

# The History, Technology and Care of Globes: Case Study on the Technology and Conservation Treatment of Two Nineteenth-Century Time Globes

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*Fig. 1 Two Juvet Time Globes, American, c. 1860-80's, after conservation treatment. From the National Museum of American History, Smithsonian Institution.*

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## INTRODUCTION

The year 1879 witnessed a breakthrough in the technology of globe manufacture. It arrived in the form of Juvet's time globe. This geographical clock, as it was also known, combined several technological advances to produce a globe which automatically rotated every twenty four hours, while indicating accurately both the time and relative degree of night or day in every part of the world.<sup>1</sup> The imitation of the earth's rotation could be made even more realistic if the globe were oriented

according to a compass fitted in its base, and illuminated by a sun-like source. Testimonials from educators throughout the United States extolled its virtues in the study of geography.<sup>2</sup>

As the Scientific American of 1880 attested, horologists had for years desired

*to apply by some mechanical device a motor to a terrestrial globe, that, while it should show the exact diurnal revolution, should also be so constructed as to have utility as a timepiece ... A French inventor made a globe in the shape of a dome, exhibiting only the northern part of the earth, and by an impelling mechanism turned it on its axis. These and other crude and cumbersome mechanical devices prevent any other than a rigid position, and one that could not accurately illustrate the earth's polar position ... (However) ... a citizen of the United States, after years of patient effort has devised a time globe which avoids the imperfections of its predecessors ... The shell that envelops the works and protects them against accident or dust is very light and uniform in thickness, allowing the mechanism to turn freely, equably, and in perfect balance. The globe surface is as hard and smooth as a sheet of steel, being made of an entirely new material, which is unaffected by moisture, or heat, or cold...we are informed that it cannot be fractured by blows.<sup>3</sup>*

The globe was recommended as a 'fit ornament for any library, a valuable adjunct in every business office, and a necessity in every institution of learning', and received an award in education and science at the Philadelphia Centennial Exhibition.<sup>4</sup> As the Smithsonian Institution curator, Carlene Stephens, has noted, when 'prominently displayed in the parlours and drawing rooms of Gilded Age America, the elegant time globe clearly demonstrated the wealth and culture of its possessor.'<sup>5</sup> Patents were issued in the United States and Europe, and the globes were reportedly ordered by the governments of Brazil, Japan, Russia, France and England. One was made for the British Geographical Society, and another was placed in the cabinet room of the White House. <sup>6</sup>

It is the purpose of this paper not only to outline the ingenious technology developed to create the unique hollow shell of this globe, as compared to contemporary innovative but flawed constructions, and to determine by the examination of one example whether it, in terms of its purported stability, indeed lived up to the claims of its inventor and the praise of the testimonials. The relationship between a small Juvet time globe (which fits the description of the 1879 patent) and a larger one (fashioned in a much different manner), and their subsequent conservation treatments, will also be addressed.

## DEFINITIONS

The word globe derives from *globus*, the Latin word for sphere. However, most "globes" consist of several components, including:

- **globe shells** covered in skin or paper in the form of gores
- **struts** of many materials
- **equatorial or meridian rings** of metal or wood
- **stands** of marble, metal, or wood, with many parts and designs

## HISTORY AND TECHNOLOGY OF GLOBES

During the **5<sup>th</sup> century BC**, Greek philosophers conceived of the earth as a sphere surrounded by a body of stars and constellations, represented as **celestial globes**. The earliest extant celestial globe rests on the shoulders of Atlas in the marble Farnese Atlantus (a Roman copy of a Greek version from 3-4 century BC). Throughout history, globe construction posed many dilemmas for globe-makers, ranging from what materials to use for different parts to representation of two-dimensional maps on three-dimensional spherical forms.

The choice of material for globe spheres could be problematic. In the **13<sup>th</sup> century AD**, Alfonso of Castile recommended wood rather than expensive precious metals such as gold or silver, or heavy materials like lead and brass, or corrosive material like copper and iron. He felt that a common material like clay was not appropriate for such a noble object, and he warned that leather, parchment, and cloth could shrink when exposed to heat.

Nonetheless, in the **15<sup>th</sup> century**, when Columbus' discovery of America led to an explosion in interest and manufacture of globes, parchment was occasionally used, as in the Martin Behaim globe of 1492 in Nuremberg, the earliest surviving **terrestrial globe**. It was made by covering a mold of papier mache with vellum, which (after drying) was sliced off at the equator and reinforced with wooden rings. After being adhered back together, a map - drawn on the parchment strips (**gores**) - was pasted onto the sphere.

Transposing the surface of the earth to a sphere was always difficult. One solution, posed by Crates Mallos, the royal librarian at Pergamon in **150 BC**, reflected the concept that the earth was composed of four evenly spaced islands, dividing the terrestrial sphere into four quarters. The problem of the ideal number of gores intrigued even Di Vinci and Durer. In the **16<sup>th</sup> century**, Martin Waldseemüller printed the earliest surviving gores, settling on 16. In 1541, master mapmaker

Mercator worked out a mathematical system for gores that included, among other things, separate polar regions (caps or calottes) and gores in many forms. The **17<sup>th</sup> century** master globe maker, Coronelli, reportedly created one of the largest globes ever made, with a 14 foot diameter, for Louis XIV of France in 1683.

By the late **19<sup>th</sup> century**, developments in globe manufacturing reached staggering diversity. Variations in hollow globe construction in America abounded. Five innovations cited in the 1876 edition of Knight's American Mechanical Dictionary<sup>7</sup> included:

- A paper shell globe covered in powdered slate.
- A papier-mache globe divided into forty-eight pieces which could be disassembled for packing when necessary or for convenient study.
- An inexpensive paper globe whose printed gores were held together with string in a roughly spherical shape.

- A tissue-paper globe that reportedly could be inflated with air to 12ft in diameter for use in school rooms.
- An inflatable globe of india-rubber-coated silk by Goodyear.

But the most prevalent manufacturing process for creating a hollow sphere described by Knight went as follows:

1. Wetted strips of strong paper were placed on a wooden mould, and a shell was built up with successive strips of pasted brown and white paper.
2. After drying, the paper shell was cut through the Equator and removed.
3. The sphere was placed within a frame and revolved as five layers of plaster composed of whiting, glue, and oil were successively applied and allowed to dry; the layers were then scraped even with a semi-circular scraper and polished.
4. Lead shot was then introduced into the interior to correct any imbalance, if necessary.
5. Guidelines were drawn to aid in the placement of 14 engraved strips (two polar circles or calottes and twelve half clipped gores), which were applied wet.
6. Finally, the globe sphere was colored, varnished and mounted.

This process may have been used even in the early nineteenth century by a pioneer of American globe making, James Wilson, the first manufacturer of globes in America. His globes were described as being composed of papier-mache and plaster, with 12 gores and polar calottes, and lead shot balancing.<sup>8</sup>

## TECHNOLOGY OF JUVET'S TIME GLOBES

Two time globes belonging to the Smithsonian Institution, which were both manufactured by **Louis Paul Juvet** of New York, had shell constructions which differed not only from the process outlined above, but also from each other (Fig. 1). Neither had 12 gores or polar calottes. The smaller one, 12ins in diameter, had 24 half gores, while the larger, 18ins diameter globe, had 12 half gores, 12 half clipped gores, and 12 gore tips forming a polar cap. Both could be separated at different seams to allow insertion of the clock movements: the small globe separated at the equator, while the large globe had a detachable South Pole. The detachable pole was made of three layers of wood and this led to initial speculation that the globe might have a hollow wooden shell. However, x-ray radiographs, while indicating a series of segments in the large globe, revealed no wood grain to suggest wooden ribs or stays in either globe. Once opened, the interior of the large globe indicated that it may have been made in a manner akin to that described by Knight, with strips of paper, joined at the equator and covered with a paper band on the inside join. However, the interior of the smaller globe had an unusual pattern of concentric circles, bumps and weave texture.

This difference in shell structure between the two globes was puzzling, considering that the maps are rather similar. They appear to be based on maps by **William and Alexander Keith Johnston, self-styled Geographers of Edinburgh in Ordinary to the Queen** during the nineteenth century, who produced the first British atlas to give a synoptic view of physical geography, indicating atmospheric and weather conditions all over the world through ocean currents. Progressive features such as telegraph cables are shown on some of the Juvet globes. Such up-to-the-moment recording attests to the achievements of this mapmaker, since, by one estimate, maps could be as much as 25 years behind in their graphing, owing to the rapid political developments of the nineteenth century and the difficulties of world-wide communication at the time.<sup>9</sup>

Both maps also identify Greenwich as prime meridian, which was agreed to by an international conference in 1884. However, the larger map has a label with patent dates between 1867 and 1879, some five years earlier.

This, along with several other clues, suggest that the 18ins sphere might have been remapped, which Juvet and Company would do for a nominal fee.<sup>10</sup> The label is stuck on, not printed on, and a second map is apparent under a loss in the first, as is a forgotten time marker which protrudes along the Equator under the first map. Consequently, the shell of the larger globe may predate 1879, and this could explain its greater affinity to the Knight's 1876 description.

The construction method of the smaller shell was difficult to determine. When opened at the equator, the interior revealed, through heavy varnish, not only the bumps, circles, and fabric impression, but also impressions of longitudinal stitching. As it turns out, Juvet's New York operations were in a building owned by **State Senator James Arkell**, an entrepreneur who pioneered the use of bags made of paper. He apparently was intrigued enough by the problem of hollow sphere construction to devise and patent a solution for Juvet.<sup>11</sup>

Arkell's device for manufacturing a hollow sphere consisted of a screw press containing hemispherical male and female dies, expandable through radial slits and perforated with extraction holes, covered by a stitched-on fabric to prevent extrusion of the shell material. This "entirely new" material, as proclaimed by the Scientific American, was actually the paper-making waste product called "**wet-broke**". Arkell described this material as a manilla fibrous sheet which was formed on the motion wires of a paper-making machine, but not calendered or passed through the pressing rolls. Unlike a finished paper sheet, it was unstretched and imperfectly felted stock, coming off the wires in a crinkled condition, and thus it could be stretched over the male die without tearing or wrinkling, 'and pressed into a solid piece of equal thickness and density throughout, and of great tenacity and strength.'

Four to six layers of "wet-broke" would be applied to the covered male die, with "paste" layers between, and then pressed into the concave female die, allowing extrusion of excess water through the perforations. Steam was then fed through a faucet at the top at 80 lbs of pressure for 1-4 hours, which, according to Arkell, baked the "wet-broke" into a solid mass capable of withstanding 300 lbs of crushing pressure. Additional advantages of his invention were the near perfect spherical shape, light weight and the low cost of using a paper-making by-product. Arkell claimed that at the time, a 9 ins cork globe would weigh 10 oz and cost \$16, while his would weigh 7 1/2 oz and cost 50 cents.

Despite its innovations, there seems to be some precedent for Arkell's steam baked, molded paper shell. Many globes have been described as made of **papier-mache**, but since these take different forms, the term needs some clarification.<sup>12</sup> Common papier-mache, that is masticated or macerated paper, was used in Europe in the eighteenth century primarily for decorative and architectural ornamentation, and formulae include pulp, paste, glue, resin, drying oil, sugar of lead, waste silk and so on. The traditional papier-mache for globes appears to have been made from scraps, rather than from pulp, adhered over a form. Other globes are made of strips of paper, which some references term pasteboard or "cardboard". Pasteboard originated in the ancient Orient and was first produced in Europe in the late sixteenth century. Cardboard, as such, was not commercially produced until the early nineteenth century in England. However, it was during the late eighteenth century that a major development occurred, ushering in a new industry in papier-mache manufacture in England that flourished for 100 years.<sup>13</sup>

In 1772, **Henry Clay** patented a method of molding paper panels to produce trays and boxes for japanning. His technique required 10 sheets of unsized rag paper coated with cooked glue and flour, pressed into a mold, rubbed to remove air bubbles, and drenched in linseed oil for waterproofing, followed by baking at 100°F to produce an inflexible and strong material.<sup>14</sup> In 1847, the English papier mache firm of **Jennens and Bettridge** improved upon Clay's technique by producing counter molds and thicker board of up to 120 sheets (Fig. 10). The firm used steam to soften the laminate in order to mold it as well as to aid in drying it. As the 1847 patent issued to Theodore Hyla Jennens stated, the layered paper was placed into a chamber of convenient form and size and steam from a boiler admitted until the desired effect was produced.<sup>15</sup> This process produced what was referred to at the time as the best papier-mache.<sup>16</sup> Some scholars believe that employees of Jennens and Bettridge had a hand in establishing the first American papier-mache factory, the **Litchfield Manufacturing Company** in Connecticut, since this company used the British firm's exclusive, patented techniques of mother of pearl decoration.<sup>17</sup>

The Litchfield firm specialized in papier-mache clock cases, and clock works were procured from neighboring firms, some of which occasionally produced cases incorporating globes.<sup>18</sup> The Litchfield Company failed after a merger in the mid-1850s that bankrupted its major supporter, **showman P.T. Barnum**, who went on to become not only the founder of the greatest show on earth, but also a mayor and member of the Connecticut state legislature.<sup>19</sup> It is conceivable that Senator Arkell knew of the transplanted British developments in the steam molding of paper, a process which could be streamlined and adapted to include the use of "wet-broke" for his New York tenant, Juvet.

## CONSERVATION PROBLEMS AND TREATMENT

Although Arkell claimed in his patent that the shell would not break like plaster globes, since it could withstand a crushing weight of 300 lbs "without any deflection of the surface", the small Juvet globe did have a small **dent**, presumably from a force greater than 300 lbs. But, true to the inventor's promise, it had not fractured. Its resistance to moisture, heat, and cold was as advertised, except for the fact that, as often happens with globes, the **varnish layer had darkened** from exposure to light, to the point of obscuring the map.

Oddly enough, the varnish of the larger globe had not discolored significantly, and this pattern appears in other Juvet time globes.<sup>20</sup> Infrared spectroscopy identified the varnish of both globes to be the same modified natural resin, but each had totally different properties.<sup>21</sup> The varnish on the large globe was a thin, even film which had remained clear although covered with surface grime, while that on the small globe was thick, brittle, and extremely discolored throughout. Simply swabbing with dilute ammonium hydroxide removed the obstructing grime from the larger globe. However, this was insufficient on the small one, which required the removal of the varnish.<sup>22</sup>

A survey of colleagues and the literature produced suggestions for the **removal of varnish** from globes which included swabbing with acetone,<sup>23</sup> alcohol,<sup>24</sup> or alcohol and turpentine.<sup>25</sup> Only one source recommended mechanical removal of thick varnish.<sup>26</sup> However, since testing for solvent removal indicated that staining would occur, mechanical removal was undertaken (Fig. 13). The tools recommended for this were a skew chisel or stainless steel spatula rounded at the heel or a dental cutter, but I used a rounded orange stick provided by our clock conservator. While one published time estimate for such mechanical removal of varnish on a globe of comparable size was under an hour, in this case it took 20 hours.

The **cleaning of paper gores** is recommended by several sources, using acetone and methanol,<sup>27</sup> ammonia water,<sup>28</sup> soap and soda,<sup>29</sup> a dry-cleaning soap called Vulpex,<sup>30</sup> and bleaching.<sup>31</sup> But in our case, the gores were not in need of general cleaning. There was some overall intermittent staining from the original varnish application, which followed the strokes of the application brush (apparently often found on globes).<sup>32</sup> It was not terribly disfiguring, so a conservative approach was adopted.

Likewise, the dent (being unobtrusive) was not treated, although published suggestions range from easing out a dent with moisture applied from within,<sup>33</sup> splitting the cover paper and filling dents with a plaster compound of papier-mache, chalk, zinc and parchment size,<sup>34</sup> or actually cutting out neighboring areas and pushing out the dents.<sup>35</sup>

Methylcellulose was used as an isolating agent for inpainting areas abraded by the meridian ring. Inpainting was done with Winsor and Newton watercolors, and the areas were coated with a second layer of methylcellulose to preclude a change in refractive index after spraying with a surface coating.<sup>36</sup>

Since the paper appeared to have retained its original size, and since the varnishing technique selected was to be a relatively dry application, resizing was not undertaken, although this is generally a beneficial step.<sup>37</sup> Revarnishing of globes has been carried out with mastic in turpentine, with linseed oil as a plasticizer,<sup>38</sup> tinted Klucel G (hydroxypropyl cellulose) in alcohol,<sup>39</sup> AYAF (Polyvinyl alcohol) in toluene, acetone and xylene,<sup>40</sup> or Acryloid B72 in xylene. Acryloid B72 and 67 were tried in a variety of solvents, including combinations of those mentioned above, as well as mineral spirits, benzine, and diethyl benzene. They were tested on a spherical mock-up of paper having approximately the same surface characteristics as the gores, in an attempt to achieve an appropriate evaporation rate.

The aim was to deposit resin only on the surface of the paper, avoiding penetration or saturation of the paper, which would interfere with reversibility or change the

refractive index of the paper. The method was to apply a first layer of 10% B67 in mineral spirits and benzine, sprayed on with an air brush from a distance of about 18ins, to build up a fairly dry base of viscous droplets of resin resting on the surface of the paper. A second layer was then applied, with the air brush moved closer, to achieve a glossier coat of smaller, less viscous resin droplets.

The final effect of this varnish coating was less satin-like than the larger Juvet globe. Several sources recommended treating revarnished globes with beeswax to enhance glossiness, and paraffin wax had been detected by infrared spectroscopy on a globe examined at the Conservation Laboratory.<sup>41</sup> A thin layer of microcrystalline wax applied to the small globe provided an even sheen, making the small globe visually compatible with the larger one, with which it was to be exhibited.

#### **CARE AND STORAGE**

An ethical dilemma presented by the Juvet globes arose because of their automation. One of the primary concerns of the curator responsible for the globes was that they represent their function as mechanisms. To this end, great pains were taken by the Smithsonian clock conservator, David Todd, to restore the clocks' mechanisms to working condition. To preserve the technological integrity of the pieces, some damaged elements, such as gears, had to be refabricated. The globes, like many composite objects, have an additional "inherent vice": simply functioning as intended can destroy them. In general, this dilemma has been resolved at the National Museum of American History by restoring an automated object to function temporarily so that it may be filmed in operation to document the technology. Thereafter, the existence of the film, supplemented by full documentation of the conservation treatment, precludes the need to operate the object itself.

#### **CONCLUSION**

While the outward appearance may be essentially identical, globes by the same maker can have radically different constructions. Often the details of construction, such as location of joins or whether the globe is hollow or solid, reflect different purposes, which will need to be considered in their conservation. Evaluation is further complicated by the fact that various components of globes, particularly in the nineteenth century, could be custom ordered, so that, for instance, the same globe might have a more or less decorated base depending on the taste of the respective owners. These factors lend complexity to conservation considerations as to what constitutes the integral parts of the globe. For example, what dictates one's concept of the original condition or authenticity of coatings, gores, cores, bases, horizon circles, meridian rings, etc., if they have been purposely altered through the ages? The problem can be exacerbated by the fact that mounted gores command a higher market value than those in Atlases, conceivably encouraging fraud in some instances. Since globes, even from the most ancient times, were perceived as utilitarian, the habit of recovering or patching to update them requires from the conservator keen observation, judgement and familiarity with this type of artifact.<sup>42</sup>

## ENDNOTES

1. For the mechanization of the Juvet Time Globes, see the following Louis Paul Juvet United States Patents: No.60,740, Jan. 1, 1867; No. 64,989, May 21, 1867; No. 189,042, Sept. 15, 1876; No. 220,480, Oct. 14, 1879; No. 238,913, March 15, 1881; and No. 238,914, March 125, 1881. For earlier clockwork driven celestial globes, see Maurice, Klaus and Mayr, Otto, eds., *The Clockwork Universe*, Washington, D.C. Smithsonian Institution: Neale Watson Academic Publishers, N.Y., 1980, pp.290-306.
2. See Anon., *Time Globe Testimonials*. Company advertising material.
3. Anon., 'Juvet's Time Globe', *Scientific American*, January 10, 1880. Information published in the *Scientific American* could reflect the bias of its subject. For a discussion of this, see Hounshell, David, 'Public Relations or Public Understanding? The American Industries Series, in *Scientific American*', *Technology Culture*, 21, July 1980, pp.589-593. For the technique of shell construction, see the following patents: James Arkell, 'Improvement in Globes and Machinery and Processes for making the Same', U.S. Patent, No. 221,013, Oct- 28, 1879, and 'Improvement in Time Globes', U.S. Patent, No. 220,462-, Oct. 14, 1879. Also, Arkell and Adelbert G. Richmond, 'Globe', U.S. Patent, No. 227,713, May 18, 1880.
4. The Philadelphia Centennial was in 1876. Publication of the award winners can be found in Walker, Francis A., *International Exhibition 1876, Reports and Awards, Group XXCII*, Philadelphia: J.B. Lippincotte and Company, 1878. The award may have been won by a prototype.
5. Stephens, Carlene, 'Juvet Time Globe', in Stephen, C. and Mayr, Otto, *American Mechanical Clocks*, unpublished manuscript, National Museum of American History, Division of Engineering and Industry, Smithsonian Institution, 1980.
6. Anon., *Canajoharie Radium Newspaper*, New York, May 2, 1878; Oct. 3, 1878; Aug, 7, 1879; Sept. 11, 1879; and July 22, 1880.
7. For the description of the nineteenth-century processes, see Knight, Edward H., ed., 'Globe' and 'Globe-clock', *American Mechanical Dictionary*, New York: Hurd and Houghton, 1876, pp.986-9. For shell constructions of paper and the use of lead shot, see also Baynes-Cope, A.D., 'Study and Conservation of Globes', *Der Globusfreund*, 33-4, March 1985, pp.1-80.
8. For Wilson, James, see Ristow, Walter W., *American Maps and Mapmakers, Commercial Cartography in the Nineteenth Century*, Detroit: Wayne State University Press, 1985, pp.89 and 278; and Yonge, Ena L., *A Catalogue of Early Globes, Made Prior to 1850 and Conserved in the United States*, New York: American Geographical Society, 1968, pp.54-73.
9. For Johnston, William and Alexander Keith see Tooley, Ronald Vere, (with preface by Wallis, Helen), *Tooley's Dictionary of Mapmakers*, Tring (Hertfordshire, England): Map Collectors Publishers Ltd., 1979, p.341; and Woodward, David, ed., *Five Centuries of Map Printing*, Chicago and London: University of Chicago Press, 1975, pp.22,65,100. Woodward, on p.100, notes that the firm of W. and A.K.

Johnston was founded in Edinburgh in 1825. It printed by copper plate engraving until about 1860, shifting to lithography in 1855. 'By 1860 the company had installed a rotary lithographic press, and chromolithography was introduced around 1865.' For maps on Juvet globes with telegraph cables, see March, Glenn A., '18-inch Juvet Globe Clock', *Bulletin of the National Association of Watch and Clock Collectors*, 22, No. 2, April, 1979, p.129-31. During the nineteenth century, particularly in the earlier decades, the best maps had to be imported from Europe, since the United States progressed slowly from wood engraving to transfer lithography. See Holden, Maria S., 'The development of Lithographic Cartography and the Conservation Treatment of a Large Varnished Map', *Book and Paper Group Annual, American Institute of Conservation*, 3, 1984, pp.75-83.

10. Juvet and Co., *The Time Globe*, Canajoharie, New York, promotion material. The tradition of updating maps by cutting out dates or old information and gluing in new information, such as changing 1700 to 1750, is noted by van der Krogt, PC.1, in 'Historisch overzicht van de globe produktie in Nederland', *Globes Produktie, Conservering, Restauratie*, Amsterdam, 1985, p.29.

11. For Arkell's patent, see 'Improvement in Globes and Machinery and Processes for making the Same', U.S. Patent, No. 221,013, October 28, 1879, and 'Improvement in Time Globes', U.S. Patent, No. 220,462, Oct. 14, 1879. Also Arkell and Adelbert G. Richmond, 'Globe', U.S. Patent, No. 227,713, May 18, 1880. For Arkell and Juvet, see Anon., 'An unusual Juvet Time Globe Patent', *National Association of Watch and Clock Collectors Bulletin*, 22, No. 2, April, 1980, pp.181-2. For further details of James Arkell and Beech-Nut, see Anon., 'Baertlett Arkell, for 50 years president (of) Beech-Nut Packing Company, Died on Saturday', *Canajoharie Courier*, Oct. 17, 1946.

12. For references to globes of papier-mache, cardboard, and millboard, see Baynes-Cope, A.D., 'The Investigation of a Group of Globes', *Imago Mundi, Journal of the International Society for the History of Cartography*, 33, 1981, pp.9-19; 'The Repair of Globes', excerpt from the Meeting of the Internationale Vereinigung Meister der Einbandkunst at the Royal Library, Stockholm, September 5- 10, 1966; 'Study and Conservation of Globes', *Der Globusfreund*, 33-34, March 1985, pp.1-80. See also Kober, B., 'Erdglobus' and 'Himmelsglobus', *Restaurierte Kunstwerke in der Deutschen Demokratischen Republik, Ausstellung im Alten Museum, Staatliche Museen zu Berlin*, April-June 1980, pp.366-8; Munro, Susan Nash 'Conservation of a Three-Dimensional Paper Object', *Papers of the AIC Book and Paper Group Session*, Philadelphia: Caber Press, 1981, pp.7-8; Wachter, Otto, 'Die Instandsetzung von Globen', *Der Globusfreund*, 9, November 1960, pp.37-42.

13. For a definition of terms and summary of the developments in papier-mache, see van der Reyden, D., and Williams, Donald, '[Technology and Conservation Treatment of a nineteenth century English ' Papier-Mache' Chair](#)', *American Institute for Conservation Preprints*, May 1986, pp.125-42. Major references include: Hunter, Dard, *Papermaking: The History and Technology of an Ancient Craft*, New York: A.A. Knopf, 1943, p.480; DeVoe, Shirley Spaulding, *English Papier Mache of the Georgian and Victorian Periods*, Middletown, Conn Wesleyan University Press, 1971; and Toiler, Jane, *Papier-Mache in Great Britain and America*, Newton, MA: C.T. Branford Co., 1962.

14. Clay, Henry, 'Manufacture of Panels', British Patent 1027, Birmingham, England, 1772. See also DeVoe, *op. cit.* (ref.13), pp.40-3.
15. Jennens, Theodore Hyla, 'Improved methods of manufacturing papier-mache articles applicable also for ornamenting purposes generally', British Patent 11670, Birmingham, 1847.
16. Simmonds, Peter, *Dictionary of Trade Products*, London, 1863.
17. DeVoe, Shirley Spaulding, 'The Litchfield Manufacturing Company, makers of japanned papier-mache, Antiques, August 1960, pp.150-3. Reportedly, in 1834, brassmakers from England's Midland japanning centers emigrated to Connecticut. Apparently some were skilled in papier-mache, because they founded the Litchfield Manufacturing Company in 1850 with 50-70 men and women. This company was the first of only two American papier-mache firms, and the only one to make clock cases, specializing in marine clocks which were shipped to South America and Missouri. At the 1853 New York World's Fair, the firm was described as producing '...real papier-mache, with the best display of goods at the whole fair.' The firm moved to East Bridgeport, becoming the Terry and Barnum Manufacturing Company, and then eventually merged with the Jerome Clock Co. in East Bridgeport. After failing, it was taken over by a sewing machine company, which hired some of the japanners to decorate the machines. According to the grand daughter of the company president, Dr. Josiah Gale Beckwith, the workers "came from Wolverhampton and Oxfordshire" and were paid \$10. Toiler, *op. cit.* (ref-13), p.99, speculates that at least one of the workers came from Jennens and Bettridge, since their secret, patented technique of "pearl inlay" was used at Litchfield, and would not have been known at Wolverhampton. The Litchfield Manufacturing Company technique is described by Palmer, Brooks in 'The Litchfield Manufacturing Company', *American Antiques Journal*, November 1949, pp.26-8.
18. For clock cases with globes, see Dworestky, Lester and Dickstein, Robert, *Horology Americana*, Roslyn Heights, New York, 1973, pp.174-5, illustrating examples from Laporte Hubbell in Bristol Conn. (c.1870) and Timby Solar Clock from Saratoga Springs, New York (c.1863).
19. For P.T. Barnum's connection, see Palmer, Brooks, *op. cit.* (ref.17), pp.26-28.
20. Dworestky and Dickstein, *op. cit.* (ref.18), pp.176 and 177.
21. The thin, clear varnish on the large globe appeared relatively plastic and flexible, without a pronounced craquelure pattern, and it fluoresced slightly blue when examined by ultraviolet illumination. That on the smaller globe had a severe, uniform crackle pattern and greenish fluorescence. The dispersive infrared spectra for both indicated a modified wood rosin such as pine. These findings are consistent with those of Dr. John S. Mills, Scientific Advisor at the National Gallery in London, undertaken for globes belonging to the Maritime Museum in Greenwich. Gas chromatograph mass spectroscopic analysis at CAL further indicated the possible presence of linseed oil in the discolored varnish of the smaller globe.
22. According to a meeting on globe conservation held in Amsterdam in May, 1985, varnish removal and revarnishing of globes is considered to be a relatively conservative treatment approach, as compared to dismantling the gores, etc. For the

ethical discussions, see 'Discussie over een restauratieplan von een globe', Globes Produktie, (see ref.10), pp.41ff. On p. 44, participants noted the aim to balance the retention of integrity while also protecting the object. Treatments are categorized as doing as little as possible (clean and apply new varnish) or doing a full treatment (dismantle totally) on p.46. Baynes-Cope, 'Study and Conservation of Globes', (see ref.12), pp.11-12, refers to the Jenkinson-Ellis rule forbidding replacement of text, and notes that examination and treatment of globes are interlocked in that one can not complete the examination until the globe is cleaned. His article provides an excellent overview of the state of the art of globe conservation.

23. Recommendations for initial cleaning of superficial grime include use of erasers or "oral enzymes". For acetone cleaning, see Baynes-Cope, 'Repair of Globes', (see ref.12), p.2.
24. For alcohol, and acetone, cleaning, see Kober, 'Erdglobus', (see ref.12), p.37.
25. For alcohol and turpentine, see Wachter, 'Instandsetzung von Globen', (see ref.12), p.37.
26. For manual varnish removal, see Baynes-Cope, 'Repair of Globes', (see ref-12), p.1.
27. For acetone and methanol cleaning, see Baynes-Cope, 'Repair of Globes', (see ref-12), p.2. The suggestion is to use a hand-size swab, applied for 5 minutes.
28. For ammonia water cleaning, see Bettina Jessel, '18<sup>th</sup> Century French Globe', Report No. 0538 (unpublished conservation report), Conservation Analytical Laboratory, Smithsonian Institution, 1968.
29. For soap and soda cleaning, see Wachter, 'Instandsetzung von Globen', (see ref.12), pp.37-8.
30. For Vulpex, or "Soap B.30", see Baynes-Cope, 'Study and Conservation of Globes', (see ref.12), p.26. He states that this material, available from Synthite Chemical Ltd., is effective in distilled water or non-polar solvents with high boiling points (not acetone or alcohol). Many other surfactant and poultice methods, including a "paste wash", are outlined. For cleaning of removed gores followed by deacidification, see pp.24-5. Also, Munro, 'Conservation of a Three-Dimensional Paper Object', (see ref.12), p.1.
31. Chlorine dioxide bleaching is discussed by Wachter, 'Instandsetzung von Globen', (see ref.12), p.38; Kober, 'Erdglobus', (see ref.12), p.367; and Baynes-Cope, 'Study and Conservation of Globes', (see ref-1 2), p.24.
32. Staining from varnish is noted in Globes Produktie, (see ref.10), p.51-54.
33. Removal of dents with moisture is outlined in Muller, Norman, '1892 Facsimile of Behaim Globe, by M. Gigot de Grandpre', Report No. 0034 (unpublished conservation report), Conservation Analytical Laboratory, Smithsonian Institution, 1964.

34. Splitting paper to fill a dent is noted in Kober, 'Erdglobus', (see ref.12), p.41. The use of screws is suggested in Globes Produktie, (see ref.10), p.55, and by Baynes-Cope, as well as other techniques described in 'Study and Conservation of Globes', (see ref.12), p.50-62.
35. For cutting out of areas, see Muller, '1892 Facsimile etc.', (see ref.33), p.6.
36. Inpainting was limited to toning selected abraded areas. Abrasion results not only from handling, but also from misplacing the globe within the assembly of its horizon and meridian circles, after prior removal. Suggestions to assure correct alignment are found in Globes Produktie, (see ref.10), p.35 and Baynes-Cope, 'Study and Conservation of Globes', (see ref.12), pp.17-18. Other documented inpainting materials include charcoal and magna colors, as well as pigments ground in methylmethacrylate and toluene.
37. Consolidants recommended in the literature include methylcellulose, gelatin, starch, and rabbit skin glue. Soluble nylon (Zytel) has been recommended by Baynes-Cope in several articles, but Catherine Sease noted the problems with reversibility and dirt accumulation with this material in 'The Case against using Soluble Nylon in Conservation Work', *Studies in Conservation*, 26, 1981, pp.102-10. Resizing is recommended in Baynes-Cope, 'Study and Conservation of Globes', (see ref.12), p.45 and 'Repair of Globes', (see ref.12), p.7.
38. For mastic in turpentine and linseed oil, see Wachter, 'Instandsetzung von Globen', (see ref.12), p.41.
39. For tinted Klucel in alcohol or tinted matt picture varnish, toned to obscure mottling on old globes, see Globes Produktie, (see ref.10), p.51-54.
40. For AYAF, acetone and xylene, see Baynes-Cope, 'Repair of Globes', (see ref.12), p.7.
41. For wax coatings, see Baynes-Cope, 'Study and Conservation of Globes', (see ref.12), p.45. Kober, 'Erdglobus' (see ref.12), notes that adding beeswax to varnish reduces glossiness. Detection of paraffin is noted in Jessel, '18th Century French Globe', (unpublished internal report, see ref.28).
42. Baynes-Cope, in 'Study and Conservation of Globes', (see ref.12), p.9, notes, 'No two makers produced globes which were identical, each globe made, by any maker, has had a different history, more likely than not involving maltreatment or neglect'.

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## **RESUME EN FRANCAIS**

On a découvert que deux globes Juvet du memo fabricant avaient des carcasses de construction différentes. Alors que Tune, composé de bandes de papier disposées en couches sur une forme rondo, représentait les méthodes traditionnelles de fabrication de globes au dix-neuvième siècle, l'autre était produite par le moulage à la vapeur de "wet-broke" entre les coquilles hémisphériques mâle et femelle, comme indiqué par un brevet américain de 1879, accordé à James Arkell. Cette technique ressemble à une modification d'un procédé plus ancien breveté en Angleterre il y a 100 ans auparavant, par Theodore Hyla Jennens, pour la fabrication de meubles en papier-mâché vernis. Cet article expose à grands traits l'évolution historique du papier-mâché, qui a eu pour point culminant la liaison entre les brevets britanniques et américains. Il établit une comparaison entre la structure, l'état et le nettoyage des couches vernissées des deux globes. Il fait référence à divers traitements de globes documentés, et pose certaines considérations éthiques.

## **BIBLIOGRAPHY FOR GLOBES PUBLICATION**

D. van der Reyden--Apr. 11, 1986

Anon. "Globes." Chambers's Encyclopaedia, Vol. V, William and Robert Chambers, Ed. J.B. Lippincott Company, Philadelphia, 1893, p. 254.

Anon. "Globe." The Cyclopaedia, Vol. XVI, Abraham Rees, Ed. London, 1918.

Anon. "The Juvet Time Globe Revisted." NAWCC Bulletin, Vol. 24, No. 6, Part I, Dec. 1982, pp. 634-635.

Anon. "Juvet's Time Globe." Scientific American, January 10, 1880.

Anon. "Time Globe Testimonials." Company advertising material.

Anon. "An unusual Juvet Time Globe Patent." NAWCC Bulletin, Vol. 22, No. 2, April 1980, pp. 180-186.

Arkell, James. "Improvement in Globes and Machinery and Processes for making the Same." U.S. Patent, No. 221,013, October 28, 1879.

----- "Improvement in Time Globes." U.S. Patent, No. 220,462, Oct. 14, 1879.

----- and Adelbert G. Richmond, "Globe." U.S. Patent, No. 227,713, May 18, 1880.

Baily, C. Two Hundred Years of American Clocks and Watches, Englewood Cliffs, New Jersey, Prentice-Hall, 1975.

Baynes-Cope, A.D. "The Investigation of a Group of Globes." Imago Mundi, Journal of the International Society for the History of Cartography, No. 33, 1981, pp. 9-19.

----- "The Repair of Globes." Excerpt from the Meeting of the Internationale Vereinigung Meister der Einbandkunst at the Royal Library, Stockholm, September 5-10)1966.

----- "Study and Conservation of Globes." Der Globusfreund, No. 33-34, March 1985, pp. 1-80.

Calvert, H.R. Astronomy: Globes, Orreries and other Models, A Science Museum Illustrated Booklet, Her Majesty's Stationery, London, 1967.

Corcoran, E.B. "Conservation Report on the Wilson Globe." Report No. 327.80, Division of Conservation, National Museum of American History, Smithsonian Institution, 1978-80.

DeVoe, Shirley Spaulding. "The Litchfield Manufacturing Company, makers of japanned papier mache." Antiques, Aug. 1960, pp. 150-153.

Diston, W.S. *The American Clock, a Comprehensive Pictorial Survey, 1723-1900*, New York, Bonanza Books, 1983.

Dworetzky, Lester and Robert Dickstein. *Horology Americana*, Roslyn Heights, New York, 1973.

Gerlach, Arch C. "Globe." *McGraw-Hill Encyclopedia of Science and Technology*, McGraw-Hill Book Company, Vol. 6, 1977, pp. 230-240.

Globes; Produktie, Conservering, Restauratie. Verslag van de Themadag Wetenschappelijke Instrumenten, gehouden op 1 Mei 1985 in het Centraal Laboratorium voor Onderzoek van Voorwerpen van Kunst en Wetenschap. Amsterdam 1985 .

Hartley, Steven A. "World Globe." *Fine Wood Working*, No. 14, Jan./Feb., 1979, pp. 61-65.

Jessel, Bettina. "18th Century French Globe." Report No. 0538, Conservation Analytical Laboratory, Smithsonian Institution, 1968.

Juvet, Louis Paul. "Improvement in Time Globes." U.S. Patent, No. 60,740, Jan. 1, 1867.

----- "Improvement in Time Globes." U.S. Patent, No. 64,989, May 21, 1867.

----- "Improvement in Time Globes." U.S. Patent, No. 189,042, Sept. 15, 1876.

----- "Time Globe Improvement." U.S. Patent, No. 220,480, Oct. 14, 1879.

----- "Time-Globe." U.S. Patent, No. 238,913, March 15, 1881.

----- "Time-Globe." U.S. Patent, No. 238,914, March 15, 1881.

Knight, Edward H., Ed. "Globe" and "Globe-clock." *American Mechanical Dictionary*, Hurd and Houghton, New York, 1876, pp. 986-989.

Kober, B. "Erdglobus" and "Himmelsglobus." *Restaurierte Kunstwerke in der Deutschen Demokratischen Republik, Ausstellung im Alten Museum Stadtliche, Museum zu Berlin*, April-June 1980, pp. 366-368.

Marsh, Glenn A. "An 18-inch Juvet Globe Clock." *NAWCC Bulletin*, Vol. 21, No. 2, April 1979, pp. 127-135.

Muller, Norman. "1892 Facsimile of Behaim Globe, by M. Gigot de Grandpre." *Conservation Analytical Laboratory*, No. 0034, Smithsonian Institution, 1964.

Munro, Susan Nash. "Conservation of a Three-Dimensional Paper Object." *Papers of the AIC Book and Paper Group Session*, Philadelphia, Caber Press, 1981, pp. 7-8.

Palmer, Brooks. *Book of American Clocks*, New York, MacMillan, 1950.

----- "The Litchfield Manufacturing Company." *American Antiques Journal*, Nov. 1949, pp. 26-28.

Ristow, Walter W. *American Maps and Mapmakers, Commercial Cartography in the Nineteenth Century*. Wayne State University Press, Detroit, 1985.

Savage-Smith, Emilie. *Islamicate Celestial Globes: Their History, Construction, and Use*. Smithsonian Institution Press, Washington, D.C. 1985.

Sease, Catherine. "The Case against using Soluble Nylon in Conservation Work." *Studies in Conservation*, 26, 1981, pp. 102-110.

Stephens, Carlene. "Juvet Time Globe" in C. Stephens and Otto Meyer's *American Mechanical Clocks*. Unpublished manuscript, National Museum of American History, Division of Engineering and Industry, Smithsonian Institution, 1980.

Stevenson, Edward Luther. *Terrestrial and Celestial Globes, Vol. 2*, Yale University Press, New Haven, 1921.

Toller, Jane. *Papier-MSchd in Great Britain and America*. Charles T. Branford Co. Mass. 1962.

Tooley, Ronald Vere. *Tooley's Dictionary of Mapmakers*, Map Collector Publications Limited, Tring, Hertfordshire, England, 1979.

van der Reyden, Dianne. "Eighteen inch Juvet Time Globe, c.1867-1884." Report No. 170.82.1, Division of Conservation, National Museum of American History, Smithsonian Institution, 1982.

----- **Technology and treatment of a 19th century American time globe** In: *New directions in paper conservation. 10th anniversary conference of the Institute of Paper Conservation. 14-18 April 1986, Oxford / Leigh: The Institute of Paper Conservation, The Paper Conservator, Vol. 12, pp. 21-30 .*

----- "Twelve inch Juvet Time Globe, c. 1880." Report No. 171.82.1, Division of Conservation, National Museum of American History, Smithsonian Institution, 1982.

----- and Don Williams. "The Technology and Conservation Treatment of a 19th Century English "Papier-Mache" Chair." Preprints, American Institute for Conservation, 1986, pp.

Wachter, Otto. "Die Instandsetzung von Globen." *Der Globusfreund*, No. 9, Nov. 1960, pp. 37-42.

Warner, Deborah Jean. "Celestial Technology." *The Smithsonian Journal of History*, Vol. 2, No. 3, Fall 1967, pp.35-48.

Woodward, David, Ed. *Five Centuries of Map Printing*, University of Chicago Press, Chicago, 1975.

Yonge, Ena L. A Catalogue of Early Globes, Made Prior to 1850 and Conserved in the United States. American Geographical Society, New York, 1968.