bubble.”\(^{68}\) Fenn noticed that some deteriorating glass beads exhibited an oily or soapy substance on the surface when in contact with leather or animal skin. The

\(^{67}\) Howard-Krahn, 24-29.

\(^{68}\) Fenn points out that the term “soapy bubble” is a slang term for trouble in England, Fenn, 195.
problem turned out to be oils from the leather mixing with the alkaline carbonate build-up from the deteriorating beads. The mixture created a type of soap that congregated around the affected beads. Treatment options for this condition had to be suitable for both the beads and the leather.⁶⁹ Fenn’s later wrote a simplified two-page version of this article, in Rotunda in 1995.⁷⁰

These two articles were the first to recognize the unique characteristics of glass disease on ethnographic beadwork.

The final account of glass bead deterioration for the decade was a brief mention in Carolyn Rose’s “Ethical and Practical Considerations in Conserving Ethnographic Museum Objects” in The Museum Conservation of Ethnographic Objects. This work was the result of a paper presented at a 1988 conference at the National Museum of Ethnology, Osaka, Japan. The thirty-eight page article attempted to cover all aspects of conservation for ethnographic objects; yet the work contained only one small paragraph about deteriorating glass beads. The problem was briefly outlined, and no treatment or preventive conservation measures were suggested.⁷¹

Both the museum and conservation communities remained void of any publications addressing glass bead deterioration for nearly a decade following Rose’s work. Carrlee and McHugh broke the silence when they

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⁶⁹ Ibid., 195-197.
presented and published their finding of an in-depth study of the physical and chemical signs of glass bead deterioration at the 1999 conference organized by the Conservators of Ethnographic Artefacts in England. Carrlee and McHugh identified 187 beaded objects suffering from glass disease in the collection of the National Museum of the American Indian at the Smithsonian Institution in Washington, D.C. They submitted samples of these objects to a series of chemical tests to determine the exact cause of deterioration and to verify that the visually identifiable symptoms were in fact signs of deterioration. Their research revealed positive results, confirming that glass bead deterioration can be accurately diagnosed through visual characteristics.  

Another paper was published in the same proceedings by Annie Lord, Textile Conservator at the National Museums and Galleries on Merseyside, Liverpool, England. Lord presented the case of a black Edwardian evening bodice that was exhibiting white crystalline formations on the beads. An inventory was conducted to identify other affected objects in the collection. Treatment and preventive measures were discussed in Lord’s paper. 

Although the collection studied by Lord consisted of historic European textiles, the information and methodology for identifying and dealing with

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72 Carroll and McHugh, 27-28.
glass bead deterioration was relevant to ethnographic and American Indian beadwork.

The most recent work on the conservation of ethnographic beadwork is found in Sherelyn Ogden’s 2004 book *Caring for American Indian Objects: A Practical and Cultural Guide*. The chapter on glass beads was written by Ann Frisina, Textile Conservator at the Minnesota Historical Society in St. Paul. This chapter offers information about storage, handling, display, cleaning, and conservation of beaded objects. The issue of glass disease is addressed in this chapter. A detailed description of the symptoms is presented in both paragraph and bulleted form for easy reference; however, museum professionals may find it difficult to recognize glass disease based on the one photograph contained in this section. The photo caption reads “deteriorating beads in the center of the flower are probably suffering from glass disease. Many other beads are missing because the threading material has broken in several places.”

The fact that the threading material is broken does not conclusively indicate glass disease. Even after studying the photo at length, it is difficult to determine which beads were actually deteriorating. The issue of cleaning beadwork is discussed and storing beaded objects in high humidity is discouraged, yet the recommendations are subtle and are not emphasized heavily.

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Conclusion

In this section I have outlined the history and process of bead manufacture and touched on the worldwide distribution of beads through trade and their use in objects such as clothing, tools, weapons, and accessories. Many of the facts about this history have played an important role in the occurrence and development of glass disease, especially on American Indian beadwork. The volume of literature about the history of glass and bead making around the world was abundant and thorough. Articles and books on glass conservation including glass disease started appearing in museum publications in the 1950s. Specific reference to the deterioration of glass beads did not surface until the 1980s with Lougheeds seminal article has been sited by all significant publications on the topic since its initial appearance. Current literature has been less than forthcoming about increasing awareness of glass disease on beaded objects. In addition universal practices and recommendations have not been supplied to the museum community regarding storage and prevention. The need for more accurate and descriptive information distributed to a wider audience of conservators and museum professionals has been long overdue.
FINDINGS AND CONCLUSIONS

For this master’s project I conducted fourteen interviews and analyzed sixty-three surveys to gather information about how museums dealt with glass bead deterioration on American Indian objects. To gain a more in-depth perspective of the issue, I conducted interviews with collections management staff at museums and with professional conservators. Additional interviews were conducted with researchers to fill gaps in the literature review. The information in this section was drawn from these interviews and surveys and was supported by the literature review outlined in the previous section. The recommendations made at the end of this project were formed by analyzing these findings and conclusions.

Surveys

I sent out 170 surveys to registrars and collections managers in U.S. museums across the United States with significant collections of American Indian artifacts including beadwork. I received thirty-seven percent, a total of sixty-three, of these surveys in return. Of these sixty-three, two were not completed to the extent of getting any usable information so they were eliminated from the totals and percentages cited in this section. The survey consisted of ten questions about glass bead deterioration and current cleaning
and conservation practices used by the museum. The surveys were
accompanied by an introductory letter outlining my research and briefly
explaining glass disease on beadwork.

The first group of survey questions asked if the museum had beaded
objects in the collection that suffered from glass bead deterioration. Sixty
percent of the responses said that they had beads affected by glass disease.
Although the introductory letter explained the condition and briefly described
how to recognize stages of deterioration, it was not ascertained from the
survey data how well the respondents were able to adequately assess the
problem and recognize deteriorating glass beads on every object in the
collection. All of the museum professionals who said their collection had
affected beads also indicated that they had observed one or more of the
significant visual symptoms of glass disease. From this information we can
assume that the sixty percent of museums that reported deteriorating beads in
this survey were representative of the number of total U.S. museums with
affected beads. Additionally, the forty percent of museums who answered no
to this question may have been unaware that deteriorating beads were present
in the collection.

The respondents were asked to estimate the number of beaded objects
currently suffering from glass disease in their collection. Of the thirty-six
museums that said they had affected beads, twelve had five or fewer, eight
had between six and ten, three had between eleven and fifteen, two had
between sixteen and twenty, and eleven had more than twenty. It is not known what the percentage of objects these numbers represent in comparison to the total number of beaded objects or the entire collection ad a whole. It is assumed from the data given that the number of affected objects is relatively low.

A study of the collection at the National Museum of the American Indian in Washington D.C. revealed 187 beaded objects suffering from glass disease.\footnote{Carlee interview, 2005.} This is a small percentage of the tens of thousands of beaded objects that existed in the collection. An internal survey conducted at the National Museum and Gallery on Merseyside Decorative Arts Department in England revealed that forty-nine of the 130 beaded objects in the collection were suffering from deterioration.\footnote{Lord, 131.} While this number is much lower than those at NMAI, it represents a much higher percentage of the overall collection—about thirty-eight percent!

The survey respondents were provided a list of symptoms and asked to check all that have been noticed on beaded objects in the collection. The six symptoms were:

- white powdery substance
- dirty beads
- small cracks
- broken beads found around object
- missing beads with threads still in place
- discoloration of backing material.
The responses varied drastically. White powdery substance received the most checks with a total of thirty-nine. Twenty-nine museums noticed broken bead fragments, while twenty observed dirty beads. I expected the number of dirty beads to be much higher, possibly even reaching one hundred percent, as some level of dirt and dust was expected to have accumulated on most ethnographic objects. A clarification of the term “dirty” might have been appropriate. Sixteen museum collections indicated having missing beads with the threading material still in place, which indicated signs of the final and most severe stage of glass disease. If beads had been broken away by other means, the shattered glass would most likely have cut the fragile threading material. Cracks in beads were noticed in fourteen museum collections. Lastly, and most surprisingly, only one museum reported seeing discoloration of the backing material on beaded objects.

In addition to the raw numbers provided in response to the first group of questions, some unexpected findings were presented by looking at how certain symptoms were observed together in comparison to the order of the progression of glass disease. The symptoms were roughly listed in order of the stages in which they occur with the earliest signs first and the worst signs last. One would expect the responses to have somewhat mirrored this order, but they instead followed an illogical and unexpected order. Some of the symptoms were related and would most likely be seen on the same objects. For instance, more than half of the respondents that observed either broken
beads or missing beads did not indicate the other symptom that lead to this final stage of deterioration. Similarly, the same proportion that observed cracking did not observe broken or missing beads. The one museum that recorded seeing discoloration of backing material also indicated having dirty beads, which would be expected. However, none of the other nineteen museums that recorded dirty beads observed discolored backing material.

The responses given to these first three survey questions asking whether deteriorating beads were present, how many beaded objects were affected in the collection, and what symptoms were noticed, revealed the first indication that collections managers and registrars did not fully understand glass disease as it applied to ethnographic beadwork. This conclusion can be made despite the fact that the respondents were provided a brief explanation of the condition and that some may have had prior knowledge of glass disease through professional training or study. At best, these responses showed an inconsistent opinion as to what constituted a symptom of glass bead deterioration. The fact that five surveys indicated a white powdery substance on beads but did not consider any objects to be suffering from glass disease illustrated the confusion among some museum professionals.

Early in the survey the respondents were asked how deteriorating beads came to the attention of the museum staff. Forty-two percent said they noticed the problem during collections surveys and inventories. Preparing objects for exhibitions and condition reporting were both mentioned by about
twenty-five percent of the total responses. Routine access to the collection and facilitating researchers was reported by less than ten percent.

The responses to this question were positive and reassuring in many ways. The most common answer was noticed during routine inventories. This information led to the conclusion that routine inventories were being conducted and that the people conducting the inventory were taking measures to inspect for and document conservation concerns. The second largest reported methods for discovering deteriorating glass beads occurred during condition reports and preparation for exhibitions. Again, these two essential functions of collections management staff were intended to spot potential problems prior to acquisition, loan, study, or exhibition. Spotting conservation issues during random access to the collection and while facilitating outside researchers was the least reported answer in the surveys. This method of identification was likely an accidental one. The results of this question revealed that museum professionals were in fact doing an adequate job of identifying conservation problems at the appropriate times.

My initial research showed a propensity for glass disease to occur on certain colors of beads, namely blues and reds. I wanted to find out how wide-spread the problem of deterioration really was in regards to color. My introductory letter did not mention anything about a correlation between deterioration and bead color. Eleven of the sixty-one responses declined to check any bead colors on the survey. Of the remaining surveys, half checked
blue beads as having signs of deterioration. The next closest colors were red and white being checked by only twenty-five percent of the responses each. The only other colors worth mentioning were yellow, pink, and green, all receiving checks from fewer than ten percent. The remaining colors, orange, black, and clear, were only checked on the three surveys in which all colors were selected.\textsuperscript{77}

One survey was particularly intriguing in the answer to this question concerning deterioration of certain colors. The respondent checked the color red with the note “for color migration” written next to the selection. Having found no chemical explanation as to why this could occur in glass, I contacted the survey respondent, Rebecca Andrews, Collections Manager of Ethnology at the University of Washington’s Burke Museum in Seattle. Andrews explained to me that the red beads on a particular object appeared to be fading to a pinkish color. Kate Duncan, a well known bead researcher, identified the beads as Czech manufacture from the 1930s. The colorant comes from a dye coating applied to the inside of the clear glass beads. The color migration that Andrews noticed was simply the dye coming off and not bead deterioration.\textsuperscript{78}

The results of the color question revealed some predictable yet interesting information about glass bead deterioration and color. The survey

\textsuperscript{77} Historically, certain bead colors were difficult to produce. The mere lack of these bead colors in a museum collection could affect the rate of detection on such bead colors, Dubin, 101.

\textsuperscript{78} Rebecca Andrews, email correspondence with author, June 9, 2005.
responses confirm the stories—and my early research findings—about blue beads being more susceptible to deterioration than other colors. The lack of deterioration on colors such as orange and black—which are generally colors produced later—indicated that modern beads were less likely to develop glass disease. However, only time will tell. Lastly, a relatively large number of survey respondents indicated white beads as having been affected. Since glass was stabilized with calcium oxide, a substance that made the glass opaque and white in color, this is unexpected. Neither I nor any of the individuals I interviewed for this project have ever seen an example of white beads suffering from deterioration.

One of the most important questions in the survey dealt with the cleaning methods used on beaded objects. I proposed five cleaning techniques: soap and water, water only, alcohol, vacuum, and dry brush. Also included was the option to add additional cleaning methods not already mentioned. Unfortunately, nineteen respondents declined to answer the question, five of which specifically saying that they do not clean ethnographic beadwork. It was not clear as to whether the other fourteen respondents had a similar practice. The cleaning options provided contained three favorable methods and two unfavorable and potentially harmful methods. Of the remaining forty-two surveys, twenty four used a dry brush, fourteen used a vacuum, and three used alcohol. These three methods were the preferred and recommended practices used by professional conservators.
A significant number of surveys admitted to using the two harmful cleaning methods. Four museums cleaned with soap and water and nineteen used water only. The only added response was saliva which was mentioned by three museums and was considered an acceptable but somewhat controversial practice for this project.

Obtaining detailed information about cleaning was difficult. It was not known who was doing the cleaning, professional conservators, collections staff, or volunteers. One question on the survey asked whether the museum had a professional conservator on staff. Sixty percent answered no, which could indicate that over half of the museums that cleaned beadwork were utilizing collections staff or volunteers for the job. The high number of museums using soap or water to clean beadwork showed a lack of knowledge about the chemistry behind glass disease and the factors that contribute to deterioration. Of the surveys that indicated undesirable cleaning practices, one stood out from the rest. The museum admitted to cleaning beadwork with water only as well as having a dangerously high relative humidity level of sixty-two percent, yet they reported no visible signs of glass bead deterioration in the collection. Under these circumstances glass disease would be expected. All of the remaining eighteen surveys that reported cleaning with soap or water observed signs of deterioration in the form of dirty beads and half reported a white powdery substance, which was most likely the direct result of moisture in contact with unstable glass.
The next question asked the respondents to estimate the relative humidity levels in their storage facilities. I recorded all of the responses and divided them into four categories: excellent, good, fair, and poor. These categories are based on the degree of fluctuation and the reported minimum and maximum humidity levels in the collections storage areas. Seventeen museums were rated excellent, twelve were good, ten were fair, and nineteen were rated as poor. Three museums declined to give relative humidity levels. Interestingly, these figures create an even split between the higher and lower two categories. The highest rated response had a relative humidity of forty to forty-five percent, while the lowest rated response reported thirty to sixty percent. Two non-numerical answers were given: “standard” and “high variation with season.” Both of these responses were rated as poor.

Only two museums categorized as having poor relative humidity conditions also reported no symptoms of glass bead deterioration in the collection—one was the extreme example listed above with thirty to sixty percent humidity. Seven of the museums categorized as excellent reported no signs of bead deterioration. The survey information supported the advise by conservators that low and stable relative humidity levels help prevent or lessen the deterioration of glass beads.

The overall conclusions drawn from the survey results showed a lack of knowledge and conflicting practices within the museum community in regards to glass bead deterioration. Collections managers appeared to be
inconsistent at best in their ability to accurately identify and respond to the symptoms and stages of glass disease on beaded objects. Conflicting reports about visual sign of deterioration, cleaning practices, and environmental conditions created a clouded vision of how glass bead deterioration develops. The respondent’s attention to the proper environmental control and cleaning of ethnographic beadwork was shown to coincide with the severity of deterioration in the museum collection. While many museum environments were within acceptable ranges for general collections, little was being done to isolate beaded objects in safe and desirable microclimates. Some practices may even be contributing to further deterioration.

**Interviews**

In addition to surveys I conducted fourteen interviews with conservators, collections managers, and bead researchers about the conservation and preservation of glass beads. These interviews helped to clarify major issues about glass bead deterioration and provided practical stories about how this condition is handled in museum collections.

My first interview with a conservator was with Ruth Norton, Anthropology Conservator at the Field Museum of Natural History in Chicago. Norton explained to me the basic chemical process behind glass disease, and mentioned that she has observed glass bead deterioration on
American Indian, African, and Indonesian objects. She also pointed out that the problem of bead deterioration was not wide-spread in the collection at the Field Museum. Norton commented that the alkaline solutions drawn out of deteriorating glass can eat away at the fibrous threading material used to secure beads to the backing material. As for treatment options, Norton explained how alcohol or acetone solutions or a stiff dry brush was successfully used to remove carbonate build-up on glass beads. Consolidants were also mentioned as a possible treatment, but these substances were highly discouraged by Norton due to their unpredictability and the difficulty of removing them from the object in the future.\footnote{Norton interview, 2005.}

Norton discussed several preventive conservation measures that have produced encouraging results. First, a relative humidity level of forty to forty-five percent should be maintained. Conservators at the Field Museum have isolated deteriorating objects in plastic storage containers sealed with cellophane tape. Silica gel was placed in the container—which was changed at regular intervals—along with a monitoring device that measured humidity. This method proved quite successful at slowing the deterioration process in deteriorating objects.\footnote{Ibid.}

Norton agreed that accurate and early identification of glass bead deterioration was essential to preventing further damage. When asked about the relationship between the conservators and the collections staff at the
museum, Norton considered the communication lines to be open and frequent. Collections staff were instructed to report any signs of crystallization or breakage to the conservators. Norton painted a pleasant and optimistic picture for the care of beaded objects in a museum. However, small museums have often found themselves understaffed and without an onsite conservator. In these instances Norton suggested that the museum develop a good relationship with a nearby conservation lab, or apply for a CAP grant (Conservation Assessment Program) to bring in outside help to survey the collection for conservation related issues.

Scott Carrlee, Conservator at the Alaska State Museum in Juneau, spoke with me on more than one occasion about the deterioration of glass beads on ethnographic objects. Carrlee conducted an in-depth research project with Kelly McHugh investigating the symptoms of glass disease in the collection of the National Museum of the American Indian at the Smithsonian Institution in Washington, D.C. The results of this study were published in *Ethnographic Beadwork*, the proceedings of a 1999 seminar by the Conservators of Ethnographic Artifacts at the Conservation Centre, National Museums and Galleries on Merseyside, England.\(^{81}\)

Carrlee first explained to me how scarce the literature was on bead deterioration, and he outlined the following points about his extensive literature review. The few articles and references that existed were in

\[^{81}\text{Carlee interview, 2005.}\]
relatively obscure publications that were not readily available to the museum collections community. The majority of the literature about glass disease focused on archaeological glass—mostly stained glass form the Roman era. Glass disease on ethnographic beadwork was unique from all other occurrences of glass disease due to the added materials such as thread, leather, cloth, and metal. Lastly, Carrlee introduced the added element of recycled beads and beaded objects that cause a particular item to exhibit unusual and inconsistent symptoms.82

Carrlee noted that glass bead deterioration was more prevalent in American Indian objects from the Plains Region, but it also appeared on objects from a variety of areas in Africa. One possible explanation for this observation was that the American Indians from the Plains Region produced an unusually large amount of beadwork during the reservation era, 1880-1910.83 The fact that more beadwork from the plains was held in the museum collection reflects the increased number of deteriorating beaded objects. Other conservators and collections managers indicated no regional area that tends to be more affected than another. My own research into glass bead deterioration showed a similar pattern.

82 Recycled beadwork is a term used by many researchers and scholars to refer to object types that have been disassembled in part and used in the construction of a new object. A recycled beadwork piece might have affected and unaffected beads depending on the storage and use of the original object, Benson L. Lanford, “Indian-made Conversions,” in ARTIFACTS/ARTIFAKES: The Proceedings of the 1984 Plains Indian Seminar Held in Cody, Wyoming (Cody, WY: Buffalo Bill Historical Center, 1992), 31-36.

83 Lyford, 12-38.
Carrlee made several good points concerning preventive conservation and the treatment of glass bead deterioration. These points were based on his personal experiences in dealing with glass disease on beadwork. Carrlee admitted that conservators have experimented with consolidants, such as Acryloid B-72 and others, but have not produced any promising results. One interesting ethical conflict that Carrlee pointed out was that of routine cleaning of ethnographic works. According to Carlee some conservators believed that cultural objects should not be cleaned but rather left to deteriorate naturally. Others in the profession considered routine cleaning an essential part of prolonging the life of the object for future generations to enjoy. Carrlee believed in cleaning ethnographic beadwork. His research has showed that the removal of alkaline carbonates lowered the pH of the environment around the object and prevented further deterioration of the glass. It was important to note that Carrlee strongly recommended that only professionally trained conservators should actively engage in any cleaning or treatment of ethnographic beadwork.

There were, however, some general preventive conservation practices suggested by Carlee that collections managers and registrars can take to prevent and lessen the affects of glass disease on beadwork. One action was to use non-buffered tissue paper when wrapping and storing objects. Carrlee believed that the increased amount of alkaline material present in buffered tissue paper actually accelerated the deterioration process in beaded objects.
Throughout my talks with Scott Carrlee, I realized how much work has already been done to understand, recognize, prevent, and treat glass disease in ethnographic beadwork, yet there were still many questions that remain unanswered. The length of time it took for beads to start to show signs of glass disease as well as the future stability of modern glass beads were just two relatively simple questions that remain unanswered. Carrlee recognized and understood that the answers to these questions, and many others, remained, but believed that through further collaboration and research conservators could gain a better understanding of glass bead deterioration.

Perhaps the most current authority on the conservation of glass in the United States at the time of this project was Stephen Koob, Head Conservator at the Corning Museum of Glass in New York. In my conversation with Koob, he revealed some astonishing facts to me about glass deterioration and conservation. I asked Koob first about why glass disease seemed to be more prevalent in blue and red beads. He responded by saying that calcium oxide, in the form of lime, was added as a stabilizer in the glass and prevented moisture from attacking the sodium and potassium ions. One adverse affect of calcium oxide was that it also acted as an opacifier in the glass—causing transparent glass to appear opaque. Transparent or semi-transparent beads often had lowered amounts of calcium oxide, thus rendering these glass colors more unstable than opaque colored beads. White beads had an
increased amount of calcium oxide, which explained why glass disease was nearly non-existent in white beads.84

Koob made reference to several startling facts about glass deterioration that I had not come across in any of my research. The first was the problem of storing or displaying glass objects in wooden cabinets or cases. Koob explained how wood emitted acetic and formic acid that contributed to the deterioration of glass. He considered the storage or display of glass in wooden cases to be the “worst thing for glass objects.” Koob also pointed out that stable glass, including many modern glasses, became unstable if the conditions were poor. Restricted air movement, relative humidity above sixty percent, alkaline environments, and frequent washing with water made any type of glass unstable over a period of time. Koob insisted that proper care and storage of glass was essential to the longevity of its existence.85

I asked Koob about the affects of the two most common pest management treatment practices in museums: freezing and anoxic environments, such as carbon dioxide (CO\textsubscript{2}). Since most glass objects were inorganic they were not likely to have infestations, thus little to no treatment was performed on glass. Ethnographic beadwork, on the other hand, contained cloth, leather, and plant fibers as well as glass beads, which made

84 Koob interview, 2005.
85 Ibid.
these objects highly vulnerable to insect and rodent damage. Koob recognized three potential problems that could be encountered while freezing glass beads: excessive dehydration during the freezing process, excessive moisture due to condensation while unfreezing or thawing, and the extreme cold environment encountered by the object while frozen. Koob suggested that stable glass beads would have no problem undergoing freezing treatments, but beads that exhibited signs of deterioration should be reconsidered before freezing. Carbon dioxide, and other inoxic treatments, expose objects to an oxygen-free environment, killing any living insects or rodents. While Koob was not familiar with any glass objects being treated with CO₂, he found no obvious threat to beaded objects being exposed to this treatment.

Emily Kaplan of the National Museum of the American Indian contradicted some of Koob’s assumptions about potential freezing problems in my interview with her. During the recent move from New York to Suitland, MD, the entire NMAI collection was frozen, including beaded works. Prior to the move a conservation survey identified glass disease on 187 objects which were also subjected to freezing. Kaplan and other conservators noted conditions before and after freezing on all beaded objects and found no formation of crystals or broken beads. Kaplan suggested that

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86 Ogden, 228-230.
87 Koob interview, 2005.
88 Carrol and McHugh, 30.
these results may be due to the strict standards of freezing objects using double bags with all air removed from the bags prior to freezing.  

Additionally, I conducted five interviews with conservators regarding the cultural impact of glass bead deterioration on ethnographic objects. The first of these interviews was with Glenn Wharton, conservator at New York University. Wharton has done extensive research on the issues surrounding living cultures and the conservation of cultural objects. Wharton pointed out that there are conflicting views about conservation among different tribes and even individuals within a single tribe. One aspect that Wharton pointed out was that ethics and practices regarding cultural objects were constantly being challenged and changed to meet the needs and wishes of various communities.

Wharton alluded to an example of how one modern American Indian tribe took an active role in the conservation process. The story was further explained in a recently published article written by Wharton. The conservation department at the National Museum of the American Indian called upon artists from the Tuscarora tribe to restore a beaded textile. The project plan called for the re-use of historic material as well as the use of period beads to complete missing beaded sections of the textile. Both of these practices go against modern conservation standards and ethics, but it was a decision made in conjunction with tribal members and museum staff.

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89 Emily Kaplan, email correspondence with author, June 13, 2005.  
90 Glenn Wharton, email interview with author, September 12, 2005.
The Tuscarora people wanted the piece to look appropriate while on exhibit and the decision was supported by both sides.  

My second interview regarding cultural issues in conservation was with Nancy Odegaard, conservator at the Arizona State Museum. Odegaard outlined a number of conditions that need to be considered before any conservation work or cleaning was performed on a cultural object. These conditions included: identification, composition, technology, deterioration, original context and use, subsequent use, acquisition context, conservation at the time of collection, museum use, indigenous perspectives, indigenous reservation, academic concerns, related museum issues, long-term preservation, treatment options, and treatment procedures. Additionally, Odegaard suggested that an object that suffered from glass bead deterioration may or may not be culturally significant to warrant active treatment. For instance, a sacred object being repatriated will often remain unchanged while in the care of the museum and the tribe would have direct and total authority as to any conservation action taken on the object. However, secular or artistic objects that were going on exhibit were handled in a totally different manner. These objects were often cleaned or actively treated to stabilize the object for display. Odegaard summed up by saying that there was no one simple formula or guideline to consult when cultural objects are in need of conservation attention. Active and open discussions between the

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communities involved and conservators was the best way to approach these sensitive and complex issues.  

During a conversation with Sherelyn Ogden, Head Conservator at the Minnesota Historical Society, some interesting cultural issues came to light. Ogden expressed concern for objects suffering from glass disease that were being actively used by tribal members for ceremonies, rituals, or other special use. Tribal use of museum objects has become quite popular in the United States and Canada. Some recent examples of tribal use of museum artifacts include: a Northwest Coast tribe using masks for a potlatch ceremony, a Pomo basket maker who “feeds” baskets in a museum storage facility, and a Miwok tribal member who sets up a cultural and educational display in a public building. Ogden is concerned about the fragility of deteriorating beads being excessively handled as well as potential exposure to sweat, water, smoke, heat, cold, and various unknown materials. Ogden also notes that American Indian people are getting more say in the conservation process. While conservation concept and terminology can be quite confusing, Ogden points out that it is easier for tribal members to grasp these complex issues than it is for non-native conservators to understand American Indian culture as a whole. Conservators now demand

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92 Nancy Odegaard, email interview with author, October 10, 2005.
94 Sherelyn Ogden, telephone interview with author, May 18, 2006.
considerable cooperation and assistance from tribal communities. However, American Indian people have been caring for these objects for years and conservators should not be so quick to expect them to change immediately.

Cultural concerns about beadwork conservation were reiterated by Ann Frisina, Textile Conservator at the Minnesota Historical Society. Frisina suggests a set of preventive conservation options that can easily be followed by tribal communities with limited resources. One technique was the cleaning and removal of alkaline salts from beadwork using a cotton swab and saliva, a solution that is not harmful to glass beads. A light wash in an alcohol solution afterward removed the remaining moisture from the beads. Frisina did express the possibility of negative cultural connotations being associated with such a practice in certain communities.

One interesting observation by Frisina focused on the interaction of museum collections staff and conservators or lack thereof. Frisina believes that the two groups have limited interaction. She explained how professional conferences and associations were separate and how individuals from one side rarely participated in the activities of the other. Publications seemed to be the one common ground where both sides of the issue could come together to share information.\textsuperscript{95}

The last interview I conducted concerning the cultural issues of glass bead deterioration was with Alyce Sadongei, Assistant Curator of Native

\textsuperscript{95} Ann Frisina, telephone interview with author, May 19, 2006.
American Relations at the Arizona State Museum. Sadongei was a member of the Kiowa and Tohono O’Odham tribes. Sadongei explained how color was an important aspect of any decorative process for American Indian people. The meaning and intention expressed by the creator of the object changed drastically when a particular color was omitted due to the devastating affects of glass bead deterioration. After some thought, Sadongei believed that tribal members would be in favor of replacing broken or missing beads in order to restore the proper appearance of a particular object. Ultimately, she believed that more open discussions between tribal communities and museums were the best solution to the issue.  

My interviews with collections managers, registrars, researchers, and other museum professionals tended to be more general and brief than my interviews with conservators. I interviewed a total of eleven individuals in this category resulting in a mixture of personal stories about dealing with glass bead deterioration and current measures being taken in regards to this problem. Some of the interviewees requested to remain anonymous; in these cases just enough background information was provided to give context to the situation yet not reveal the identity of the institution or individuals involved.

Personal stories about glass disease on ethnographic beadwork provided a unique insight to the ways in which museum professionals

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96 Sadongei interview, 2006.
recognized and dealt with this problem. The collections manager from a small inland Northwest art museum related one such story. In this instance an object on display was exhibiting symptoms of glass disease, namely a white crystalline substance on the surface of the beads. The collections manager had never considered glass disease on beaded objects. The white powdery substance began to appear on one object shortly after it had been put on exhibit but never showed signs of deterioration while in storage. Thinking that the substance could be dust or particles from the exhibit case, the collections manager simply wiped the surface of the object with a rag dampened with water. Only a few weeks later the white powdery substance re-appeared and the treatment was repeated. Another museum professional visiting from a neighboring institution pointed the problem out to the museum staff. Since that time no cleaning or treatment has been done to the object.

Rebecca Andrews, Collections Manager for Ethnology at the Burke Museum of Natural History and Culture at the University of Washington in Seattle, pointed out a unique and intriguing symptom that she thought could be glass disease. Andrews had heard of glass bead deterioration but had little specific information about the condition in which to reference. She noticed pink beads on an Athabaskan baby carrier appeared to be fading or migrating color. Good quality close-up photos of the piece could not be obtained, but based on the information presented this particular instance does not appear to
be glass disease. Further research and inspection of the beads by an outside researcher determined that these beads were a unique type of Bohemian glass bead that were colored with a dye on the exterior of the glass and that it was the dye not the glass that was the issue in this problem piece. The valid point in this story was that the museum staff considered this problem as a possible sign of glass bead deterioration, further evidence that collections staff have not been provided with adequate information to properly recognize glass disease on ethnographic beadwork.⁹⁷

The characteristics of dirty, broken, or missing beads were the most difficult and potentially misleading symptoms of glass bead deterioration related to me in personal stories with collections staff. Dirty beads may have been a result of dirt or dust that adhered to the alkaline hydroxide solution surfacing from the glass or from the soapy substance created when deteriorating beads were in contact with leather. More common, however, is the accumulation of dirt and grime over the many years of use and storage. Reports of dirt and grime on beaded objects were conveyed by nearly every interviewee; however, few of these examples seemed to indicate glass bead deterioration. Beads were often missing when the fragile threading material broke, which caused beads to simply fall from the object. In rare occasions alkaline solutions from deteriorating glass beads caused this thread breakage, but this was difficult to prove in most instances. The repeated reports of

⁹⁷ Rebecca Andrews, telephone interview with author, June 6, 2005.
dirty and missing beads as being potential signs of severe deterioration proved that the physical descriptions for symptoms of glass disease on ethnographic beadwork were not well defined or clear.

**Online Discussion Groups**

In addition to interviews and surveys, I decided to search through some of the online discussion groups that became quite popular among many professional interest groups in recent years. The information obtained from these message boards was not as strong as my interviews nor was it as direct as surveys, but it presented real issues from real people and the unprompted responses from actual professionals in the field. I found references to glass conservation or glass bead deterioration in four discussion groups: Conservation DistList, MUSEUM-L, The American Institute of Conservation discussion group, and the Plains Indian Seminar E-Group. The results of my search revealed only a few examples of glass disease discussion, and even fewer references specifically relating to glass beads.

The first online discussion group that I searched was the Conservation DistList, an international email distribution list for conservators and museum professionals from a variety of institutions. The topic of glass beads was only briefly touched on. A March 13, 2002 post by a private conservator asked about a white powdery substance on a black garment embellished with
black beads. Corning Glass Museum Conservator Stephen Koob responded by suggesting that the beads were the culprit, not the cloth garment as previously assumed by the author of the post. Koob explained how dark colored beads—especially reds, blues, and black—often have low amounts of lime as a stabilizer. Koob responded to another post from July 28, 2003, regarding the presence of salt on glass. A brief overview of glass disease ensued pointing out that increased humidity was the most contributing factor to the problem. In a side note, Koob mentioned that airborne pollutants from wooden cabinets accelerated the deterioration process.

A similar online forum for a broader professional museum audience called MUSUM-L was also searched for references to glass disease and beadwork conservation issues. I was only able to find one thread discussing beadwork on MUSEUM-L. On December 29, 1997, one individual asked for suggestions on how to clean beaded objects. The responses were limited; however, one reply stated that “glass beads are generally not the problem” but the main concern should be with the material to which the beads are attached, such as leather, cloth, and thread. The author of this reply was apparently unaware of glass bead deterioration, although the information given coincided with the available literature of the time concerning the care of ethnographic objects.

A 2005 post to the American Institute for Conservation online discussion group specifically addressed the issue of glass bead deterioration.
In this post a Yoruba beaded object was exhibiting signs of deterioration. The conservators at the museum had obviously done considerable research into the condition, yet they still felt the need to ask for clarification and guidance from other conservators. Steve Koob once again served as the sole respondent to the query. Koob’s response to this post was nearly identical to his previous responses on other discussion boards, thus adding little new information to that already available on the internet.

The largest amount of “chatter” about deteriorating glass beads came from the Plains Indian Seminar E-Group. This message board was designed as a year round discussion of American Indian art and material culture stemming from the annual conference of the Material Culture of the Plains, Plateau, and Prairie, each fall. Members of this list came from the United States and Europe and ranged from museum professionals, to researchers, to private collectors. The topic of glass bead deterioration came up as a thread in September of 2004. The comments and assertions made were full of inaccuracies and unsupported creative solutions to the problem.

In regards to the cause of glass disease, one author with a background in chemistry related that the problem was due to the oxidizing of certain colors, and named blue beads that contained radioactive cobalt salts as a specific example. Another member of the group from Europe insisted that the problem was isolated to only the so-called “greasy” colors of beads, mainly blue and yellow. The author continued adding that some museum
professionals were of the opinion that glass bead deterioration was the result of camphor—a chemical used to prevent pest damage—drying the beads and causing more damage. I found no such references during my literature search or in any of my interviews with museum professionals and conservators.

A variety of treatment options were also suggested by members of the Plains Indian Seminar E-group. Cleaning beads with an ethanol solution and storing in a cool, dry environment was proposed by one member with a museum and conservation background. While these measures are commonly accepted practices, the reasons given for such treatment are slightly flawed. The author asserted that the white powdery substance was acidic and that light can accelerate the deterioration process. Both of these claims were inaccurate and false. Another group member bravely suggested the use of super glue to hold fracturing beads together or Teflon film to separate the beads from the substrate material. This last author made the effort to remind the other members that “this [was] only neophyte conjecture…I am not a bead physician.”

These internet discussion group postings showed how modern day museum professionals turned to quick and fast answers using the World Wide Web. Many of these professionals were already short on time and resources and in the age of “Google” a simple internet search or post to an online forum saved valuable time. Unfortunately, the answers provided by well meaning and often knowledgeable individuals were insufficient and misleading.
Conclusion

The findings of the literature review, survey results, and interviews reveal some interesting yet disturbing facts about glass bead deterioration. In reviewing the museum and conservation literature it is apparent that the general topic of glass disease is covered and published in conservation sources. However, specific references to how glass disease relates to ethnographic beadwork remain scarce and obscure. The small amount of available publications also lack clear photographs that are essential when identifying glass bead deterioration.

The general knowledge that collections managers have on glass bead deterioration is shown clearly in the survey results from this project. First, the problem of glass bead deterioration is evidenced by the fact that sixty percent of museums surveyed claim to have affected beadwork in their collection, yet the survey respondents are inconsistent in reporting signs of glass disease and are inaccurate in identifying the problem in detail. When glass disease is present on ethnographic beadwork, treatment options and preventive measures frequently contradict the recommendations set forth by conservators and those knowledgeable about glass disease. Half of the museums surveyed report substandard environmental conditions or unacceptable cleaning procedures. In short, a general lack of knowledge and
information about glass disease on ethnographic beadwork is abundantly clear.

The conservators interviewed for this project show a firm grasp on the topic of glass disease and glass bead deterioration. Clearly a large amount of work has gone into understanding the problem, and there is a definite direction set for the continuation of research and experimentation to fully understand glass bead deterioration. This precious information, however, is not reaching the general collections management community in many museums across the country. My interviews with collections managers closely echoes the findings from the surveys in that most individuals are ill equipped to deal with the problem of glass disease on ethnographic beadwork. Lastly, the results of the online discussion groups show how well meaning people are searching for answers using twenty-first century technology of the internet, yet almost no online information exists.
RECOMENDATIONS

In response to the problem of glass bead deterioration, I have developed a number of recommendations based on my research and findings from this project. These recommendations are grouped into two main categories: those for museum collections managers and those for professional conservators. Many of these recommendations are targeted toward professionals at small and medium sized museums, but staff at museums of all sizes can benefit from these guidelines.

For Collections Managers

The museum community can take several steps toward recognizing and preventing glass bead deterioration in their collection. Once the issue has been identified, collections managers can begin to store, handle, and display ethnographic beadwork in ways that will not contribute to further deterioration. The following recommendations should be taken into consideration by all museum professionals and volunteers who manage collections of ethnographic beadwork.
1. Learn to identify the physical symptoms of glass bead deterioration.

The most overwhelming finding of this project is that collections staff in museums lack information and specific knowledge about what glass disease is and how it relates to ethnographic beadwork. The greatest problem that these individuals face is their lack of information on how to recognize glass bead deterioration. Collections staff are often the first line of defense when it comes to spotting conservation issues in museum collections. These individuals need to learn the physical symptoms of glass disease and how they specifically relate to ethnographic beadwork. By knowing these signs and spotting potential problems early on, conservators may be able to stabilize or minimize the damaging effects of glass disease on the object.

Collections managers should also know which objects are more prone to deterioration. Beadwork on leather may exhibit soapy or oily residue, dark beads may show signs of efflorescence more frequently than white beads, broken threads and missing beads should be examined to determine if glass disease is the cause of the problem. Objects that may have come from humid environments, have been stored in wooden cases, or have been frozen for pest management should be inspected on a regular basis for signs of deterioration. Special notice should be given to beads in contact with leather as well as transparent or semi-transparent beads.
The physical signs to look for are:

- Moisture spots on beads (weeping or sweating)
- White crystalline deposits, usually on only one type of bead
- Tiny web-like cracks (crizzling)
- Large cracks or broken bead fragments
- Missing beads with threading material still in place
- Ghost image on cloth substrate or darkening of leather substrate
- Oily or soapy substance on beads in contact with leather

2. Practice sound preventive conservation to avoid problems with glass bead deterioration.

In addition to knowing the physical symptoms of glass bead deterioration, collections staff should understand the basic principals that contribute to the condition. When the causes are fully understood preventive conservation measures can be enacted to reduce the probability of glass disease to occur on ethnographic beadwork. Any museum that has a
significant number of ethnographic beaded works should visit the web site designed as the product of this master’s project at http://bead-disease.122mb.com or at http://bead-disease.com. This web site contains multiple color photos and useful links.

**Humidity**

The most important factor to control is humidity. High humidity or fluctuations in humidity accelerate the deterioration process. In ideal circumstances a relative humidity of forty to forty-five percent should be maintained with as little fluctuation as possible. Museums unable to meet such demanding levels should strive to come as close as possible in order to preserve beaded objects.

**Air Circulation**

Adequate air circulation should be available to beaded objects as well. Air circulation helps to dry the glass and prevent excess moisture from accumulating on the glass surface. Avoid storing beaded objects in air tight containers, bags, or cabinets that restrict air flow. Larger cabinets and display cases can be fitted with small electric fans to circulate air within the case.

**Storage and Display**

Wooden storage units and display cases are discouraged. Wood off-gasses acidic agents—namely acetic and formic acid—that contribute to the
deterioration of glass beads. Cabinets and cases made from metal, plastic, and glass are ideal for objects made with glass beads. If wooden cabinets are all that is available to the museum, objects showing signs of deterioration should be removed immediately to reduce further damage. Other museum objects made of wood should be kept separate from beaded objects. Wooded display mounts are also discouraged. Chemical wood sealants can also be applied to storage and display furnishings to prevent off-gassing.

**Pest Management Practices**

When freezing objects for pest management take extra care to notice pre and post-freezing conditions. Double bag beaded objects and seal tightly to prevent transference of moisture through the opening. Ensure that all air is removed from the bags prior to freezing. Beaded objects exhibiting signs of deterioration should not be frozen. In these instances CO$_2$ or other anoxic treatment options should be explored. When practical, all beaded objects should be treated to CO$_2$ as opposed to freezing.

3. **Consult professional conservators to treat and clean ethnographic beadwork.**

Collections staff should focus their efforts on the above mentioned preventive conservation methods. Aggressive treatment and cleaning of beaded objects should only be done with the supervision of a
professional conservator. Improper cleaning can escalate deterioration of glass beads as well as remove vital historical and cultural elements of an object. Conservators are also trained to work with native communities to determine the best course of action for a particular object. The use of any type of liquid chemical on beadwork for any reason is highly discouraged. When such treatment is advised, the application should be performed or overseen by a conservator.

4. Museums without a conservation staff should apply for outside aid and assistance to effectively conserve problematic objects in the collection.

As most small and medium sized museums do not have conservation staff, a working relationship with a nearby conservation department should be developed. Small museums can apply for Conservation Assessment Program (CAP) grants to fund an outside conservator to evaluate the collection and make practical recommendations. Other funding opportunities may also be available on the state or local level. Contact a state, regional, or national museum professional organization to find more information.
FOR CONSERVATORS:

The conservation community plays an integral role in the prevention of glass disease on ethnographic objects. The lines of communication are not always clear enough to properly relate the important aspects of glass conservation to the museum collections community. The recommendations presented below are important concepts that conservators should strive to make available to collections managers in order to ensure the best possible outcomes from the museum community as a whole.

1. Educate collections staff on how to deal with glass bead deterioration.

The survey results and interviews from this project show that collections staff are inconsistent in their handling of objects with glass bead deterioration, while conservators have proven their expertise and competence in dealing with the issue. Conservators should take extra time to educate collections staff on the specific aspects and potential problems inherent to their particular institution. The signs of deterioration should be explained along with proper handling and storage techniques to minimize damage to the objects.
2. **Publish and present understandable information on ethnographic beadwork to the general museum community.**

In many museums, collections managers, registrars, curators, and volunteers all handle ethnographic beadwork on a regular basis. Often times these individuals turn to books, journals, or even the internet to seek answers to everyday problems. There is little literature specific to the issues of glass bead deterioration. The good work that has been done has been published in relatively obscure sources not likely to be readily available to museum professionals and volunteers.

Conservators are the most knowledgeable about glass deterioration and are therefore the most likely people to write about it. Conference presentations, journal articles, and book chapters should be written in easy to understand language that non-conservators can put to practical use. Lastly, good quality color photographs are essential to show the different stages and characteristics of glass bead deterioration.

3. **Continue to research glass disease and share findings about its effects on ethnographic objects to the conservation community.**

Recent publications and conference presentations have done a great deal to bring the issue of glass bead deterioration to the conservation
community, but there is still a great amount of work to be done to fully understand the problem and how best to prevent and treat it. By building on the work that has already been done, the international conservation community should continue to push the issue of glass disease on beaded objects. Professional organizations like the Glass Studies Institute, Association for the History of Glass, and the International Council on Museums Conservation of Glass Committee are prime audiences to introduce the issue of ethnographic beadwork. In addition, organizations like the Center for Bead Research and numerous regional and national bead societies openly welcome outside conservators to publish and present current research on the issue of bead deterioration.

By following these recommendations, museums will greatly extend the life of ethnographic beaded objects allowing future generations to experience the artistic culture of beadwork from around the world. The continuation of research and the increased availability of its findings will serve to educate the professional museum and conservation communities about the unique issues posed by beaded objects suffering from glass disease.
BIBLIOGRAPHY


Fenn, Julia. “Glass Bead in Soapy Bubble.” Rotunda, Fall 1995, 40.


**Interviews and Personal Communications:**

Allen, Jamey D. Researcher and Adjunct Curator of the Bead Museum, Glendale, AZ. Personal conversations with author.


Foniciello, Nancy. Private conservator. Personal communications with author.


Sheere, Alice. Director, Society for Bead Research. Interview with author. Sonoma, CA, April 18, 2005.


APPENDIX A

PHOTOS
Blue beads with efflorescence of alkaline hydroxide
Photo by Scott Carrlee, NMAI Collection

Some beads reacting while others remain stable
Photo by Scott Carrlee, NMAI Collection

Black beads showing spots of efflorescence
Photo by Scott Carrlee, NMAI Collection
Red beads reacting with leather  
Photo by Scott Carlee, NMAI Collection

Black beads with alkaline carbonate  
Photo by Scott Carlee, NMAI Collection

Red beads showing crizzling  
Photo by Nancy Fonicello
Blue beads showing signs of deterioration.
Minneapolis Institute of Art Photo

Weeping on a blue bead
Photo by Adam Lovell,
Vesterheim Museum Collection

Blue beads showing alkaline carbonate
Photo by Alan Cronister, Private Collection
Amber beads with crystalline deposits  
Photo by Adam Lovell,  
Vesterheim Museum Collection

Blue beads deteriorating while stable beads remain  
Photo by Adam Lovell, Benson Lanford Collection

Blue beads near total deterioration  
Photo by Alan Cronister, Private Collection
Total deterioration of blue beads leaves a void in the design with threads still in place
Photo by Adam Lovell, Private Collection

Example of bead loss NOT caused by deterioration of the glass
APPENDIX B

SAMPLE SURVEY
My name is Adam Lovell, I am a graduate student in the Masters of Museum Studies Program at John F. Kennedy University in Berkeley, CA. I am writing my thesis on the deterioration of glass beads on ethnographic objects in museum collections. I am specifically looking at how registrars and collections managers address this issue. My final product will be a guide book for collections staff on how to identify, treat, and prevent glass bead deterioration.

Please take a few minutes to complete the enclosed survey form about glass beads in your collection. Answer any and all questions to the best of your ability and return in the enclosed self addressed stamped envelope by June 1st.

Electronic copies of my final thesis will be available on CD. Please indicate at the bottom of the survey if you would like a copy of my thesis. Copies of my product, a guide book for dealing with glass bead deterioration, will be available at cost by this fall.

Thank you for your assistance.

Adam Lovell
4. Approximately how many objects in your collection show signs of glass bead deterioration?

- 0-5
- 6-10
- 11-
- 16-
- over

5. What color beads have you found evidence of deterioration in place? Check all that apply.

- Reds
- Blues
- Oranges
- Black
- Clear
- Yello
- Greens
- Pinks
- White
- Other

6. What methods of cleaning have you used on objects with glass beads? Check all that apply.

- Soap and
- Alcohol
- Dry brush
- Water only
- Vaccum
- Other

8. If so, please briefly explain the treatment and result.


9. Do you have a professional conservator on staff?  

- Yes  
- No

10. What are the approximate ranges of Relative Humidity in your storage area?  


If you would like a free CD copy of my finished thesis, please provide a mailing address.


APPENDIX C

LIST OF INTERVIEWS
INTERVIEWS

Jamey D. Allen. Researcher and Adjunct Curator, Bead Museum, Glendale, AZ. April 8, 2005, Sonoma, CA.

Rebecca Andrews. Collections Manager, Ethnology, Burke Museum of Natural History and Culture, University of Washington, Seattle, WA. Telephone interview with author, June 6, 2005.


Nancy Foniciello. Private conservator. Personal communications with author.


Alice Sheere. Director, Society for Bead Research. Interview with author. Sonoma, CA, April 18, 2005.


APPENDIX D

PRODUCT

“Glass Bead Deterioration on Ethnographic Objects”

http://bead-disease.122mb.com

or

http://bead-disease.com
GLASS BEAD DETERIORATION

This web site is devoted to the awareness of the deterioration of glass beads on ethnographic objects. Museums around the world have beautiful objects decorated with many small glass beads. Over time these beads can become unstable and result in chemical deterioration of the glass. This web site serves as a resource for information and further research into how to prevent and handle the problem of glass bead deterioration. Feedback is greatly appreciated in order to continually update this site with current and accurate information.

This web site is the product of a Master's Project in Museum Studies at John F. Kennedy University in Berkeley, CA. The project was conducted over one year and concluded with a written thesis, oral presentation, and this web site.

History

Glass was first discovered around 1700 BC in the Middle East, probably by accident. After centuries of experimentation with glass, various cultures throughout the Mediterranean learned to control and form molten glass to produce a variety of colors and shapes. As glass making spread to Europe, the secrets behind the formulas and manufacturing processes were closely guarded. Venice, and later the island of Murano, became the center for glass making during the 13th century. By the late 1600s glass making secrets began to leak out of Italy and production boomed in France, Bohemia, England, and Germany.

Lakota man and girl with dress, vest, quirts, trousers, and moccasins covered in glass beads c. 1500
Denver Public Library Photo
Glass Making

Glass is made by melting silica (SiO₂) found in sand, shaping the glass into a desired form, and allowing it to cool. The temperature required to melt silica is extremely high. To reduce the temperature required to melt the glass, fluxes are added to the mixture. Fluxes are chemical agents that allow the molecules to flow easier, decreasing the temperature at which the silica melts. The most common fluxes are soda ash and potash (sodium, Na₂, and potassium, K₂). Adding too much flux to a mixture can cause the glass to weaken once it cools, so stabilizers can be added to correct the problem. The most common stabilizer is lime (calcium, CaO).

Glass can be colored by adding pure metal elements to the glass mixture. Some common coloring elements are copper (Cu), chromium (Cr), manganese (Mn), iron (Fe), cobalt (Co), nickel (Ni), vanadium (V), titanium (Ti), and even uranium (U). Adding different amounts, combinations, and orders of the same metals can produce drastically different colored glass. A cloudy or milky effect in the glass can be achieved by adding thorium in the form of fluorspar or phosphates.

Bead Manufacture

Glass beads can be made using a variety of techniques. The most common bead types are drawn, wound, and molded beads. Drawn beads are made by placing molten glass on the end of a hollow pipe. Air is blown through the pipe creating a bubble of molten glass. The pipe is then plugged and a metal rod attached to the opposite end of the bubble. The rod and pipe are pulled in opposite directions creating a long hollow tube of glass. The tube is cut into sections, sized, and cut into beads. Drawing beads is the fastest way to produce a large volume of identical beads.

There are some variations to drawn beads. The glass bubble can be pressed creating flat edges that remain as the bubble is drawn. The bubble can also be dipped or coated with another color of glass creating a bead with one color inside and another color outside. The most common bead of this type is red or pink with a white center, often called “white heart” beads.

Wound beads are made by winding strands of molten glass around a metal rod. These beads are made one at a time and can be decorated with patterns and additional colors. Wound beads, also called lamp worked beads, often contain more than one type or color of glass. The glass is removed from the rod before cooling creating the hole for the bead. Molded, or pressed beads, are created from molten glass put into a mold and pressed into a desired bead shape. Molded beads are also made one at a time and are often made of one solid color of glass.
History

Trade and Use

Glass beads were produced very early in Venice to supply rosaries to the rapidly growing Roman Catholic Church. Beads quickly became a popular embellishment on garments of the 15th and 16th centuries. As European expansion pushed into North America, Africa, and the South Pacific, explorers brought beads along as trade items with the native people they encountered. Beads became particularly popular among American Indian peoples, and beadwork later became the artistic medium of choice among several tribes. Beadwork is made using a variety of techniques including string, sewn, braided, and woven.

Glass Disease

Most glass objects have remained relatively stable for hundreds of years. However, some problems exist in certain types of glass rendering them chemically unstable. Conservators and chemists have researched this problem and in true conservation fashion have coined the term “glass disease” when referring to this condition.

Glass disease refers to the instability of glass caused by poor or inconsistent manufacturing techniques. The visible symptoms of glass disease are weeping or sweating, cloudy appearance, white powdery substance on the surface, small cracks or crazing, and breakage. Aside from visual symptoms, certain tests measuring acidity and chemical composition can be performed to determine if an object is suffering from glass disease.

Glass disease occurs when alkaline salts in the glass are drawn to the surface by water or humidity. Molecules of sodium and potassium, common fluxing agents in glass, are drawn to the surface by hydrogen ions in water causing the salts to dissolve. This surface solution is a mixture of sodium hydroxide and/or potassium hydroxide which can be seen on the surface of the glass in the form of moisture spots—commonly referred to as weeping or sweating. Once the alkali hydroxide solution is exposed to the dry outside air, the sodium and potassium crystallize in low humidity resulting in a white powdery substance known as sodium carbonate and potassium carbonate. These alkali carbonates usually have a high pH of up to 9 or 10. The alkaline environment attracts more moisture causing the glass deterioration process to escalate. There are several terms used by conservators to describe glass disease, such as de-aluminization, leaching, alkali-deficient, silica-rich, hydrogen glass, or the gel layer.

As more alkaline salts are removed from the glass, small pores form on the surface. These pores increase the surface area allowing for more moisture to come in contact with the glass. Over time the pores grow and form tiny cracks. Small networks of cracks are known as crazing. Eventually larger cracks will develop and objects become brittle and can break or even shatter.

Fluctuations in humidity as well as the introduction of water cause the greatest amount of damage to unstable glass. Consistently low humidity levels will stabilize the glass preventing further deterioration. Consistently high or fluctuating humidity levels will continue to cause the alkaline salts to surface. For this reason conservators recommend low humidity levels of 40-45% RH as the best environment to prevent glass disease.
Bead Deterioration

Not all glass beads suffer from glass disease; in fact, very few beads currently show signs of deterioration. However, beads can be more susceptible to glass disease due to the nature of their manufacture. Beads were among the smallest and most mass-produced glass objects manufactured in Europe. Beads had the same purpose of being aesthetically pleasing. For these reasons beads were made from glass with an increased amount of flux—sodium and potassium—lowering the melting temperature and reducing the amount of costly flux needed to make the beads. The unusually large amount of alkali fluxing materials used in the glass greatly increased the possibility of glass disease occurring in the future. Chemical analysis has determined that some beads have a flux to silica ratio of nearly 1:1. To correct this problem of instability, calcium oxide, in the form of lime, was frequently added as a stabilizer. Adding calcium made the beads white or opaque in appearance. To obtain certain colors or a transparent look to the beads, calcium oxide was eliminated from the glass mixture, thus making these beads colors more susceptible to glass disease.

Although the deterioration process is the same, glass disease develops in a unique way on beaded objects due to the addition of threading material, cloth, and leather.

Prevention

The best conservation approach to glass bead deterioration is prevention. There are several steps that can be taken to prevent or lessen the effects of deterioration.

Humidity

The most important factor to control is humidity, because high humidity or fluctuations in humidity accelerates the deterioration process. In ideal circumstances a relative humidity of 40-45% should be maintained with as little fluctuation as possible. Museums unable to meet such demanding levels should strive to come as close as possible in order to preserve glass objects. Silica gel can often be used in storage and display cases to absorb excess moisture. The gel may need to be changed often, follow instructions on the packaging material.

Air circulation

Adequate air circulation should be available to beaded objects as well. Air circulation helps to dry the glass of any moisture accumulated on the glass surface. Avoid storing beaded objects in air tight containers, bags, or cabinets that restrict air flow. Larger cabinets and display cases can be fitted with small electric fans to circulate air within the case.

Storage and display

Wooden storage units and display cases are discouraged. Wood off-gasses acidic agents that can contribute to the deterioration of glass beads, namely acetic and formic acid. Cabinets and cases made from metal, plastic, and glass are ideal for objects containing glass beads. Wooden cabinets are all that is available to the museum, objects showing signs of deterioration should be removed immediately to reduce further damage. Other museum objects made of wood should be kept separate from beaded objects. Wooden display mounts are also discouraged. Chemical wood sealers can also be used to coat storage shelving and display cabinets to prevent off-gassing.

Pest management practices

When storing objects for pest management take extra care to notice pre and post-freezing conditions. Double bag beaded objects and seal both to prevent transfer of moisture through the bagging. Examine as much as is the bag as possible.

Treatment

Glass bead deterioration is an irreversible process. Once bead deterioration has been identified on an object, there are very few treatment options available. If the deterioration is found during an early stage, preventive conservation measures can help to stop or slow the process. These steps are outlined in the prevention section.

Some conservators have experimented with consolidates such as Arysta B-72 and thylene. These techniques are intended to hold beads together to prevent further breakage and loss of beads. The experiments with consolidates has been largely unsuccessful and there is little indication that future work with consolidates will become an accepted practice.

To properly clean beadwork do not use plain water or soap. When possible a dry brush or vacuum should be used to remove dirt. Difficult areas can be cleaned with a mild alcohol solution or saliva and a cotton swab. Make sure not to overheat the swab and use a fresh one often.

It is highly recommended that individuals not trained in object conservation should not attempt to perform active cleaning, treatment, or restoration on object suffering from deterioration.
Glossary

Acriloid B-72: A glue-like chemical used by conservators. It has been unsuccessfully used as a consolidant in treating bead deterioration.

Alkaline: Refers to substances with a pH greater than 7. For this project, it refers to sodium or potassium solutions.

Calcium oxide: Stabilizer added to the glass mixture to prevent deterioration in the future. Often reduced or eliminated from certain colors and many transparent colored beads. It is added to the mixture in the form of lime or chalk.

Crizzling: A network of tiny cracks.

Fluorescence: Process of alkaline salts coming to the surface of the glass.

Flux: Chemicals added to the glass mixture to reduce the temperature at which the silica becomes melt. Soda ash (sodium) and potash (potassium) are the most common fluxes in glass beads.

Lime: A form of calcium oxide added as a stabilizer to the glass mixture.

pH: (potential of hydrogen) a measure of the acidity or alkalinity of a solution.

Potassium hydroxide: Clear alkaline solution that is drawn to the surface of the glass by hydrogen ions in water.

Potassium carbonate: Crystallized potassium hydroxide. A white powdery substance that is alkaline.

RH: Relative humidity.

Saponification: Process when alkaline hydroxide mixes with oils in the leather backing creating a soap-like substance.

Silica: Basic ingredient for making glass, found naturally in sand.

Soda lime glass: Glass made with soda ash as the main flux and calcium oxide as a stabilizer. The most common type of glass for making beads.

Sodium hydroxide: Clear alkaline solution that is drawn to the surface of the glass by hydrogen ions in water.

Sodium carbonate: Crystallized sodium hydroxide. A white powdery substance that is alkaline.

Sweating: Process when alkaline hydroxide solutions surface from the glass creating moisture spots.

Tehene: A glue-like chemical used by conservators. It has been unsuccessfully used as a consolidant in treating bead deterioration.

Weeping: Process when alkaline hydroxide solutions surface from the glass creating moisture spots.

Resources

American Institute of Conservation

ICOM Committee for Conservation

Corning Museum of Glass

American Association of Museums

John F. Kennedy University
Bead Deterioration

Symptoms and Stages

Sweating and Weeping

The early signs of glass bead deterioration occur during the sweating or weeping stage of glass disease. The alkaline solution that seeps onto the beads is sticky and attracts dust and dirt. This stage may be difficult to recognize on small beads, but they will often have a dirty or grimey build-up not present on nearby stable beads on the same object.

More Photos

Saponification

When sweating or weeping occurs in beads attached to leather, an additional chemical reaction can take place. The alkaline solution reacts with fatty material in the leather creating an oil or soapy residue, known as saponification. The soapy mixture attracts high amounts of dust and dirt and can spread to adjacent beads. This condition has been observed with varying bead types, animal skins, and tanning methods.

More Photos
White Powdery Build-up

The next stage of deterioration occurs when the reacting alkaline solution crystallizes forming a white powdery substance composed of sodium carbonate and potassium carbonate. Alkaline carbonates form when the humidity lowers. The salts also attract moisture to the glass surface causing the deterioration process to accelerate. Weakening and breaking of the threads and material can occur during this stage. A white "ghost image" of the beadwork design can appear on cloth as well as dark spots on leather.

More Photos

Crizzling

As more sodium and potassium migrate to the surface, an intricate network of tiny cracks known as crazing or crizzling can occur. Crizzling is often difficult to recognize, especially on opaque beads, yet macroscopic examination will reveal the symptoms quite easily. In transparent and translucent beads, crizzling can produce a dull finish or opaque appearance.

More Photos

Broken or Missing Beads

The final and most severe stage of deterioration results in broken and missing beads. Crazing and cracking will continue until the glass is so weak that the beads simply fall apart. This stage is relatively easy to recognize as bead fragments may be present on the object or on storage and display lining. Normally only one type or color of bead will be missing while surrounding beads remain intact. Deterioration should not be confused with broken threads from normal wear and use.

More Photos