



Historical and technical insight into the human motifs in the glass sculpture

M. Angeles Villegas-Broncano¹; J.Alberto Durán-Suárez²

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Abstract. Although glass proto-sculptures were made with deep artistic value since the most remote times, in the late 19th century the glass sculpture was developed, and during the 20th century the *Studio Glass Movement* reached the maximum level of technical perfection and aesthetic variety. The scientific and technical glass knowledge contributed to achieve appropriate hot and cold working procedures, and the artists improved their designs and creations. This paper focuses on the binomial glass sculpture and human motifs. The historic evolution of the glass sculpture with human motifs is analyzed, taking into account the production techniques and the relationships between the glass work and the expression of the finished artwork. A set of sculptures and sculptors are shown as representative examples of the main historical periods in which the glass plays an important role in the sculpture scene. The human representation in the glass sculpture can be considered as a constant throughout centuries, even though it is not the most frequent creative or ornamental motif. Either figurative or abstract human references can be found, although the former are the majority. This tendency is also present in the contemporary *Studio Glass Movement* sculptures.

Keywords: Sculpture; glass; human motif; history.

[es] Visión histórica y técnica de los motivos humanos en la escultura en vidrio

Resumen. Aunque las protoesculturas en vidrio se realizaron con profundo valor artístico desde los tiempos más remotos, a finales del s. XIX la escultura en vidrio se desarrolló, y en el s. XX el *Studio Glass Movement* alcanzó la máxima perfección técnica y variedad estética. El conocimiento científico y técnico del vidrio contribuyó a conseguir procedimientos apropiados para el trabajo en caliente y en frío, y los artistas mejoraron sus diseños y creaciones. Este artículo se centra en el binomio escultura en vidrio y motivos humanos. Se analiza la evolución histórica de la escultura en vidrio con dichos motivos, teniendo en cuenta las técnicas de producción y las relaciones entre el trabajo del vidrio y la expresión de la obra acabada. Se recogen ejemplos representativos de esculturas y escultores de los principales periodos en los que el vidrio desempeñó un papel importante en la escultura. La representación humana en la escultura en vidrio se puede considerar una constante en el tiempo, si bien no es el motivo creativo u ornamental más frecuente. Se pueden encontrar referencias a lo humano tanto figurativas como abstractas, siendo las figurativas mayoría, lo mismo que en las esculturas del *Studio Glass Movement*.

Palabras clave: Escultura; vidrio; motivo humano; historia.

¹ Centro Superior de Investigaciones Científicas (España)
E-mail: mariangeles.villegas@cchs.csic.es
<https://orcid.org/0000-0002-9727-5478>

² Universidad de Granada (España)
E-mail: giorgio@ugr.es
<https://orcid.org/0000-0002-9714-3555>

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1. Introduction

Glass can be considered as a non-traditional sculpture material. This is probably due to the difficulties to work glass both under hot and cool conditions (Rich, 1988). In some aspects it is similar to bronze casting, but also difficulties arise in the fact that glass has been mainly considered as a functional material for conventional or luxury objects, or only used in artisan small-scale objects and decorative arts. In the case of glass work under hot conditions, the hot glass forming needs expensive and specialized investment in furnaces, refractory materials and tools, apart from experience and skills to handle glass at temperatures at least as high as 500-600°C. In the case of glass work under cool conditions, this cool work is always subjected to glass mechanical properties connected with its brittleness (Fernández Navarro, 2003) (Freiman, 1980), which determines complex and complicated techniques to achieve carving, engraving, polishing, etc. on the glass surface as in stone working techniques. Therefore, glass sculptures in Antiquity were dependent on the technical development of glass as a material and on the scarce technical knowledge that artisans had about it. In fact they were limited by the poorly developed heat technology and the limited technological knowledge about glass behavior and properties, both in hot and cool conditions, even though the artisans possessed wide empirical expertise. The glass proto-sculptures that have survived up to now were undoubtedly the result of the hard work of craftsmen, which created their artworks combining great artistic sense, few material media and little technological knowledge.

Most of the glass works throughout History are related to common uses of glass, i.e. functional objects, very often obtained by blowing, with hollow shape and relatively small size, compared with artworks made on other materials (stone, ceramic, metal, alloy, wood, bone, etc.). Nevertheless, glass has been used to make luxury items and artworks (Villegas, Durán Suárez, Sorroche Cruz, Fernández Navarro, 2015), and throughout the centuries, thanks to the technical and scientific development, glass became a sculpture material, mainly from the second half of the 19th century (Villegas, Durán Suárez, Sorroche Cruz, 2017).

Since ancient times the motifs of glass artworks have been taken from Nature and the human body, as well as geometrical and abstract designs (Ricke, 2002, p. 130). The human representation in glass is traditionally very common in stained glass windows (Wilie, Cheek, 1997) (Alonso Abad, 2016). However, it is not so frequent in glass sculptures. The objective of the present study is to highlight representation of human attributes in the glass sculpture, from ancient times to the present day. The consideration of the glass sculpture evolution from the point of view of its production technique is also addressed. The chronological evolution of the glass

sculpture devoted to the human figure includes the concern and meaning of the artists and craftsmen to perpetuate a part of the Human Culture as a witness of History: the human being is the main character that will be shown and preserved.

2. Glass proto-sculpture: portraits, heads and amulets

Despite glass appeared in Mesopotamia c. 2400 BC (M. García Heras, Fernández Navarro, Villegas, 2012) (Oppenheim, Brill, Barag, Von Saldern, 1970), the first well documented glass sculpture is considered to be an Egyptian portrait attributed to Amenothep II (XVIII Dynasty, c. 1426-1400 BC). In spite of the small dimensions of this portrait (H: 4 cm, W: 2.9 cm, D: 3.4 cm) conserved at the Corning Museum of Glass, Corning, NY (USA), it is undoubtedly a sculpture which includes all the features of a traditional sculpture. The portrait was made by means of casting and pressing glass into a mould and, simultaneously, it is an example and antecedent of the portraits of important people whose sculptures were frequently made by Egyptian and classical Roman and Greek sculptors. In addition to the basic mould pressed glass technique, the Egyptian artisan probably used very simple tools and a great effort to create a very realistic expression. We can say that this Amenothep II glass sculpture was certainly true to the Pharaoh, at least if we bear in mind other portraits made on stone that shows very similar facial features. It has been supposed that the portrait could be a part of another bigger sculpture. In any case if so or not, the portrait shows great perfection and realism. Delicate contours were accomplished on blue glass, which appears surface deteriorated due to the atmospheric interaction. Fortunately such alteration layer did not destroy the figurative details of the portrait.

Other small human sculptures, mainly heads and profile bodies, both tridimensional works and reliefs, were found in archaeological surveys and excavations. All of them were characterized by a realistic representation of the human body and its members, and frequently the artisans handled different colored glasses as an expression tool to intensify the symbolic message of the whole sculpture. Thus, they distinguished the hair or the jewelry from the face, arms or legs. Egyptian glass sculptures and reliefs combine human bodies or members with animals' elements, as well as in all materials in Egyptian art. This is a consequence of the mythological tradition and deep beliefs of ancient Egyptian people on magic features of some animals, which survived up to the Ptolemaic-Roman era (1st century BC to 1st century AD).

In the Phoenician civilization (some centuries BC) only heads and faces were the human available representation made on glass. There are in general small sculptures which were used as amulets and, therefore, the facial features were intensified, both in morphology and colors to express a deep symbolic value. Frequently the amulets were used as pendants and their dimensions were about 3-5 cm in height and 2-3 cm in diameter, showing hyper realistic eyes and eyebrows due to the prophylactic use of the amulet against the evil eye or hex (Ruano, 1996). Also the hair and the beard were represented with curls marked that were accomplished by means of rolled glass yarns or small rods. The use of glass yarns was one of the most common ancient techniques to decorate glass objects and sculptures, but it is a different technique respect to the most frequent in the Egyptian portrait. Moreover, the Phoenician amulets show a relatively varied palette of colors: at least black, blue, grey, red, white and yellow, compared with the limited palette of colors of Egyptian artisans.

Obviously, the most representative glass sculptures of the Roman culture were portraits of important people. Those of the Emperor Caesar Augustus are relatively abundant and very similar concerning facial features, even they were made on different materials, e.g. marble, stone, glass, bronze, etc. and among them the rarity of glass portraits should be stressed. The portrait of Caesar Augustus (first half of the 1st century AD, H: 4.7 cm), conserved at the Römisch-Germanisches Museum, Cologne (Germany), was made on turquoise-colored glass, probably by mould pressed technique (Harden, 1987). It is known that Caesar Augustus disseminated his own image throughout the territory of the Roman Empire with the intention that all people recognize him as the Roman Emperor. For that purpose all kind of media were used: coins, portraits, statues, etc. and all of them show the almost same young and handsome man. In fact, they all were official portraits of the Emperor made to demonstrate his power and vitality.

Middle Ages, Renaissance and Baroque were periods in which the glass sculpture is absent in practice. On the one hand, other materials considered noble and more beautiful were used for sculptural purposes and, on the other hand, the glass was devoted above all for stained glass windows production in the Gothic and Renaissance styles, as well as for sumptuary objects, such as common and luxury tableware and for decorative items in the Baroque style. Therefore, the glass sculpture had to wait for several centuries to be reborn.

3. *Art Nouveau* and *Art Déco* glass sculpture

The glass sculpture did appear again in the late 19th century as a consequence of the powerful fashion of decorative objects made on glass. This was the *Art Nouveau* era (Vidrio de artista, 2004). Artists and artisans dedicated their knowledge and effort to improve their skills and experience with glass both under hot and cool working conditions. Nature inspiration, as well as designs and models based on living beings dominated the artistic motifs. Complete human representation and human members began to be present in the sculptors' repertoires. The sculptures become a mixture of realistic and abstract concepts in a colorful synthesis of Nature and Art (Arwas, 1996).

The French sculptor Henry Cros developed the modern technique of *pâte de verre*. It is important to note that the true *pâte de verre* was technically produced in this time starting from powdered glass previously melted and then crushed and finely grounded. This procedure must be distinguished from the ancient process for making partially melted glass objects (e.g. ancient Egyptian objects), even though many people consider that such ancient objects were made with *pâte de verre*. The aspect of both kinds of glass objects once finished is similar, but their origin is different: in the ancient ones such aspect is due to a partial glass melting, while in the objects made with true *pâte de verre* their aspect is due to the re-melting or at least softening of a true glass powder (Fernández Navarro, 2003) (García Heras, Fernández Navarro, Villegas, 2012). The works of Henry Cros were influenced by the European Antiquity that was present in motifs and ornaments of his glass works such as reliefs, vases, portraits, etc. in which the human body, members and faces are the main motifs or complementary motifs.

Georges Despret played an important carrier as a glass artist. As Henry Cros he worked with *pâte de verre* making translucent and seductive works, mainly depicting human faces, in which the light subtly suggests the glass depth both to eyes and to touch. Other techniques used by Despret were glassblowing, molding, murrhines, decoration with colored powders, and so on.

Although Émile Gallé represented mainly natural designs such as vegetal and animal motifs, the artwork *La main aux algues at aux coquillages* (H: 33.4 cm, L: 13.4 cm) conserved at the Musée d'Orsay, Paris (France), is an example that shows this kind of union: one hand oriented with the fingers in the top position and surrounded by algae and shells; in the bottom of the sculpture the hand wrist emerges from a sea wave base. This sculpture consists on several hot formed glass layers, partially blown and further engraved at wheel and decorated with inclusions and applications. Inclusions were made with metallic oxides and stains, whereas applications were undertaken in low and high relief (Warmus, 1984). This figurative representation of a hand has been interpreted as something connected with the born of Venus in the ocean waters. Other explanations refer to a symbolic meaning: the emergence of human beings from vegetable beings (algae) and animals (shells and small marine living beings). Apart from these interpretations, this sculpture is the result of several glass working techniques, some of them carried out under hot conditions and others run at room temperature. The techniques were combined to achieve a determined design and, thus, they constitute a secondary role compared with the creative and expressive intention of the author, i.e. the technical creation procedures were subjected to a design that is dominated by a human motif and its symbolic meaning.

In the short period of time between the First and Second World Wars the *Art Déco* imposed renewed art and decorative concepts. Natural motifs of the *Art Nouveau* style were adapted and stylized. Flowers and other vegetal ornaments were simplified and geometrically transformed. For instance, asymmetrical flowers like iris and glycine were substituted by symmetrical roses and daisies. Designs evolve towards simple and reiterative vegetal motifs that represent idealized sketches of the real flowers. Something similar takes place with the human representation: the figures lengthen and show a quasi dreamlike aspect.

René Lalique was the most famous jeweler and designer of *Art Nouveau* and *Art Déco* times which used elements of the human body in glass artworks. For instance, his stylized sculpture *Voilée mains jointes*, designed in 1919 (H: 27.7 cm, W: 6.9 cm, base diameter: 6.3 cm) and conserved at the Corning Museum of Glass, Corning, NY (USA), was made on glass and patina. This is a good example of the *Art Déco* concepts in glass sculpture and, as well as others of the same designer, was produced by mould casting and pressing of colorless bluish-green glass. The patina frosted aspect was obtained by one of the methods to depolishing the glass surface with an acid bath and/or sandblasting, making the matting by acid attack the most common process (Orgaz Orgaz, Jiménez Calvo, 1984). The figure appears as a unique volume that integrates the body, head, arms and legs; even all the clothes and veil are part of the volume. However, the aesthetic result is impressive: some simple reliefs and lines are enough to express a female body in a serene attitude, but full of life and feeling. Other similar sculptures also represent static human bodies, for instance the work in opal glass named *Grande ovale joueuse de flute* (H: 37 cm) by René Lalique at about 1919. Several sculptures were produced under such title, as well as many

other Lalique's works that were not handmade. These sculptures point out how the designer knew to extend and organize a marketing network around its glass artworks by means of the serial production.

The sculpture *Danseuse* by Gabriel Argy Rousseau (c. 1928, H: 25 cm, W: 13.5 cm, D: 13.7 cm) conserved at the Corning Museum of Glass, Corning, NY (USA), was made on *pâte de verre* and is a realistic interpretation of the human body in movement. The female figure is also a stylized vision, but the contours of the different parts of such body are well marked. Nothing needs to be interpreted by the observer, since the sculpture corresponds almost linearly with reality. A new element contributes to that reality: the color. In fact a subtle greenish color mixed with some red veining beautifies its very bubbly transparent and translucent aspect. The representation of a scherzo-like posture was frequent in the sculptures of this period, for instance the design named *Chrysis* by René Lalique in 1931, which is a nude female statuette used to make a car mascot and also bookends, paperweights, etc. Other example showing similar features is the sculpture *Silhouette* produced by Marius Ernest Sabino in opal glass c. 1930 (Fig. 1).



Figure 1. Marius Ernest Sabino, *Silhouette*, c. 1930 (H: 18 cm, W: 7 cm), <http://sabinoartglass.com>.

However, coeval sculptures with a vessel primary form of Maurice Marinot (Fig. 2) show a very different aspect. Marinot used to handle thick glass walls in all kind of works, made by blowing and carving, combining bubbles of different size and basic colors entrapped into two thick glass layers (Marcilhac, 2013).



Figure 2. Maurice Marinot, *Blown and acid etched vase representing a head*, c. 1928 (H: 22 cm, W: 16.6 cm diameter), The Cleveland Museum of Art, OH (USA).

Contour lines and expressive motifs are simple and scarce, i.e. the minimum necessary to show the idea abstracted by the artist. This type of convincing sculpture of the *Art Déco* period coexisted with those of realistic and stylized representation of the human figure. Therefore, both can be considered as the two faces of the same chronological time, highlighting the sculpture tendencies of *Art Déco*. On the one hand the delicate lines stylizing the human figures and, on the other hand, the forthright and absolute designs. In this sense the glass as a sculpture material plays an important role, since it can be definitively adapted for both types of designs and sculpture tendencies by combining hot and cool glass working procedures.

Something similar could be said for the series of glass sculptures executed one decade after. Figure 3 shows the portrait of Takijiro Iwaki, the founder in 1883 of the Japan's first privately owned western-style glass factory. The bust modeled by Yuhei Ogawa and executed by Sotoichi Koshiba was made on translucent colorless *pâte de verre* (Blair, 1973). It is slightly frosted on the exterior surface, while the lower part is slightly grayish, smooth and glossy inside.



Figure 3. Sotoichi Koshiba, *Portrait bust of Takijiro Iwaki*, 1935 (H: 28.4 cm, shoulder H: about 18 cm), Corning Museum of Glass, Corning, NY (USA).

This sculpture, almost an absolute real representation of a person showing all facial features, as well as all the clothes details, is in deep contrast with that of Figure 4. This big sculpture (weight 300 pounds) possesses a definitive *Art Déco* style. It was created with colorless cast and polished glass for the 1939 New York World's Fair by the Steuben's designer Sydney Waugh. The sculpture represents a mermaid riding on the waves of the Atlantic Ocean, commemorating the start of glassmaking in America by European people (50 Years on 5th, 1984) (Madigan, 2003). A team of five glassworkers was needed to cast glass into the mould, and another three worked to polish the sculpture for several months. Once again, similarly to Marinot's artworks, few expressive and simple contour lines are enough to transmit the author's vision of reality.



Figure 4. Sydney Waugh (Steuben Glass Works), *Atlantica*, 1938-39 (H: 94.5 cm W: 57.9 cm), Corning Museum of Glass, Corning, NY (USA).

4. Contemporary studio glass sculpture

The next step in the human representation on glass sculpture reaches the *Studio Glass Movement* started by Harvey K. Littleton in Toledo, Ohio, in 1962 (Byrd, 2011). Nevertheless, it is important to mention previous glass sculptures by Littleton in which he explores the glass potential under different approaches: hot work, cool work, *pâte de verre*, several glass compositions, etc. Figure 5 shows a realistic female torso made by sintering *Vycor*® glass, which is a 96 % silica and 4 % boron oxide glass obtained by acid leaching from a phase separated sodium borosilicate glass, patented by Corning Incorporated, NY (USA) (Fernandez Navarro, 2003).

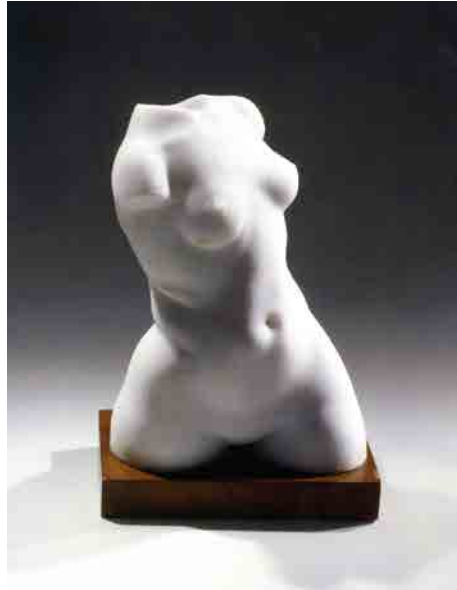


Figure 5. Harvey K. Littleton, *Female torso*, 1946 (H: 25.1 cm, W: 19.4 cm, D: 16.4 cm), Corning Museum of Glass, Corning, NY (USA).

From the technological point of view, *Vycor*[®] glass was a very important advance to obtain a high silica-content glass (practically a pure silica glass, known in the market as quartz glass) starting from a borosilicate glass, less expensive and easier to be handled. This is because the direct melting of a 100 % pure silica glass needs furnace temperatures higher than 2,000°C. To reach this very high temperature, special factory investments (furnaces, refractory materials, burning systems, combustible, etc.) are needed, which hugely increase production costs. Therefore, this is one clear example on how the technological advances of the 20th century from the glass industry were implemented, not only to improve the glass properties and its extension towards better technical applications, but to offer a new and versatile material for artistic works. The technique used by Harvey K. Littleton to create the sculpture of Figure 5 was slip-casting of opaque white *Vycor*[®] glass. Why Littleton used this kind of special glass as early as 1945 was not a chance at all, since he was the son of Jesse T. Littleton, head of Research and Development at Corning Incorporated, NY (USA), during the 1930s and then Vice President of the company. In the Littleton's sculpture shown in Figure 5 the scherzo-like posture of the torso is a soft natural helix developed throughout the vertical axis. In fact this is one of the few works by Littleton representing the human figure. Most of his further sculptures, however, show abstract forms combining colored and colorless blown glasses or made by assembly several elements of flat glass sheets.

As early as in the late 1950's the works of Stanislav Libensky and Jaroslava Brychtova must be considered as a part of the *Studio Glass Movement*. The sculpture shown in Figure 6 is a good example of the heads created by this couple of artists. This mould cast glass and further grinded and polished is a manifestation of the technical art tendency born during the 1950s in Europe (Frantz, 1989). Glass came

out from Decorative Arts and was installed in the Fine Arts, combining techniques, technologies and designs. Glass sculpture even adopted big dimensions and moved from figurative designs towards abstract representations (Sensitive touch, 2001). In such a movement the ideas and designs by Stanislav Libensky and Jaroslava Brychtova matured concerning the concepts of light and form combined with color and transparency. This was the scenario of Czech sculptors when the *Studio Glass Movement* was founded a few years later in 1962 by H. K. Littleton in Toledo, OH (USA).



Figure 6. Stanislav Libensky and Jaroslava Brychtova, *Head I*, 1957-58 (H: 35.5 cm, W: 10.7 cm, D: 14.7 cm), Corning Museum of Glass, Corning, NY (USA).

The *Studio Glass Movement* artists did not use the human representation as a frequent inspiration source. Glass sculptures concerning human motifs were and nowadays are relatively scarce. In the 1990s we could account for two kinds of the binomial glass/human. On the one hand, those sculptures in which the human motifs are no more than an excuse to show the artistic work made with a special glass. For instance, this tendency is evident in sculptures in which a special glass was used; e.g. luminescent, chalcedony or opal glass. In this case the glass is the main protagonist. And, on the other hand, the sculptures were conceived and executed to show a human design, using glass to do it, but always subjected to such human motif. In this case the motif is the main protagonist. This later intention can be clearly observed in the works by Dana Zamecnikova, for instance in *Zeny and Pisanello* (1999, H: 86.4 cm, W: 83.8 cm, D: 17.8 cm) conserved at the Corning Museum of Glass, Corning, NY (USA). Certainly, in this sculpture, glass is used as a background to paint human figures in a more or less abstracted expression, as a mirror for feelings, experiences and life. This work has been made on sheets of glass combined with metal. It contains two pieces of enameled sheet glass, a gilded metal panel, and a metal mount.

Extremely original are the shattered glass sculptures by Daniel Arsham, a designer and artist who has expanded his eclectic works, including glass as a raw material, by using compacted broken glass and resin. He mainly depicts the human body in a quiet and even passive attitude, inducing to compassion and sympathy as a natural response against the life fragility and pain (e.g. *Seated figure*, 1990s, life size, <http://www.danielarsham.com>). The production technique of this sculpture can be compared with the traditional *pâte de verre*. However, in this case the work is carried out at room temperature and glass fragments are compacted by means of an adequate adhesive resin.

The equilibrium between the uses of glass as a simple sculpture material and a material to be worked and exhibited by its own properties and merits arises in some sculptures of the present century. Glass in contemporary sculpture plays friendly among the rest of traditional materials, both as the own sculpture support and main character. In the work *Dream* (2008, H: 88.9 cm, W: 66 cm, D: 15.2 cm, <http://www.latchezarboyadjiev.com>) by Latchezar Boyadjiev this is a real fact. This head of the Bulgarian sculptor from the Academy of Applied Arts in Prague (Czech Republic) and settled in USA, shows a balance between design, color, material and abstraction level. It consist on delicate and stylized contour lines perfectly combined with the frosted finishing of this human form made with blue cast glass.

New sculptural tendencies on glass have reached a great number of artists, even those whose works are usually created with materials such as metals, concrete, wood, plants, fibers, textiles, etc. Recycled materials are also re-used under the philosophy that discarded items and old ideas can be successfully transformed into new ones. This is the key of many artists such as Carol Milne who combines expression, life, art and glass to create new and original treasures full of diversity and individualism. Her sculptural work is characterized by color, realism and humor (e.g. *Envy*, 2009, H: 25.4 cm, W: 20.3 cm, D: 26.7 cm, www.carolmilne.com).

One important trend in contemporary glass sculpture is the creation of volumes from flat glass sheets, as introduced by Harry Seager at about the first 1960s. This British artist established in Stourbridge, an important glass centre in the United Kingdom, is one reputed sculptor whose works are in several collections in Washington, Leeds and London's Victoria & Albert Museum. Since those years many artist followed this idea, and nowadays one can find a wide variety of sculptures in which the flat glass is stacked in very different ways for generating both abstract and figurative forms. Spanish artists Javier Gómez and Pedro García, whose works are internationally known and exhibited in museums, are quoted as representative examples of flat glass sculptors. Gómez and García follow Joaquín Torres Esteban who was the Spanish pioneer of this technique (Villegas, 2017, p. 9).

Among the works of Javier Gómez, the sculpture *Cabeza VII* (2001, H: 52.0, W: 39.0, D: 14 cm, <http://www.javiergomezescultor.com>) is an abstraction of a head probably crying out, in the case that the semicircular upper form was interpreted as a mouth. It was constructed by stacking brown grayish flat glass whose surface was matted by a soft finishing. The big sculpture by Pedro García *Dama oferente* (2008, H: 150.0, W: 110.0, D: 36.0 cm, <http://www.pedrogarciaescultor.com>), pointed out the experience and skills of this artist who made the design by computer and carefully built it up using flat glass sheets of different thickness ranging from 20 to 4 mm. Thicker sheets form the bottom of the sculpture and guarantee its stability, while the thinner sheets form the upper part.

5. Some contribution to the glass sculpture based on human motifs

The present authors have worked for several years in the design and execution of several glass sculptures based on human motifs. The starting conditions assumed were: use of recycled common glasses; use of both hot and cool forming procedures; when working under hot conditions, forming temperatures easy to reach in the sculpture workshop of the Fine Arts Faculty (University of Granada), i.e. below 1,000°C; designs based on historical concepts from different periods of time; attainable whole sculpture size, e.g. within the 5-30 cm range of height. Among the works created two of them are described as follows.

In the relief entitled *Nactanebo* (Villegas Broncano, Durán Suárez, Sorroche Cruz, Fernández Navarro, 2017) the human motif was taken from an Egyptian relief representing a head profile made on blue-greenish glass with superimposed dark and straight hair made on silver. The relief (2.4 cm height) is dated from the early Ptolemaic XXX dynasty, 4th-3th century BC. From the Egyptian relief picture a digital design was prepared, which served as a starting image to obtain a plastic tridimensional model by using a 3D BQ printer model Witbox. The model obtained was at about 10 x 10 x 2 cm in size. A mould on refractory plaster was elaborated from the model and it was then dried, pre-heated and fired up to ~1,000°C to appropriate resist further glass melting. The mould was refilled with recycled common glass fragments from jars (1-4 cm size range), introduced into a conventional ceramic furnace and submitted to a fusing process up to 950°C for 1 h. After that the furnace temperature was cooling down slowly to allow the annealing of the glass piece. Once cooled the glass piece was extracted from the mould and finished by means of sand blasting. White corundum 120 µm grain sized was used as abrasive to obtain a soft and slightly matted appearance in the surface. Final piece dimensions are 9.5 x 9.5 x 1.8 cm.

Another glass work was based on an interpretation of moais of the Pascua island (stone human figures from 700-1600 AD). The sculpture entitled *Pascua* (Villegas Broncano, Durán Suárez, Sorroche Cruz, Fernández Navarro, 2017) was made from a ceramic model imitating a moai from a photograph. Once fired properly, the ceramic model was used to prepare a mould composed of six parts that could be easily mounted and dismounted. The mould was dried up to 50°C. Glass fragments from recycled beer bottles were crushed, grounded and sieved to obtain grains of 1-2 mm in size. These glass grains were mixed with a polyester resin to form a mortar that was deposited into the mould. After 48 h at room temperature, consolidation was finished and the glass piece was extracted from the mould. Surface finishing consisted of a soft polishing carried out with a small rotary tool. Final piece dimensions are 21.0 x 11.5 x 8.0 cm.

6. Final remarks and conclusions

Human representation in glass sculpture has been a constant motif throughout glass history in those periods when the sculpture made with glass has been sufficiently remarkable. Features of human motifs in glass have been subjected to development of knowledge and technical aspects connected to glass. Therefore, during the first centuries, in which glass was considered as a luxury material with similar value to

precious gems or gold, it was employed to mainly create amulets and reliefs. Such objects can be considered as true sculptures since they contain an artistic and, in general, non-functional intention, apart from a symbolic sense and prophylactic use in the case of amulets (e.g. against the evil eye or hex). Ancient glass objects include an intense charge of artistic work, both in designs and ornamentation, as corresponds to very valuable items. Glass portraits of important people (e.g. pharaohs, emperors, kings, etc.) demonstrated the high appreciation that this material inspired to sculptors, which included glass in the same consideration than marble or other traditional sculpture materials.

Human representation in glass sculpture during the Middle Ages and the Renaissance followed the same tendency than that of glass; that is, an absence period because of the lack of interest in glass (apart from stained glass windows for architectural applications), while consideration of other materials such as marble, bronze, stone, wood, and so on was improved. In the Baroque period glass was one of the most appreciated materials for sumptuary and luxury functional objects (e.g. tableware, decorative and jewelry) in which traditional sculptural features were practically absent.

The *Art Nouveau* and *Art Déco* new trends boosted glass fashion at the late 19th century and early 20th century. Glass sculptures emerged suggestive and impressive thanks to development of scientific and technical knowledge of glass. Sophisticated sculptures created with different types of glass and a wide variety of ornamentations and finishing invaded art galleries, homes and exhibitions. Regular people learned to appreciate and collect glass objects and, among them, sculptures were highly regarded. Human portraits, more or less abstracted, and human figures and figurines enter successfully to the sculpture repertory. This tendency is maintained up to the official launching of the *Studio Glass Movement* in 1962 in the USA and, even though human representation is not the most frequent inspiration and motif of the *Studio Glass Movement* sculptures, access of glass to the sculpture world was a reality from 1960s and it continues up to the present. Figurative motifs from the human body are more frequent than abstract ones. Advance of knowledge on properties and behavior of glass under both hot and cool conditions allows this fascinating material to be adapted to almost all designs, and hence artists working on glass have been worldwide multiplied.

Very original techniques have been developed to create human representations: painting on flat glass, assembly of flat glass sheets, use of glasses with special chemical compositions (chalcedony, opal, luminescent, etc.), compacting of glass fragments, etc. All of them combined with traditional glass work, both under hot conditions (blown and pressed glass, *pâte de verre*, etc.) and cool conditions (carving, engraving, resin compacting, flat sheets stacking, etc.), have worldwide expanded glass sculpture devoted to or containing human motifs.

The two simple glass sculptures made by the authors with recycled glasses under hot or cool conditions in a common sculpture workshop demonstrate that concepts of the *Studio glass Movement* are attainable at all, and that human motifs are easy to be developed in glass pieces.

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Referencias

- Alonso Abad, M.P. (2016). *Las vidrieras de la Catedral de Burgos*. Sci. Ed. M.A. Villegas y M. García Heras. ISBN: 978-84-608-8912-0.
- Arwas, V. (1996). *The art of glass: Art Nouveau to Art Déco*. Andreas P a p a d a k i s Publisher.
- Blair, D. (1973). *A history of glass in Japan*. Kodansha International Ltd. & The Corning Museum of Glass.
- Byrd, J.F. (2011). *Harvey K. Littleton. A life in glass*. Skira Rizzoli.
- Fernández Navarro, J.M. (2003). *El Vidrio*, 3ª Edition. CSIC.
- Frantz, S.K. (1989). *Contemporary glass*. Harry N. Abrams Inc.
- Freiman, S.W. (1980). Fracture mechanics of glass (Chapter 2). In *Glass. Science and Technology* vol. 5: Elasticity and strength in glasses. Eds. D. R. Uhlmann & N. J. Kreidl. New York: Academic Press Inc.
- García Heras, M., Fernández Navarro, J.M. & Villegas, M.A. (2012). *Historia del vidrio. Desarrollo formal, tecnológico y científico*. Project PIE 200460E594, CSIC.
- Harden, D.B. (1987). *Glass of the Caesars*. Olivetti.
- Madigan, M.J. (2003). *Steuben glass, an American tradition in crystal*. Harry N. Abrams Inc.
- Marcilhac, F. (2013). *Maurice Marinot (1882-1960): artisan verrier*. Éditions de L’amateur.
- Oppenheim, A.L., Brill, R.H., Barag D. & Von Saldern, A. (1970). *Glass and glass-making in ancient Mesopotamia*. The Corning Museum of Glass.
- Orgaz Orgaz, F. & Jiménez Calvo, I. (1984). El proceso de mateado del vidrio. *Boletín de la Sociedad Española de Cerámica y Vidrio*, 21 (3), 163-173.
- Rich, J.C. (1988). *The materials and methods of sculpture, Series Dover Art Instruction. Mineola*, Dover Publications Inc.
- Ricke, H. (2002). *Glass art reflections of the centuries*. Ed. Prestel.
- Ruano, E. (1996). *Las cuentas de vidrio prerromanas del Museo Arqueológico de Ibiza y Formentera*. Govern Balear, Treballs del Museu Arqueològic d’Eivissa i Formentera.
- Sensitive touch (2001). London: The Studio Glass Gallery.
- Vidrio de artista. Art Nouveau y Art Déco. Colección Salvador Riera (exh. cat.) (2004). Fundación Francisco Godia
- Villegas, M.A., Durán Suárez, J.A., Sorroche Cruz, A. & Fernández Navarro, J.M. (2015). El vidrio artístico de Asia oriental desde la Antigüedad hasta la escultura contemporánea. *Cuadernos de Arte*, 46, 119-133. DOI:10.30827/caug.v46i0.5134

- Villegas, M.A., Durán Suárez, J.A. & Sorroche Cruz, A. (2017). Antecedentes de la escultura del Studio Glass Movement en el vidrio artístico soplado del periodo 1800-1950. *Arte, Individuo y Sociedad*, 29 (1), 9-22. DOI:10.5209/ARIS.47613
- Villegas, M.A. (2017). *La escultura en vidrio en España. Boletín Mensual Amigos del MAVA*. Asociación de Amigos del Museo de Arte en Vidrio de Alcorcón.
- Villegas Broncano, M.A., Durán Suárez, J.A., Sorroche Cruz, A. & Fernández Navarro, J.M. (2017). *La escultura en vidrio*. Colección Bellas Artes. Granada: Project PIE-CSIC ref. 201310E081 and University of Granada Ed.
- Warmus, W. (1984). *Emile Gallé, dreams into glass*. New York: The Corning Museum of Glass.
- Wilie, E. & Cheek, S. (1997). *The art and decorative glass*. Todtri Productions.
- 50 Years on 5th. A retrospective exhibition of Steuben Glass (exh. cat.). (1984). New York: Steuben Glass Inc.