NATIONAL COLLEGE OF ART AND DESIGN
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DEPARTMENT OF GLASS

The development of Ancient Glass from the Egyptian period to the fall of the Roman Empire.

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CONTENTS

INTRODUCTION

Glass is a common material which we use every day, it appears in such abundance and variety that its familiarity has blunted our sense of wonder as to its fundamentally exceptional character. Though glass appears to be a solid hard substance, similar to many other materials that man has been producing since prehistoric times, we know that it passes from a hot liquid state to a cold rigid one without undergoing the kind of internal structural change that occurs with most molten substances, such as metals as they cool.

In iron the component atoms rapidly become re-organised to form crystals, but glass when it cools, has no crystalline structure. As it cools, glass becomes viscous, like toffee, and has the power to resist the change in the arrangement of the molecules - thus it has been described as a 'super cooled liquid'. Therefore the characteristic fluidity of the matter has remained a fundamential property of glass since it was first made in the third millennium B.C. and has always given glass objects their unique quality.

In this thesis I will trace the initial discovery of the glass substance in ancient Egypt and Mesopotamia through the various stages of experimentation and technological developments that led Glass to be used independently up until the fall of the Roman Empire in C.500 AD.

CHAPTER 1

The first recorded use of glass, not glass as we know it today, but natural volcanic glass such as obsidian, was used by man 8,000 years ago in the later stone age to form cutting tools, jewellery and stone utensils. Glass in antiquity however, never equalled the importance of bronze which dominated the economy of early civilisations.

For Egypt the Bronze Age was the period of world power economically and culturally i.e. the origins of artificial glass as we know it to be today. Although glass was considered the equal of the most valuable semi-precious stones such as lapis lazuli, it still had much in common with the less rare substance bronze. They were both synthetic materials, which had earlier counterparts in natural products (copper being the forerunner to bronze.)

Before artificial glass was invented, obsidian, jasper, chalcedony, rock-crystal and other semi-precious stones were treated by polishing, boring holes and cutting to form beads, amulets, seals and vessels in just the same way as glass was later worked.

The fact that copper or bronze and glass so often appear together suggest strong technical similarities between metallurgy and glassmaking. Copper is easily extracted from its ore; all that is required to reduce malachite to copper is a fire made of dung, Egypt's principal fuel. During the smelting of copper a scum or dross forms on the surface of the melt, this substance when cooled quickly and hardened to a glossy state can be crushed or fritted and used as a powdered flux, in the further process of glassmaking.

It is probably through this smelting process of metals and the production of the glassy dross, that led to the first instances of glazes being used on other materials, one of the first being Steatite or soap stone. It was used to form pots for the smelting of metals ideal due to its softness offering itself as an easily carved material, during the smelting process it was noticed how the glaze or dross adhered to the steatite and how the presence of copper in the dross caused a blueish, greenish tint in the glaze.

It was also discovered that steatite - hydrated magnesium silicate - on heating became a hard durable substance, capable of causing scratches on the glaze. Soon beads of steatite were being dropped into the smelt and collected on cooling, we know these to be the first glazed wares ever made. Further attempts were made to develop the glaze production but early efforts led to failure. It was discovered, when trying to glaze pottery that the alkaline glaze proved incompatable to ordinary clay, their attempts not succeeding until much later on discovering the introduction of lead and other metal oxides to the mix. During this period many different uses and techniques were employed in dealing with these glazes, what we now call Egyptian paste sometimes referred to as Faience which is known as the forerunner to glass, (though the technical definition of the substance is still in dispute), was being widely used.

Egyptian paste forms its own glaze through chemical reaction. The paste contains soda, which is water soluble; as the paste dries out the soda travels with the water to the surface of the piece and forms a coating of soda crystals. These act as a flux during the firing, melting the outside layer and forming a glass. The Egyptian paste itself, is believed to consist of ground quartz and sand which is held together by an alkaline binder (fluxes and glass modifiers such as soda potash, calcium, magnesium). The production of Egyptian paste continued from predynastic times throughout pharaonic, hellenistic and Roman times, dying out around 640 A.D. after the Arab invasion.

Another type of glaze used is similar to a technique known today as pate de verre. On seeing the beautifully coloured, shiny substance that had been accidentally formed on the furnace walls the ancient Egyptians put it to further use. As with the precious stones which they had being excavating for centuries, they knew how to chip and carve to form amulets out of larger pieces. It was observation that brought the next step: chipped bits of glass will fuse back together when reheated. From this point the development goes two ways; on the one hand, glass powder or frit can be packed into an open mould and fired to fuse the glass particles together. The kilns used in the firing process would have been furnaces similar to those used in the metal smelting. When the piece had cooked it was removed from the mould to be polished, ground and carved to reach the desired effect. There is evidence from predynastic times of red ceramic moulds in use in the Tell El Amarna region of Egypt dating from the eighteenth dynasty. These moulds came from the factory of the palace of Amenhotpe III. The small ones were used to form beads, amulets and rings while the large moulds would have been used to cast figures.

Fig. 1.

One fine early piece found in Egypt, whose exact method of production is disputed but which must at some point have involved the use of a mould, is an eye paint container in pale turquoise blue. It is possible that the main form was mould cast and then the central tubular opening was made by the technique known as cold cutting. Other examples of cast glass are a dish in translucent turquoise, blue glass in the shape of a clam shell, the walls so thin that they are almost transparent and the edges sharp. Although it is known that this shape was popular in other media, serving as a scoop for unguent and that actual clam shells were used to hold coloured inks, it is extremely rare in glass and it is certainly a production of the palace workshops in Malkata or El-Amarna.

Fig. 11. **Fig. 111**

FIG. I.

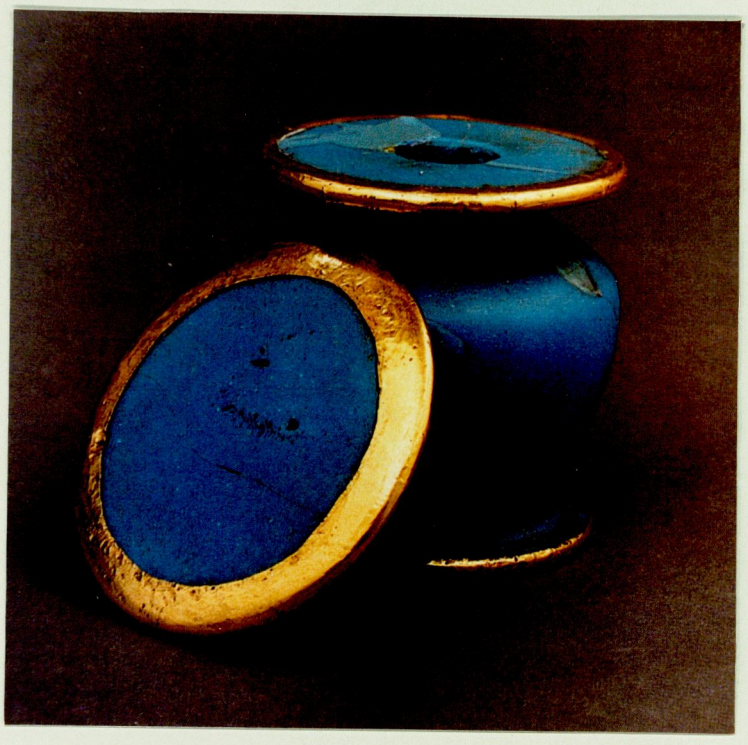


FIG. II.

FIG. III.

Lost wax casting (Cire Perdue) in a closed mould was the method used to produce small scale sculpture which is often as fine but never as common in glass as in glazed composition, very few examples of this method of casting have survived but from what must have been a miniature masterpiece there survives only the head and part of the shoulder of a pharoah as sphinx, it is made of opaque turquoise blue glass with a glossy surface. The features are tiny but clear enough to suggest it is a portrait of Amenophrs II.

Also evidence of vessels that would have been turned on a wheel or lathe and hand built from such pastes. On the other hand, the glass powder could be mixed with a binding agent such as water and applied to quartz or stone beads, or even brushed onto the surface of a pot and fired again until a "glaze" was formed. Technically speaking this would be termed as an enamel (finely powdered glass).

One of the earliest datable Egyptian glass vessels, came from the burial of Tuthmosis III in the Valley of the Kings. It is a turquoise blue jug with elaborate yellow and white patterns of stylised trees, threads, dots and hieroglyphic text. This decoration was created by enamelling, and this vessel is so far the earliest known employing this technique. Colours used for the main body of glass vessels were usually blue, green, greenish-blue or turquoise sometimes violet, white and yellow. These colours were developed through knowledge of compounds available in silica sand.

Fig. IV Fig. V.

The Egyptians became experienced in recognising which sand produced clear glass such as those relatively free from iron and which oxides added, such as copper and tin, produced what colours in the glass. Although it is generally thought that early glass was opaque it was when properly cleaned found to be quite translucent.

As the discovery of glass cannot be dated exactly we must view the evolution of this material not as a mistaken act.

Such as the historian Pliny's theory:-

Reference No. IX P.21.

"There is a story that once a ship belonging to some traders in Nitrum put in here (the coast of modern Lebanon) and that they scattered along the shore to prepare a meal. Since, however no stones for supporting their cauldrons were forthcoming, they rested them on lumps of nitrum from their cargo. When these became heated and were completely mingled with the sand on the beach a strange liquid flowed in streams and this, it is said, was the origin of glass"

[Pliny, Natural History XXXVI 191-2]

but as a process, and to regard the entry of glass into history not as a point but as a span in time providing with the three principal ingredients of glass in antiquity, soda, silicia and lime. The flux soda often being replaced by a metallic flux. This span extends from the first use of alkali as a flux in the hot powdered minerals to the time when glass became an independent material, this development took about 2,000 years to develop from C. 3500 to 1500 BC. In terms of technique the divorce of glass from its ceramic basis took place when it ceased to be formed cold, treated as though it was stone and began to be worked in a heated state. This was the beginning of a process of development in which, within a further fifteen hundred years, every technique of glassmaking - casting, drawing, pressing and blowing - was represented. In the way of working techniques nothing new or original emerged during the following millenia.

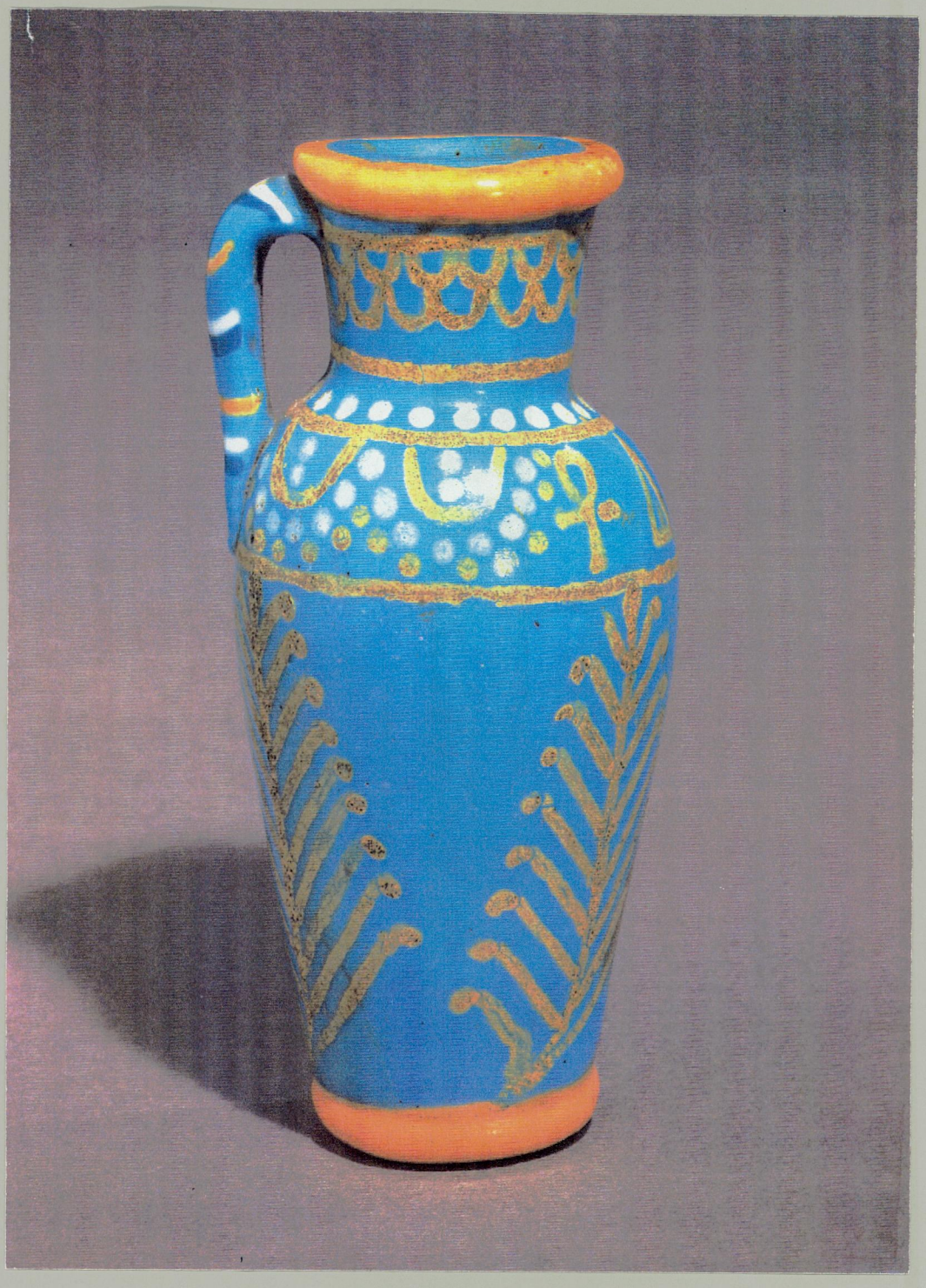


FIG. IV.

FIG. V.

All this considered we must not regard the pre-christian millenia simply as a period of preparation, but rather as a sequence of periods of independent cultural character with independent movements and climax bronze and iron were correlated with these movements, while clay and glass, being less important materials, were dependant upon them.

Comparing early syntheses of glass with contemporary metallurgical developments, we find that the common denominator is colour. Colour was obviously being sought as a means of producing an optical impression. It is evident from the fact that powdered malachite and lapis lazuli were used as pigments for paint in ancient architecture that the desire for colour played a part in the origin of glazes and glass.

Fig. VI

Another important factor to consider in the use of colour was the urge to transmit the magical powers the Egyptians believed colour possessed. By fusing an alkali with powdered malachite a green glaze was produced, which like malachite, was believed to enable men to hear the language of the beasts and rendered them invisible to the eyes of other men. The blue of lapis lazuli warded off evil - as did cobalt glass, which was believed to radiate good.

FIG. VI.

CHAPTER 2

Whereas it was possible for glaze, the earliest artificial glass to develop independently of copper, although not before it, copper is believed to have been used first about 5,000 B.C - the working of glass depended upon the availability of tools which could withstand the heat of the viscous glass mass. Though copper and bronze may not have been indispensable to the independent evolution of glass, it contributed immensely to the possibility of a new and different progression in the handling and treatment of glass. The glass was now not being treated as a solid cold mass of stone but it was worked in its heated state and was dependent upon it being viscous - viscosity being the typical property which makes it possible for glass to be worked at all.

The Egyptian dry climate favoured the preservation of organic materials, such as wood, textiles and even food, because of the custom of providing the dead with everything they needed in the afterlife. Due to these facts, Egyptian tombs are treasures of information about how Egyptians lived. Thus the majority of ancient glass for study in museums are of Egyptian origin rather than Mesopotamian.

What makes the production of glass in Egypt at this time surprising is that the basic material being used - an alkaline calcium silicate (sand found in the Egyptian deserts) is the same glaze used as early as the predynastic Badrain period C. 4000 B.C. to coat stone beads and also a little later in the manufacture of glazed compositions. The only real differences, i.e. in the method of employment: if the raw product was to form glass it was used independently, whereas if if were to form glaze it was provided with a permanent core of a suitable material.

The great majority of these vessels were sand-core formed using hot viscous glass, while the other techniques of casting and a compilation of cold working methods were also being employed. The Egyptian empire during the era of Thotmes II was vast and stretched from the Nile to the Euphrates and took in the Aegean Islands as well. Egypt was open to many foreign influences and was visited by many people from foreign lands. The prosperity of the country offered craftsmen abundant scope to develop.

The sand-core vessels of this era may have been made in one of two ways. By one method, a core consisting of a mixture of sandy clay, straw, rags and other available voluminous materials were packed tightly together to form a core of the form required, this core would be attached to a rod. The core was then dipped into a pot of molten glass, it was rolled possibly on a slab of marble to make the surface uniformly smooth. When the piece was cooled the rod was removed and the core painstakingly scraped out of the centre of the vessel. Further cutting, grinding and polishing was carried out to form the final vessel. The second technique was similar to the first but after the initial coating of the core with molten glass, more molten glass was gathered, usually of a contrasting colour. It was wound around the body several times, perhaps using several colours; patterns were created by re-heating the glass and dragging the colours into each other with a metal tool giving the surface a "feathering" effect, a process similar to that still in use today in both glass making and in slip decoration of ceramics.

This technique of using glass in canes was later to be employed to form mosaics by the Egyptians and by the Romans in the first centure A.D. to form millefiori pattern vessels. The Egyptian containers for cosmetics, but also drinking vessels. Despite their diversity, they share one basic characteristic, which is typical of early glass objects, they are small. There were limits to the size of objects that could be formed round a core, and to the quantity of glass that could be melted in a primitive furnace. Another factor of interest was that most Egyptian vessel shapes in glass were copies of those which already existed in other materials such as alabaster and other forms of stone and metals.

One of the most popular of these shapes used was an unguent container which whether in stone or glass, was a footed squat vessel with or without handles, but with a very wide cylindrical neck. The wide opening made it equally easy for an ointment spoon or fingers to remove the contents and also allowed the complete removal of the core after manufacture. The decoration of glass toilet vessels usually consists of patterns of chevrons of festoons, but a wide diversity of effects is achieved in a number of ways. Also of interest during this period were the eye paint containers, manufactured from glass during the new kingdom, in general these take the characteristic shape of the palm column, retaining such elements from the architectural prototype as the bindings immediately below the front of the capital. A good deal of variety was still possible within this single shape, which was also core-formed.

Fig. VII **Fig. VIII**

FIG. VII.

FIG. VIII.

CHAPTER 3

By the Mid-Ramesside period C. 1200 B.C, the Egyptians had perfected virtually all the glass making techniques which were to be employed during the remainder of the dynastic period, yet a gap followed the end of the new kingdom C. 1070 B.C. when scarcely any glass seems to have been manufactured. This was in part due to the fact that Libya and some Asian countries became a threat to Egypt which lead to an instability in internal politics and economy. The glass industry was not be be revived again until the 9th century B.C.

By 900 B.C. glass pruduction re-emerged with a new strength and vigour that continued for the next four hundred years, gradually spreading westward into mediterranean regions. Although the core-forming technique survived, shapes reflected the new cultural emergence of Greece and its Hellenic aesthetics ("Hellenes" being an old term for the Greeks). No longer architectural in inspiration by the 6th century B.C., core-formed vessels took over several forms found in Greek pottery and metal work. The function of these new vessels revealed the shape of their related pottery prototypes. The small round aryballos with a narrow neck and a wide flat rim functioned as a container for perfume or precious oils. The tall cylindrical alabastron served a similar purpose. Widespread trade in the meditteranean expanded glass production, thus, these forms have been found in all countries bordering the meditteranean including Spain.

A second technique developed around this time involving the adaptation of metal casting technology to create glass plates, bowls and goblets, vessels too large to be successfully produced by the core-formed method. Casting required that the molten glass be cooled to a solid state, crushed or powdered and then placed in a mould to be remelted. The object was left to cool, then removed from the mould, ground and polished.

By the late 8th century, B.C., glassworkers at the mesopotamian sites of Ur, Nimrud and Babylon (modern day Iraq) were casting objects in colourless glass that closely imitated forms usually made of precious metals. This tradition continued into the 5th century, B.C. with the rise of the Achaemenio Persian Empire.

Elegant goblets and lotus motif bowls were created, objects **Ref No. VIII P. 124** so splendid that the Greek poet Aristophanes marvelled at their use as tableware at the court of Persians. The cast technique reached Italy by the fourth century B.C. where excavated finds from the town of Canosa uncovered five hoards of glass vessels buried in ancient tombs. These elegant tomb furnishings were part of the elaborate burials of the Hellenestic Age possibly influenced by Etruscan funerary rituals. The importance of these rituals is made obvious by the costly objects entombed. Relatives of the deceased filled the tomb with food, glass vessels, drinking goblets, jewellery and other personal items. The tombs themselves were painted with banquet scenes that depicted dancers, musicians and a funerary meal, not unlike the rituals performed for the dead by the Egyptians.

Glass vessels from these tombs are the earliest documented examples of cast Hellenistic tablewares, but the regularly used forms continued to expand during the fourth century B.C. include large plates with outsplayed rims, deep hemispherical bowls, lidded bowls and finned bowls.

Western Asia was the birthplace of a third technique used in the manufacture of glass. Now referred to as mosaic glass, small fragments of cut glass were bonded together. This technique also used by the Egyptians earlier during the reign of Tutankhamun from 1352-1343 B.C. to imitate gemstones in jewellery. After the decline of the new kingdom the art of mosaic glass was lost only to be revived a thousand years later during the rise of the imperial courts of the Hellenestic age [323-30 B.C.] After the conquest of Alexander the Great these Hellenestic wares set the standard for later roman products. In the Hellenestic and Roman periods mosaic glass was formed by juxtaposing fine rods of glass of various colours to create a pattern, this thicker rod was then heated and stretched. The process could be repeated many times with the pattern getting smaller and more complex each time. The rods were then cooled and cut transversely into small discs which were then placed in patterns in a paste or clay form. The polychrome patterns created by the bundling of the monochrome rods formed visual three-dimensional spirals and star patterns on a one dimensional surface.

These designs were exploited by the Romans during the first century BC-AD into patterns now called "millefiori" or a thousand flowers. These patterns of light green, rose, grey blue opaque red and violet florets were moulded into functional but costly tablewares such as plates and deep bowls.

Fig IX **Fig X**

As refined in the Imperial age of Rome, these brilliantly coloured, transulcent, mosaic vessels remain one of the greatest achievements in the glass makers art. During this period also it seems that sandwich gold glass, or at least gold leaf applied to the underside of a layer of colourless glass which would protect it, was being made and used in a number of different places. Not only were sandwich gold glass vessels quite widely distributed in the earlier Hellenistic period, but motifs in gold leaf and silver covered by colourless glass had also been used in the fourth century B.C. in the decoration of luxury items, such as a wooden couch encased in ivory and a shield found in the tomb of Philip II King of Macedon, father of Alexander the Great. The Egyptians had developed the technique to a point of complexity far beyond anything comparable around 360-343 B.C. The canes when bundled together often formed figures and faces, when heated, pulled and then sliced they often depicted only half a face, but when two slices of the same cane joined in the centre they produced a full face. Most slices depict a full figure or face and were often used as inlays into other materials, such as wood.

Fig XII

The first century B.C. witnessed the introduction of new types of mosaic and monochrome glass vessels. Core-formed bottles and slumped grooved conical and hemispherical bowls continued to be produced in the levant, and it appears likely that the workshops producing the grooved bowls were also responsible for a new type of bowl with ribs on the outside that were mould pressed and slumped over moulds. These ribbed bowls were the forerunners of a very widespread and well known class of bowl of the Roman period.

Fig. XIII

FIG. IX.

FIG. X.

FIG. XI.

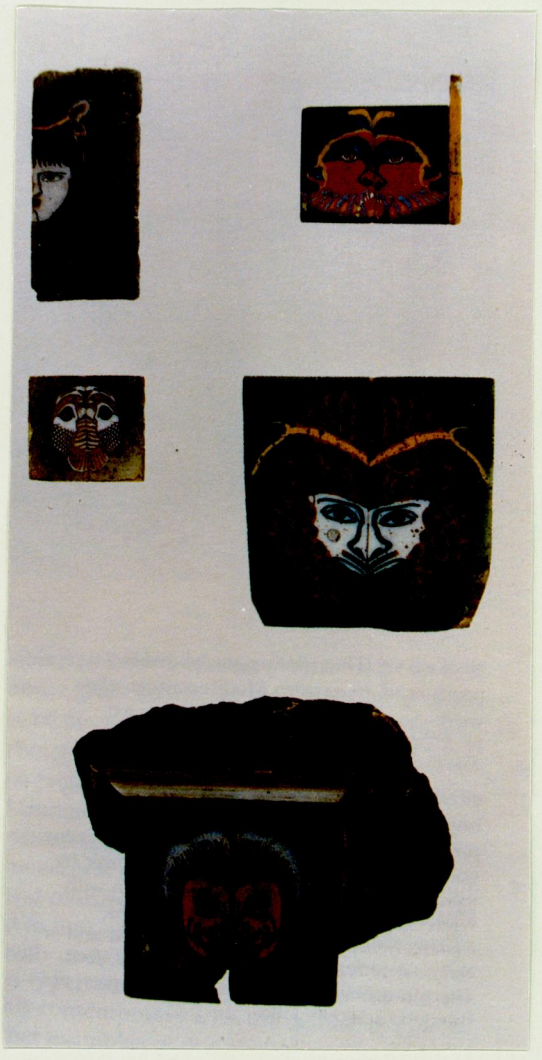


FIG. XII

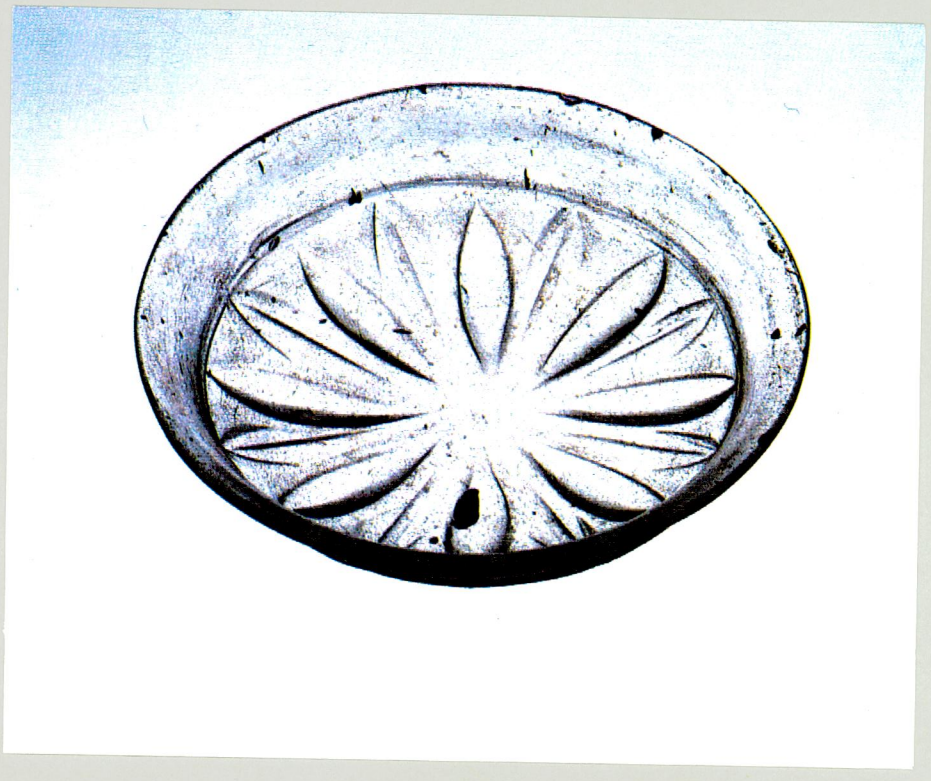


FIG. XIII.

Another innovation of this time was gold-band glass. This was used to make alabastra for scented oils and perfumes and takes its name from bands of gold sandwiched between two layers of colourless glass which are interspersed among bands of translucent coloured glass. Some are provided with monochrome stoppers which have been pierced to act as sprinklers. These pieces would have been manufactured on the Syro-Palestinian coast in the Eastern Mediterranean.

Fig. XIV

During the rule of Augustus, the first Roman Emperor (27B.C. A.D 14), the Glass industry was in the process of being revolutionised by the invention of blowing. Nonetheless, non-blown glassware continued to be of preference. The most significant step at this time was the establishment of factories producing these non-blown vessels in Roman Italy. Manufacture continued in the Eastern Mediterranean and it seems likely that migrant glassworkers from the east had arrived in Italy to establish the industry, since it demanded skill and expertise. Many types of non-blown glass ware of the early Roman factories have their origins in the preceding Hellenistic era, but innovations include a much wider variety of patterns and more brilliant colours for mosaic glass vessels found almost exclusively on Italian and other western Meditteranean sites.

Ribbed bowls were produced in large numbers. A speciality of the Italian factories was colourful mosaic glass. Striking examples of gold and coloured band and lacework can be seen in many bowls. Cups, bowls, plates and dishes were also made of translucent, blue, green and opaque reds. These fine pieces resemble pottery vessels and in many cases, the glass versions pre-date the pottery, some of the shapes also being made in silver and gold.

Fig. XV

Throughout the Roman Imperial period, glass formed by non-blown techniques also continued to be used for a wide variety of items other than vessels. It was popular in jewellery making. Bangles and beads were made completely of glass. Also glass gems were made as settings for rings and pendants as their predecessors were. There is also evidence of a few glass mirrors being manufactured during the Roman era.

FIG. XIV.

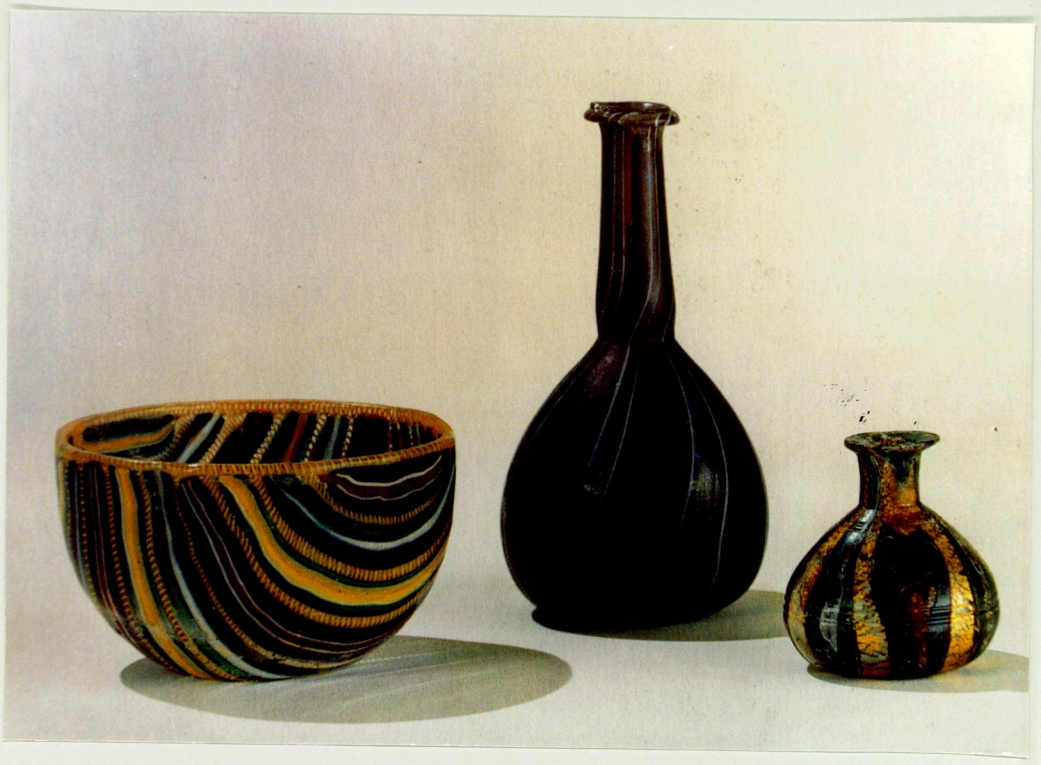


FIG. XV.

The Elder Pliney describes to us a theatre built in 58 B.C. The lowest storey of the stage was of marble, and the middle one of glass, an extravagence unparalleled even in later times.**[Ref. No. XI P.20]** There is other writing to confirm that throughout the Roman era the use of glass in both public and private dwellings remained a luxurious form of decoration available only to the very wealthy. Glass cubes, not unlike dalle de verre still used today in architecture, were quite often incorporated in both floor and wall mosaics. Similar panels of fused marbles were employed as ceiling and wall decoration. Panes of glass for use in windows were popular from the first century A.D. Such finds were made during the excavations of the city of Pompeii, a wealthy city just outside Naples.

Italy continued to import glass tiles from Egypt which were used to lavishly inlay furniture and decorate interiors. It also still had a thriving industry of lost wax cast phalerae or medallions given to soldiers as parade decorations to be worn on their breastplates. As we can see, the older techniques of glassmaking were not forgotten or abandoned even though glass blowing began to revolutionise glass production. While there are some blown vessels in antiquity of high technical and artistic merit, glass made to such a colourful, luxurious standard as seen earlier, seems to have ceased production.

CHAPTER 4

During the time when Alexandrian and Roman glass workers were exploiting the mosaic technique, the greatest single advance in glass technology, the technique of glass blowing was being developed along the coast of the Eastern Meditteranean in the first century B.C. It was not before the closing years of that century however that the technique was fully utilised, revolutionising the industry. Around 50 B.C. a collection of waste from the glass factory was dumped in the jewish quarter of the old city of Jerusalem, the small number of tiny bottles and inflated bulbs found were made by using the glass tubes found with them. One end of the glass tube was pinched shut and then inflated by blowing through the open end while still hot to form a small bottle. These finds suggest that during this period of experimentation only by using a metal pipe could a glassmaker produce tableware and storage containers in many shapes and sizes in a much wider variety, more easily and quickly than any other technique previously available to him.

We may ask the question, why after two thousand years of glass production was such a simple process so revolutionary? Glass vessels, produced prior to glass blowing, although functional, were precious and rare. Objects of such adornment, wonder, ritual and mystery were available only to those of substantial wealth and social and political prominence. The advent of blowing, however, allowed objects to be created quickly and cheaply requiring a skilled craftsman only 5-10 minutes to complete his task. A new elegance in form and greater finesse in technique could be achieved with this new technique. The vessels produced were thinner therefore making them lighter in weight. This factor also led them to be more transparent making them desirable utilitarian containers and tablewares. After two thousand years as a luxury commodity, glass, in a mere one hundred and fifty years became a common household item. Along with this the expanding Roman empire created an internationalism that opened new but interconnected markets from Spain to the Euprates for Glass and Glass workers. This led to a rapid distribution of glass products and their producers throughout the Empire. Goods were shipped throughout the Meditteranean in glass containers. Wine was poured into glass jugs and people ate from glass plates with greater frequency than we do even today.

Fig. XVI

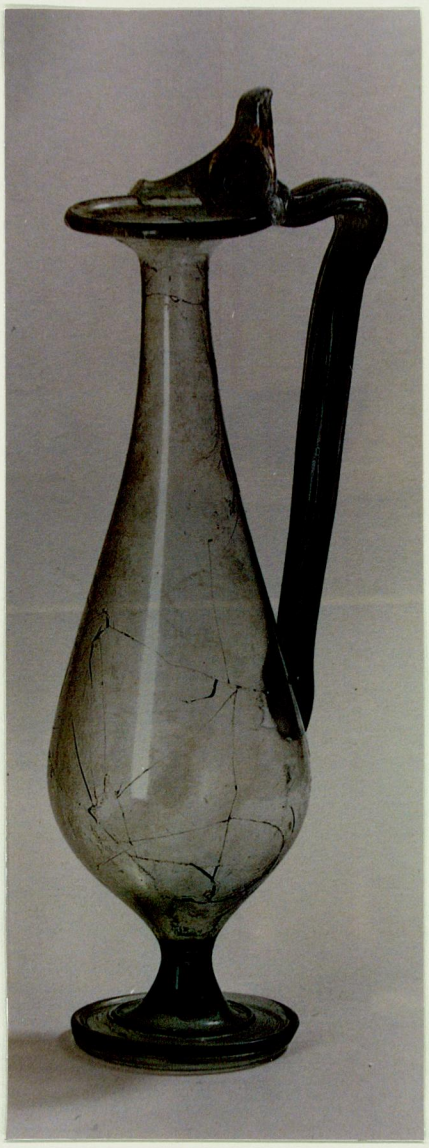


FIG. XVI.

Although essentially a simple process, the art of Glassblowing demands great skill and dexterity. A molten glass bubble is picked up from the furnace on the end of a hollow iron pipe and then inflated by placing the mouth over the opening in the iron and blowing. The malleable bubble can then be manipulated with wooden or metal rods to give the vessel the form desired, or it can be blown into a mould to imprint an embossed or relief design or pattern.

[Fig. XVII]

A solid metal rod of about 3-5 ft in length with a gather of glass attached to one end of the iron is then fixed to the bottom of the vessel. This rod called a pontil iron is helped by an assistant. The blowing iron is detached, then various tools are used to shape the opening of the vessel into a variety of forms according to the use intended for the vessel.

Rims and handles may also be added to the piece by trailing hot glass onto the main body. When the vessel is complete it is knocked off the pontil iron, leaving a pontil mark on the base of the vessel. The piece is then placed in the lehr, or a special oven which cools gradually over a one or two day period. This cooling is vital to ensure no stresses build up in the glass which could result in the piece cracking or shattering.**[Fig. XVIII]**

An important factor in tracing ancient glass, its origins, its makers, their nationality and dates lies in the fact that many Roman glassblowers signed their work. This could be recognised as possibly the earliest form of advertisement.

FIG. XVII.

FIG. XVIII.

It is believed that Sidon, now Lebanon, was the principal centre of glass blowing in the first century A.D. and evidence of inscriptions or signatures most commonly recorded were of a group of Sidonian glassmakers whose names were Artos, Artas, Erenaion, Neikon and Philippos. Roman mould blown glass serves as a recorded diary of events supplying us with names of popular athletes depicted in scenes of gladitorial combat, chariot racing and other sporting events popular at this time. The glass vessels also served as vehicles of fads and fashions with perfume bottles taking on lighthearted forms such as bunches of grapes and other fruit and flora, figues representing Gods and humans.

One rectangular bottle found in Austria believed to have been made in the first century A.D. bears the signature of one Senita Secunda. This provides us with the rare example of a female glassmakers work, unusual in a field that was generally dominated by men. Even though blown glass was being produced widely from the 1st century onward this did not mean that all blown glass was cheap. The Egyptians were once again displaying brilliant mastery and control in glass production. With the emergence of cameo glass vessels the long used technique of carving gem stones was adapted to glass. Cameo glass was created by casing various layers of glass over a cast block of opaque white glass, a similar structure to that occuring naturally in such stones as onyx. **[Ref. No. XI P.31-32]** The pattern was carved in relief by cutting away the upper layers to reveal the white beneath. Very few examples of these masterpieces survive today, perhaps a dozen or so. They depict mythological scenes related to Dionysian rites, the most famous piece of all being the Portland Vase.

Fig. XIX

Total control over the material was necessary as the glass cutter created subtle shading to produce an impression of depth and three dimensional space. The glass cutters employed to carry out this meticulous work held the same status as gem cutters, their occupations often being interchangeable. Glass cutting had by the third century A.D. become so important, that these artisans were protected legally from any liability. If the object had been damaged previously during the manufacturing process. But they were given great responsiblity and were severely punished for any damage due to their own lack of experience or negligence.

FIG. XIX.

During the second half of the third and fourth century A.D. glass cage cups or diatreta were being made in many parts of the Roman Empire. These works in glass were to represent the apogee of the glass cutters technical mastery in antiquity. The general form of these vessels are deep bowls or 'cups' approximately 16cm in height. They were formed by blowing a thick 'blank' which was then cut away, applying the greatest skill to create an open lacework design which would be connected to the background wall by a number of 'bridges' carefully worked into the design. There are two main classes in design excecuted to form the cups, those with figurative decoration and those with network decoration only. From the details of archaeological digs it is assumed that most of the cage cups found were made in the west, many presumed to have been made in the Rhineland.

Considered the most beautiful piece, with increadibly complex carving is known as the Lycurgus cup. The most remarkable is a cup which illustrates the story of Lycurgus, the ill fated King of the thracian Edoni, who was strangled by vines after taunting the God Dionysos [Ref No. X. P. 92].

Fig. XX

In addition to its complex carving the colour of the Glass used is most unusual due to the fact that in reflected light the glass appears a pale pea green but in transmitted light the glass is a brilliant magenta. There are two theories as to how this change in colour was achieved. It could either be the amount of gathers taken on the blow pipe and the fact that the glass was at a critical temperature causing a chemical reaction within the glass, or that when the batch of glass was being mixed minute particles of gold and silver were introduced to the mix. Gold particles are still added to glass mixes today to produce red pigments in glass, thus making it the most expensive colour to produce successfully. In fact in 1958 when the British Museum carried out tests on fragments of the cup, which loosened when cleaning was being carried out. It was found when analysed that the glass used was the normal soda-lime-silica compound and did actually contain a degree of gold and silver particles.

Fig. XXI

FIG. XX.

FIG. XXI.

Another feature that distinguishes the Lycurgus cup from many others produced at this time is that when the carving was complete, ordinary cage cups seem to have been given a slight polish, while the Lycurgus cup appears remarkably smooth and shiny inside and outside, a finish almost impossible to achieve by rotary polishing.

The only other viable means would have been to fire polish the piece, an equally risky method considering the delicacy of the carving, producing various thicknesses within the body of the cup which leads to technical complications during the firing.

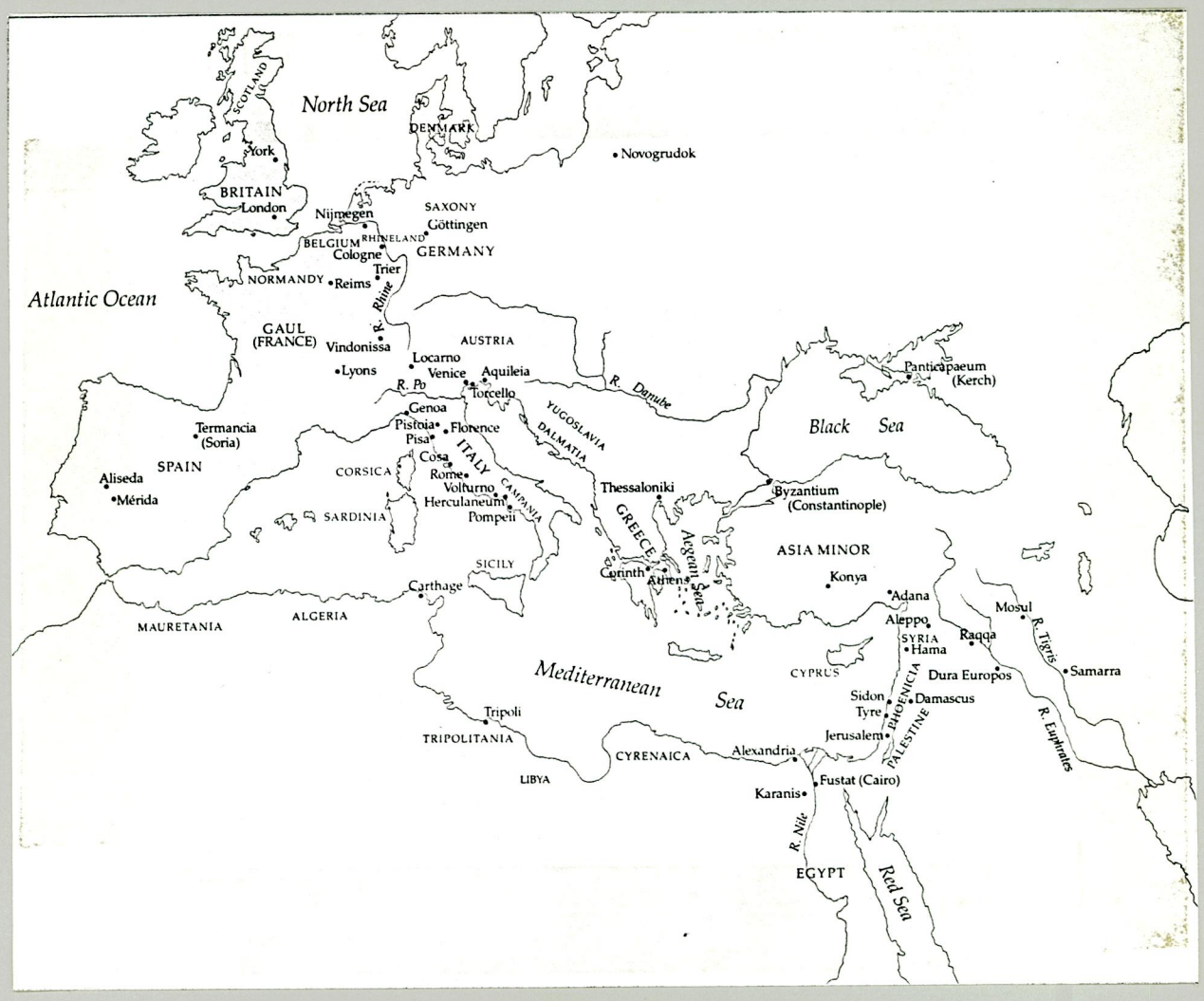
The cage cups both in conception and execution marked the apogee in glass making in the ancient world. Such creative skills were never to be seen again in the Glass world. With the collapse of the Roman Empire in the 5th century, A.D. due to constant invasions of Germanic tribes leading to general instablity caused an overall decline in production an standards and a virtual end to the age of experimentation within the field of glass.

C O N C L U S I O N

The story of Roman Glass came to an end around the beginning of the Fifth Century, which was to witness the final collapse of the Roman Empire in the West.
For about 100 years the Roman Empire was wrought with internal rebellion and suffered from external attacks. Though the Empire recovered from it's instability it was never to return to it's previous social and economic conditions. Even the official capital of the state transferred from Rome to Constantinople.

As would be expected, the Arts and Crafts of the Roman Empire underwent a tremendous change. Although the major glass making centres survived the political and economic turmoil and continued to produce glass in abundance, there was a dramatic shift away from the decorative styles and high standards previously produced. Glass had now become more ordinary for use as storage and tablewares with a significant lack of diversity in form.

Roman Traditions were to persist in the East for several hundred years later and in the West they laid the solid foundations for glassmaking for centuries to come.


North Sea
SCOTLAND
DENMARK
Novogrudok
York
BRITAIN
London
Nijmegen
SAXONY
Göttingen
BELGIUM
RHINELAND
Cologne
GERMANY
Trier
NORMANDY
Reims
Rhine
Atlantic Ocean
GAUL
(FRANCE)
Vindonissa
AUSTRIA
Locarno
Lyons
Venice
Aquileia
R. Po
Torcello
R. Danube
Panticapaeum
(Kerch)
Genoa
YUGOSLAVIA
DALMATIA
Black Sea
Termancia
(Soria)
Pistoia
Pisa
Florence
SPAIN
Cosa
ITALY
CORSICA
Rome
Aliseda
Volturno
CAMPANIA
Mérida
Herculaneum
Pompeii
Thessaloniki
Byzantium
(Constantinople)
SARDINIA
GREECE
Aegean Sea
ASIA MINOR
SICILY
Corinth
Athens
Konya
Carthage
Adana
Aleppo
Mosul
R. Tigris
MAURETANIA
ALGERIA
SYRIA
Hama
Raqqa
Mediterranean Sea
CYPRUS
Dura Europos
Samarra
Sidon
Damascus
Tyre
PHOENICIA
PALESTINE
Tripoli
Jerusalem
R. Euphrates
TRIPOLITANIA
CYRENAICA
Alexandria
Fustat (Cairo)
LIBYA
Karanis
R. Nile
EGYPT
Red Sea

LIST OF ILLUSTRATIONS

FIG. X. Mosaic glass footed bowl composed of single coloured canes laid side by side to give a striped effect, together with sections of multicoloured canes showing white spirals in a brownish-yellow ground.
1st. C.B.C.

FIG. XI. Three elaborate vessels of virtually colourless glass; A bossed bowl with a fine linear-cut rosette pattern on the bottom, a wing-handled cup on a tall foot-stand and a bowl of sandwich gold glass.
2nd C.B.C. Canosa Southern Italy.

FIG. XII. Agroup of Egyptian Mosaic glass slices
1st. C.B.C.

FIG. XIII. Shallow bowl cast in almost colourless glass with a design of sixteen petals alternating in relief and in intaglio. Bowls of this type made in the Persian Empire were used as drinking vessels in the later 5th and 4th Centuries B.C.

FIG. XIV. Three perfume flasks, two of Gold band glass evidently formed around a core and the third perhaps in the same way but composed of two bands of dark blue seperated by one of colourless glass.
1st C.B.C. Eastern Mediterranean.

FIG. XV. Three cast Mosaic vessels, respectively using striped colour-band and gold band techniques.
1st. C.B.C. Italy

FIG. XVI. Large jug, for which there are parallels in late Roman silverware.
4th. C.AD. Syria..

FIG. XVII. Bottle blown in the shape of a bunch of grapes.
4th. C. AD. France

FIG. XVIII. Large jar, of urn, still containing cremated bones, it must have origionally served as a storage jar. Western Roman Province. A.D. 50-200

FIG. XIX. Cameo glass amphora known as the Portland vase 1st. C. AD. Rome

FIG. XX. Cage cupdepicting the story of Lycurgus the ill-fated Thracian King strangled by vines after taunting the God Dionysos. In reflected light it is pea green in solour.

FIG. XXI. The Lycurgus cup in transmitted light, when it appears a deep red, often described as Magenta, and Amethystine purple on the Tjorso of Lycurgus.

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