History of Mirrors Dating Back 8000 Years

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ABSTRACT

Purpose. The purpose of this study is to consider the ancient history and early development of mirrors, because mirrors played a key role in refraction and magnification for an extended period of time before the invention of spectacles, including broad use in Roman times.

Findings. The earliest known manufactured mirrors (approximately 8000 years old) have been found in Anatolia (south central modern-day Turkey). These were made from obsidian (volcanic glass), had a convex surface and remarkably good optical quality. Mirrors from more recent periods have been found both in Egypt and Mesopotamia and still later in China and in the New World. In each of these areas, mirrors were in use by approximately 2000 BC or 4000 years ago.

Key Words: history of optics, ancient mirrors, obsidian, corundum, grinding of mirrors

First Mirrors

The very first mirrors most probably were quiet pools of water and rock or clay containers of water. Interestingly, from approximately 722 BC onward, Chinese characters for mirrors, known as jian and jing, were best translated as "a [large] tub filled with water."1,a

Except for naturally occurring pools, mirrors have been manufactured. They also have played a lengthy and important role in early vision corrections and as magnifiers2,b; thus, it is of interest to trace mirror origins, development, and use. Here, earliest known manufactured mirrors are discussed and their origins in different parts of the world are considered and compared. Contrary to popular belief, mirrors did not appear to have originated in China.

The first known mirrors were recovered from graves in Anatolia by Mellaart in the region of the Neolithic settlement of Çatal Huyuk,3–5 which is also written as Çatalhöyük (Fig. 1). It is located near Konya in south central modern-Turkey.6,7 The cemetery, and oldest sections of buildings containing secondary burials, were dated approximately 6000 to 5900 BC.3–5 Pendergrast6 cites this find as occurring in 6200 to 6000 BC. These mirrors were manufactured from ground and polished obsidian (a volcanic glass) and had a round reflective surface; some were conical. These mirror surfaces were slightly convex and highly polished. Their diameters were approximately 9 cm,3,4,8 and they form reasonable images.9,c

The fine mirror image seen in Figure 2 is remarkable!9 Conolly9 states, “Their use as mirrors, in the sense that a reflective surface was the functional surface, cannot be disputed.” One specimen stands upright on a small flattened base, and the finest one was set into lime plaster; these mirrors were believed to have originated in graves of females, based upon the contents of the grave.3,9

Anatolia is a source of both obsidian and corundum. Corundum (also known as carborundum®, or emery) is a grinding and polishing material and although very hard (no. 9 on the Mohs hardness scale in which no. 10 is the highest value), it is easy to work in mineral form.

Obsidian objects were among early exports from Anatolia, and they were used for spears, arrowheads, knives, axes, scrapers, and jewelry. It is reasonable to conjecture that mirrors were also exported from there. Conolly9 suggests the first shaping/grinding of an Anatolian mirror surface was quite coarse; the surface was then polished with a fine-grained material such as silt and buffed with material such as leather.

In a recent report Prof. Colin Renfrew, Cambridge University,7 argued that, in approximately 6000 BC, Çatalhöyük (Fig. 1), which then had a population of 10,000, was the center for major

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aIn reference 1, almost all mirror surfaces and decorative rear surfaces are illustrated. Note: bubble formation, associated with cooling metal castings, adversely affected mirror surfaces. From the Song Dynasty (960–1279 AD) onward, white metal was used for plating/smoothing mirror surfaces.


cLilyquist notes (personal communication, 2004): “Thefinest of these was set in lime plaster and beautifully smoothed to fit the owner’s hand.”

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developments in farming and language. If he is correct, it follows that Çatalhöyük, and greater Anatolia, were likely associated with the spread of other critical civilizing components to other areas and peoples.

Next Mirrors

The next known mirrors may have been Egyptian. William M. Flinders Petrie (1853–1942) suggested that ground stone "pallettes" were wetted and used as mirrors in Pre-Dynastic times.3 They apparently could provide good mirror images. Lilyquist notes that water evaporated very rapidly from their surfaces; she also noted that ceramic bowls designed to hold water were apparently used as mirrors and cites early findings at El Badari.3 Pendergrast6 dates items from Badari at approximately 4500 BC, although there is controversy as to dates of El Badari articles. The items from Badari include a slab of selenite with traces of wood (a possible frame?) around it and a slate disc.3,6 Also, a piece of reflective mica pierced with a hole (a possible wall attachment?) was located.6 Lilyquist also notes that polished stone mirrors from ancient Egypt are not known nor are metallic mirrors before Dynastic times.3

During the time period approximately 4000 to 3000 BC, small copper disc mirrors were recovered in the Tigris-Euphrates Valley in Southern Mesopotamia, now Iraq.4 These were found near Uruk and at Tello (in approximately 3200 BC). From then onward, in Egypt, in city-states of Mesopotamia, and in the Levant, records of mirror use appeared within sculptures, raised and incised carvings, papyrus texts, and as mirrors (see Figs. 3–6).3,4,10 Tables 1 and 2 are created from published data.4,10 (Items are aligned to allow comparisons of dates of findings). Early mirrors were near flat (but not at Çatal Hüyük); later mirrors were convex, which created an upright image in a smaller mirror surface area, thus requiring less bronze. Concave mirrors served to magnify objects and both mirror forms allowed correction of some refractive errors.

FIGURE 1.
Map locating ancient Çatalhöyük, Anatolia, within modern Turkey. Adapted from Culotta E, Hanson B. First words. Science 2004;303:1326.

FIGURE 2.
Color reproduction of a woman viewing her face in an image of her captured in an ancient Anatolian mirror (Neolithic) from Çatalhöyük. The mirror is in the collection of the Museum of Anatolian Civilizations, Ankara, Turkey. The photograph was taken outdoors in bright sunlight and the mirror is dated “first half of the 6th millennium BC.” Photo provided by C. Lilyquist, September 2004, and is reproduced with permission of both Dr. Hikmet Denizli, Associate Director, Museum of Anatolian Civilizations, Ankara, Turkey, and Dr. James Conolly.
In these societies, mirrors were sometimes used to symbolize religious or other beliefs. They served as symbols of the sun or moon and may have been carried on tops of standards. A one-sided flattened disc symbolized a setting or rising sun. Mirrors were sometimes used to symbolize the inner self; they also provided a way to "look back." Magical properties were sometimes attributed to mirrors and mirrors served as burning glasses, as weapons, and as time-keeping devices. References can also be found to the use of mirrors in pornography.

From Tables 1 and 2 it is suggested that parallels in mirror development existed between cultures, and similarities in developments increased with time. Early civilizations were not completely isolated. There were exchanges and communications between peoples through trade, war, conquest, emigration, and importation of slaves. In 2003, at the Brooklyn Museum in New York City, a major exhibit titled “Art and Interconnections” showed fine mirrors and lenses in eyes of an ibis statue. It revealed remarkable ties between art objects found in Egypt and regions extending eastward to Western India and north and westward. There were connections among Egypt, Greece and its islands, the Holy Land, and the Levant. Byblos, Lebanon, served as a meaningful entrepôt for many products, including mirrors.

**East and Central Asia, Including China**

There are discussions in the Source addressing possible Central Asian origins of apparently later-appearing Chinese mirrors; both Julianno and Robinson, in their discussions, suggest Chinese mirrors developed outside of China per se. Precursors of Chinese mirrors may have developed in southern Siberia (Fig. 7), e.g., at Andronovo, or Karasuk, Scythia, or Kelermes, just north of the Caucasus Mountains near the Black Sea. They had different structural features than Western mirrors.

Within China, two mirrors were located at Guinan Xian, Quinhai, approximately 2000 BC (Qijia culture). They originated during the Xia period, 2100 to 1200 BC. Nakano shows a clear image of a Guinan Xian mirror (8.9-cm diameter, obtained from Tomb 25) (Fig. 8).

Later, mirrors were found in the tomb of Lady Hao, Tomb 5, Anyang (late Shang Dynasty approximately 1300-1028 BC) (Fig. 9). Mirrors came into limited general use in China during the Eastern Zhou Dynasty (approximately 1045–771 BC). Early Chinese mirrors ranged from 6 to 12 cm in diameter, were not ornate, and had a centered pierced knob or raised area on the ornamented back surface. The knob served as a means of holding...
the mirror or for tying it to a supporting cord. These early mirrors were generally thin, and raised ridges included in patterns on their rear surfaces possibly provided some rigidity. Copper alloys/bronze were used early, and handles appeared later than in Western-based civilizations. Of course, mirrors found could have originated in China itself, but the available early mirrors do not exhibit orderly evolutionary properties and are consistent with existing Southern Siberian designs. Evidence exists for trade in mirrors along the Silk Road (mirrors were wrapped in Chinese silk cloth). Early Chinese mirrors appeared as items in graves and were mentioned in Chinese texts.

Here again, mirrors were believed to be endowed with special properties, including the ability to look backward in time (and to take warning) and to see oneself as you are (to be aware of faults); magical properties were attributed them. These are similar to characteristics discussed vis-à-vis Egyptian and other ancient mirrors.

Central and South America

Pre-Columbian optical workmanship has been found in Central and South America and is described by Calvo and Enoch. For example, South American mirrors were reported from approximately 1925 BC onward. In Mexico, they were made by the Olmec, Mayan, and Teotihuacan peoples, and the Zoque tribe in a remote region of Chiapas State during Mayan times. It is known that lenses and mirrors were made in Chiapas State. In southern Columbia and northern Ecuador, refined manufacturing techniques for working gold and polishing precious stones were developed by the La Tolita culture (600–300 BC). In Peru, there was the Chavin culture (or Chavine, or Chavin de Huantar) (900/800–200 BC), which developed polished anthracite mirrors, and later there was the Moche culture (approximately 200 BC–600 AD), which had copper-framed mirror-holders (Metropolitan Museum of Art, New York) and (probable) rock crystal lenses (Larco Museum, Lima, Peru). The Incas also had mirrors. In Brazil, mirrors were known in the Mogi Mirim City area, Sao Paulo State.

Comparison of Early Mirror Developments in Egypt and Mesopotamia

<table>
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<tr>
<th>TABLE 1. Egypt</th>
<th>(3200 BC onward)</th>
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<tr>
<td>ca 3200 to 2700 BC: Menphite region, outside Cairo; copper alloy metal discs, cordiform, no handles were preserved, cords might have fitted into mirrors or believed to be in handles</td>
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<td>Old Kingdom</td>
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<td>ca 2700 to 2200 BC: round or elliptical discs, one lotiform (really, water lily form) disc; had papyriform wood handles</td>
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<td>ca 2450 to 2300 BC: Tomb 24 of Shiek Said disc with handle (relief on tomb)</td>
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<td>ca 2300 to 2250 BC: Tomb of Mereruka, Saqqara, Dynasty VI; disc had more complex handle</td>
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<td>Middle Kingdom</td>
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<td>ca 2050 BC: Sarcophagus of K3wi.t, Dynasty XI; disc with advanced handle</td>
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<td>ca 2000 to 1600 BC: mirrors became more elaborate, made of polished copper alloy, gold, silver, electrum, generally with fabric or woven reed cases, and sometimes wooden boxes; handles were simple compared with the 1600 BC–Roman era</td>
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<td>Other regions in Western and Central Asia</td>
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<td>ca 3200 BC: Sialk, Iran; plain copper disc mirrors found in two female tombs; discs measure 12 to 16 cm, convex, with edges angled concave, some fabric adherent</td>
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<td>ca 2000 to 1000 BC: mirrors found at many sites; copper alloy mirrors appeared</td>
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<th>TABLE 2. Mesopotamia</th>
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<tr>
<td>ca 3200 BC: Jemdet Nasr Tombs at Kish; copper mirrors with short handles found in tombs containing no weapons; females believed to be in tombs with mirrors</td>
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<td>ca 3000 BC: private dwellings, Khafaje; plain copper mirrors</td>
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<tr>
<td>ca 3000 BC: Ur, early Dynastic period; two copper discs, round, long handled</td>
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<tr>
<td>ca 2900 BC: Ur, Dynastic I level; copper disc, 13.5 cm, edges turned as if to secure mirror to wooden backing</td>
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<tr>
<td>ca 2300 BC: Ur, Sargonid period; mirror found in grave</td>
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mirror (Fig. 10). He provides comparative reflection data for different materials: 21% for magnetite, 28% for hematite, and 55% for iron pyrite. Further, he points out mirrors were also used for making fire, self-contemplation, medicine, divination, and astronomy.

A polished iron pyrite mosaic-style mirror was discovered by archaeologists in Chiapas State (attributed to the Zoque tribe, approximately 1000 AD). In this video, the mirror is disassembled in the hands of the digger, but there is a good view of the concave mirror and the mosaic of mirror elements. There are varying numbers of sides of the well-fitted individual mosaic elements, i.e., three to four to six sides. The mirror retained its highly glossy surface after a millennium of burial.

At a dig at Takalik Abaj, in Guatemala, a late-Olmec, early-Mayan center, the grave and body of a king were discovered. Evidence was presented for early trade between Takalik Abaj and neighboring areas in “...quetzal feathers, (iron) pyrite, obsidian, and jade for tools, jewelry, and works of art.” Included in the royal tomb, dated between 800 BC and 200 AD, was a mosaic mirror made of iron pyrite.14

Separately, Wirth discusses some interesting “parallel” developments occurring in Central America and Egypt (pre-Columbian era).17

CONCLUSIONS

The first known manufactured mirrors were located in Anatolia approximately 8000 years ago. We can assume mirrors were used...
much earlier through observation of reflections in quiet pools of water and in water containers. A number of early manufactured mirrors were essentially flat (but not those found in Çatal Hüyük). A variety of crystals/stones were used in a number of early mirrors. Included were polished obsidian (generally) black volcanic glass, mica, polished iron pyrite, polished hard stone surfaces, anthracite, and/or possibly smooth and wetted rock surfaces. With development of copper, and later copper alloys (including bronze), these readily shaped and molded metals became substances of choice for mirror manufacture. The more expensive but harder and stronger bronze alloys superseded early copper mirrors. Still later, gold and silver were used in mirrors and for plating them. Plated white metallic coatings were added to bronze mirrors to provide smoother surfaces with higher levels of polish and reflectance.

By approximately 2000 BC, there existed dispersed utilization of mirrors in virtually every major region of the world with settled societies; this includes Central and South America. After that time, mirror distribution and quality increased rapidly.

Convex mirrors, providing upright but smaller images having an acceptable field of view, came into vogue, e.g., in China, because they required much less costly metallic bronze for manufacture. Concave mirrors offered upright images within defined optical constraints (object–image relationships, aberrations); these allowed meaningful magnification of images for a number of purposes as well as refractive corrections just as concave mirrors are used today for shaving and makeup mirrors.

Hard rock grinding and polishing technologies developed in part through availability and use of corundum found in ancient mines in Naxos (Cycladic Islands, Greece), Anatolia (modern Turkey), and in the Indus Valley. Other hard rock materials were used as well, e.g., see Conolly.12 Because the volume of corundum containing rocks required for processing a small batch of mirrors or
lenses was not particularly large, it is conceivable that mined materials could be shipped in sufficient quantities. Another form of corundum, emery sands (a limited supply exists in Egypt), was also used for grinding and polishing. In addition, quartz sands were available in Egypt and could be used to grind rock crystal (quartz).

One wonders how, early on, appreciation of suitability of corundum and other hard materials originated or evolved for use in grinding, shaping, and polishing surfaces because this was a major and broadly applicable technologic advance.

Materials needed for early mirror development were present in Anatolia, and there were early trade connections with neighboring regions. It does not follow that achievement of defined purposes will occur because of the presence of necessary resources, but, apparently, these purposes were achieved. I assume that development of polished mirrors followed already traded chipped and polished obsidian knife blades, scrapers, arrow points, and jewels.

China played a major role in the development of mirrors, but the Chinese were not among the early contributors to this art and science; they may have imported this technology from other Asian sources.

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REFERENCES


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