

OCCASIONAL PAPERS
of the
CENTER for BEAD RESEARCH

OCCASIONAL PAPER No. 2
CHINESE GLASS BEADS:
A REVIEW
OF THE EVIDENCE
Peter Francis, Jr.

THE CENTER FOR BEAD RESEARCH
4 Essex Street
Lake Placid, New York 12946 (U.S.A.)

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CHART OF CHINESE HISTORY, GLASS, AND GLASS BEAD DEVELOPMENT

<i>Dynasty, Date</i>	<i>Cultural Developments</i>	<i>Glass, Glass Bead Developments</i>
Shang 1523-1027 BC	Rise of cities; bronze, irrigation, writing.	First pottery glazes are feldspathic.
Chou 1025-221 BC	States compete, written history, Great Wall, iron, Confucius, Taoism.	First glass 8th-9th c.; Late Chou (Loyang) great variety of beads; lead glass, barium; 2-3 centers?
Chin 221-106 BC	Foundation of Empire, books burned.	Glass beads found in graves.
Han 202 BC-220 AD	Imperial expansion; plow, crop rotation, paper, water wheel; Buddhism.	Early literary references to glass; some Loyang material may be Han.
Three Kingdoms 220-280 AD	First pilgrim to Central Asia.	Western glass vessels admired.
Tsin 265-420 AD	Expansion, conquest in the south.	No records of glass; perhaps beadmaking near Nanking.
Ten Dynasties 420-588	Great Wall to 1500 kms., first stirrup.	Histories say glass introduced from abroad.
Sui 589-617	Big canals completed, Loyang rebuilt.	Ho Chou makes glass.
T'ang 618-906	Control of Central Asia, Chinese coins in Africa; sky map; ban on Buddhism.	Many glass ornaments, some beads known; Foreign glass still admired; lead glass abandoned.
Five Dynasties 906-959	First rudder, invasion of Kitan.	Glass beads in tombs.
Sung 960-1279	Foreign commerce, paper money, moveable type, canal locks, compass.	Glassmaking described; glass beads traded to southeast Asia; glass lanterns.
Yüan 1260-1368	Mongol invasion; Marco Polo.	Marco Polo notes palace windows; enamel introduced.
Ming 1368-1644	Chinese restored; silver imported from America.	Jesuits note Chinese glass was poor; lapidary techniques.
Ch'ing (Manchu) 1644-1911	Chinese made to wear pig-tail; 1762 census: 200 million; 1851 = 432 million; Opium War, Boxer Rebellion.	Imperial Workshops; Poshan makes glass beads; Canton makes glass; beads sold to Japan, Russia, India, Africa, etc.; sophisticated techniques.
Republic 1912-	Sun Yat-sen proclaims Republic; Communist and Nationalist Chinas.	Poshan continues as main beadmaking city; others probably exist.

CHINESE GLASS BEADS:
A REVIEW OF THE EVIDENCE

Peter Francis, Jr.

Foreword

The importance of Chinese culture to world civilization cannot be overstated. No artifactual or material studies are complete without an understanding of the role played by this ancient land. This is as true with the study of glass as with anything else, and, because of their distribution, it is especially true with the study of glass beads. If we are ever to understand the history of glass beads, it is imperative that we deal with those of China.

Very little is known of Chinese glass beads. The scientific study of beads of all types has attracted serious professional interest only in the last few years. Moreover, until very recently the political climate in much of China did not encourage either foreign scholars or the free flow of information. Fortunately, however, bead research is emerging as a recognized field of specialization, and a new open spirit in China is most encouraging.

These developments suggest that in time a comprehensive history of beads in the Middle Kingdom can be written. That time has not yet arrived, and this paper is not to be regarded as the definitive study of this problem. Nonetheless, an outline of the history of glass beads in China is sorely needed. There are many expressed or implied assumptions about them which call for examination. In this survey I have sought to collate the available information in Western languages about Chinese glass and its relationship to beads, supplementing that with data derived from examining Chinese beads in some museum and private collections. By making available what is presently known about this topic it is hoped that this paper will serve as a reference point for and an inducement to further work.

Several questions about Chinese glass beads need to be examined in detail to give us a broad outline of the subject. These questions may be phrased as follows:

- 1.) What is the origin of glass and glass beads in China?
- 2.) Is there evidence for the continual production of glass and glass beads from the date of its origin to the present?
- 3.) What sorts of glass beads have been produced in China and what techniques were employed to make them?
- 4.) Where have the major production centers of glass beads been located?

5.) To what extent have Chinese glass beads participated in international commerce and been traded or sold to the outside world?

The foregoing questions may be regarded as defining the boundaries of our interest and will be the foci of our investigation. Although the answers to each question are bound with those of the others, this survey is organized into sections dealing with each topic in turn.

Notes to the Reader

Since Chinese words cannot be precisely transliterated into Roman characters, various systems of writing Chinese have been devised. Although the officially recognized system is the Pinyin, I have chosen to write names in the older Giles-Wade system or other common spellings familiar to Westerners because most of the source material referred to herein uses them. Some other systems have been employed by various authors (in particular Needham), and substitute transliterations are noted.

There is not always complete agreement on the chronology of events in China, especially older ones. For dates I have relied upon Gernet [1972] and S.C. Lee [1952].

Acknowledgments

No one works on such a project alone, and I am particularly grateful to several people who have aided this work by furnishing information in the form of examples of beads and literature, as well as institutions that allowed me to examine and photograph material in their collections and to use their libraries.

Elizabeth Harris of the Society of Bead Researchers (SBR) and the Bead Society of Los Angeles (BSLA), has been most generous in providing both ancient and modern examples of Chinese beads over the last several years which have been invaluable in my investigations. Gabrielle Liese of the Bead Museum in Prescott, AZ, the SBR and the Arizona Bead Society, and Albert Summerfield of the SBR and the Northwest Bead Society have also furnished important examples of Chinese beads.

The most valuable sources of information have been obtained through the Interlibrary loan system, and for that I must thank Kathy Tummons of the North Country Community College of Saranac Lake, N.Y., and many people on the "other side" of the loan system in various institutions. Elizabeth Harris has also been very helpful with the obtaining of literature and the reading of the manuscript.

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SECTION ONE:

THE ORIGIN OF GLASS IN CHINA

The Definition of Glass

The American Society for Testing Materials has adopted as a standard definition of glass the phrase: "an inorganic product of fusion which has cooled to a rigid condition without crystallizing." Subheadings under the main definition note that glass is typically hard and brittle and breaks with a conchoidal (ribbed like a clam) fracture. It may be translucent or opaque, and colored with dissolved, amorphous, or crystalline materials [Scholes and Greene 1975:4].

Glass is often considered a state of matter, a substance which has been cooled below its crystallization point without crystallizing. Many materials, even metals, may be made in the glassy state, but usually the term "glass" refers to a product made chiefly of silica, the most abundant mineral on Earth.

Glass can be made by natural processes: obsidian, "desert glass," and tektites have been known and employed for a long time wherever they were available. However, as the term is used here, glass is understood to be an artificial, synthetic substance produced by and for human use.

The Origin of Glass Outside China

The first people to make glass are not definitely known. The Egyptians glazed steatite (soapstone) beads in the Badarian period, from 5500 to 3800 B. C. [Brunton and Caton-Thompson 1928:27, 39; Hoffman 1979:142]. Faience, widely regarded as a precursor to glass, has been uncovered at Qustul, Nubia, from about 3400 B.C. [B. Williams 1980:19]. Glass beads appeared in Egypt during the VII-VIII Dynasties [Beck 1928:25; 1934:13-14], about 2387 to 2365 B.C. [Mellaart 1979:facing 18]. Other early glass has been discovered in Mesopotamia. Although controversy exists over its age [Beck 1934:9-10; Frankfort 1934:56-7; Garner 1956; Engle 1974], it can be ascribed to the Akkad Dynasty (probably the reign of Sargon); recent recalibrations of radiocarbon ages date his reign to 2445-2414 B.C. [Mellaart 1979:facing 18]. Glass beads and melted glass have been discovered in the Caucasus region from about the same time [Besborodov and Zadneprovsky 1965:127].

It is widely held that the techniques for making glass were developed in one or a few places whence they diffused to other parts of the world. Certainly the development and spread of glass technology was a slow process [Oppenheim 1973]. East of the fertile crescent and adjacent hilly regions, glass is recorded in India around the year 1000 B.C., where a few pieces of bangles and two beads were uncovered at the site of Bhagwanpura [Francis 1984:152].

Glass in China

The genesis of Chinese glass has been a point of contention among scholars for a long time, with no immediate solution in sight [Blair 1951:347]. Two general theories have been advanced: one maintains that

glass was a native invention and the other holds that glassmaking was a technology which had been imported into China.

Two disciplines may be called upon to help resolve such problems: history and archaeology. China is particularly rich in historical source material. Though old records were occasionally destroyed, many of them have survived into the present.

Archaeologically, China has been less explored than other comparably ancient civilizations. Despite an early realization of the importance of ancient artifacts in China, which lead Feng Hu Tzu to formulate a "Three Ages" system 2000 years before C.J. Thomsen, scientific excavation had only just begun when it was interrupted by World War II [see Chang Kwang-chih 1963:1-19]. Subsequent political events deterred exploration for some time. Initially, archaeology was held in little favor by the People's Republic of China, but the traditional Chinese reverence for the past reasserted itself, and archaeology came to be recognized as a legitimate field of study. During the Cultural Revolution, peasants were encouraged to report any finds of ancient materials, and an astonishing number of new finds were made during this time [Hsia 1974:1]. Work has accelerated in the last few years, and we may expect much more material to emerge, be studied, and be published in the near future.

The earliest specimens of glass in China thus far discovered include a bronze axe with inlaid glass decoration dated about 1000 B.C. [Taylor 1974:28-9] and beads from tombs at Sian and Chung-chou-lu dated on stylistic grounds of associated bronze objects to at least the 9th or 8th centuries B.C. They may be even a bit earlier, but are certainly from the Western Chou period (1025-771 B.C.). These were small round beads of light green glass found near the heads of the dead. There is no reason to believe that they were imports [Chêng 1963:198-9].

As for historical sources, they tend to concentrate on the lives of emperors and their courts and on military and political developments. The earliest mention of glass only discussed the importation of foreign glass: the *Annals of the Former Han* (*Ch'ien Han Shu*) by Pan Kuh, about 115 B.C. [Needham 1962:105]. Glassmaking in China was suggested in the Later Han period (A.D. 25 to 200) in the *Lun Hêng* by Wang Ch'ung when describing lenses, a work which we shall discuss in greater detail below [Needham 1962:111-2], and about the year 300 by Wan Chen in the *Strange Things of the South* (*Nan Chou I Wu Chih*) [Ibid.:107].

The archaeological record shows that these accounts do not describe the first production of glass in China because it was made nearly a thousand years before these events. China was relatively late in achieving glassmaking, even though as a civilization it was no less developed than areas which produced glass much earlier; the tardiness of its glass production must be ascribed to other causes.

It has been suggested that the Chinese had little need for glass. Objects commonly made of glass elsewhere were traditionally of other materials in China: jade was favored for ornaments, ceramics for vessels, and oiled paper for windows. These substances were preferred to glass for aesthetic reasons [Ayers 1965:17-8]. This argument carries some weight. At least as regards vessels, the Chinese always favored ceramics over glass; as a result "[they] have always been comparatively careless in the manufacture of glass. . . ." [Bushell 1914:2 61]

The relationship between glass and jade in China is especially important. Chinese glass often imitated the most precious of stones. So widespread was the substitution of glass for jade that many ancient objects initially classified as jade have since been discovered to be glass [Chêng 1969:255]. As a jade substitute, glass has several advantages. When produced in quantity, it is much cheaper than jade. It is also softer than either jadeite or nephrite (the two minerals which are considered jade), and therefore easier to work [Liu 1975a:10]. Modern scholars often regard glass jade imitations as inferior objects, but this is an anachronism; in ancient China glass was highly valued.

A case in point is the flat perforated ceremonial disc known as *pi*. Large ones were put on pillars and small ones worn at the side of the owner [Harada 1962:58]. The earliest written records of Chinese glass are to glass *pi*. Ki Pin wrote about a *pi liu li* (glass *pi*) in 114 B.C. [Taylor 1974:27]. At about the same time, *liu-li* was used poetically to mean a glassy radiance [Needham 1962:104-5]. An inscription on the 2nd century tomb of Wu-liang shows a glass *pi* and is variously translated as, "[Glass *pi*] come to the hands of a king who does not try to conceal his own faults," or "When the sovereign does not commit secret faults, it [the *pi*] will arrive." [Harada 1962:60; Engle 1980a:41] Thus, a glass object was worthy of rewarding a king for his virtue.

The name for glass in Chinese has undergone change over time. The word *liu-li* was used first. Associated with the *pi*, it occurred in the the *Shou-won* (ca. A.D. 100); Tuan Yu-ts'ai, an 18th century editor of this book indicates that the word is Western Asian in origin [Hirth and Rockhill 1911:227 n.]. Some writers believe that the term is a transliteration of the Sanskrit *vaidurya*, generally thought to mean lapis lazuli [Bushell 1914:2 58; Hirth and Rockhill 1911:227 n.], while others doubt this etymology [Chakravarti 1972:102]. Needham points out that *liu-li* is phonetically two radicals meaning "to flow" or "to fuse" and "jade," hence, "fusible jade" [1962:104 n. d]. Somewhat later, the word *po-li*, whose derivation is uncertain, came to be used for glass. It is generally thought that *liu-li* refers mostly to opaque (jade-like) glass, while *po-li* refers to translucent glass [Hirth 1885:228-230; Honey 1937:212, n. 3; Needham 1962:104]. The complex and double origin for Chinese glass (foreign and domestic), indicated by the very words used for it, is typical of the subsequent story of Chinese glass [Needham 1962:106].

The Origins of Chinese Glass

Several possibilities have been advanced for the origin of glass in China. One postulates that it developed as an offshoot of the glazing of pottery, since glaze is in fact a thin layer of glass. The earliest Chinese glazed pottery has been found at the Shang capital of An-yang, occupied from 1384 to about 1085 B.C. [Chêng 1960:4-5]. Chemical analyses of this glaze show it to contain 72 to 75 % silica and 14 to 19 % alumina [Chêng 1963:204]. This indicates that it was a felspathic glaze, while true quartz glazing did not appear until the late Chou period (5th to 3rd centuries B.C.) [Hobson 1915:8-9].

In the late Chou or Chan-Kuo (Warring States) period, three types of glazes were in use: the hard green felspathic glaze, a soft green lead glaze, and a blue glaze for certain beads, perhaps in imitation of blue

glass. The latter two were developed in that period [Chêng 1963:215]. Some ceramics of Chou China are glazed only on the top, indicating that glazing was done by agitating the fire and depositing a film of ash on top, which acted as a flux to bring out the quartz of the clay and form a glaze [S.E. Lee 1964:49-50]. There are also several soft clay jars decorated with glass inlays set into the clay known [Taylor 1974:27].

Therefore, as tempting as it may be to associate glass origins with glazing in China, the archaeological record indicates that glass was produced before quartz glaze was employed. The use of glass beads or inlays set into clay and the glazing of faience cores (perhaps to imitate glass) also suggest the primacy of glass over quartz glazing.

The arts of metallurgy, in particular copper smelting, are often cited as origins for glassmaking in the Middle East. Although there are uncertainties about this as an origin for glass, the relationship between metallurgy and ceramic technology (including glass) cannot be denied [see Brill 1963:120; Biek and Bayley 1979:3]. The ancient Chinese were thoroughly familiar with copper and bronze technology by the time they first began to make glass.

Another origin for Chinese glass has been proposed: a result of the search for the elixir of life. Taoists employed alchemical methods in their work, and among their concerns was the manufacture of artificial gems. A description of this work by Wang Ch'ung, an alchemist of the first century A.D., says:

The Tribute of Yü speaks of bluish jade and *lang-kan* (possibly agate, ruby, or coral). These were the products of the earth, and genuine like jade and pearls. But now the Taoists melt and fuse five kinds of minerals and make 'jade' of five colours out of them. The lustre of these is not at all different from that of true jade. Similarly, pearls from fishy oysters are like the bluish jade of the Tribute of Yü; all true and genuine (natural products). But by following proper timing (i.e. when to begin heating and how long to go on) pearls can be made from chemicals, just as brilliant as genuine ones. This is the climax of Taoist learning and a triumph of their skill.

[Needham 1962:112; a few interpolations have been omitted]

The passage clearly refers to glass production for making artificial jade and pearls; the artificial pearls can be nothing other than glass beads. There is a scholarly controversy over the phrase, "by following the proper timing" (*Sui hou* in Chinese). Early commentators took this to mean "the Marquis of Sui" (in Hupei) who owned pearls. Harada read *Sui hou* as the name of an alchemist who could make artificial pearls, or alternately as a place where such beads were made, and suggested Seleukia, Syria, or the Syrian Seleukos dynasty [1962:59]. Needham has discussed the problem at length. The term *Sui hou* may mean either the Marquis of Sui or "following the (fire-)time," and he believes it is a pun [1962:112 n. a]. The passage does not otherwise indicate foreign influence, though it is still possible that Sui is an alchemist.

It is by no means certain that glass in China developed from the search for the elixir of life, pottery glazing, or copper smelting. These imply indigenous roots for glass in China. The claims of a local origin is strengthened by the chemical evidence which shows that most

early Chinese glass is lead glass, usually with barium as an added ingredient. Lead was a rare glass ingredient outside of China at this time. Although a Babylonian chemical text of 1700 B.C. calls for lead in glass [Turner 1956a:47T], lead glass is rare in the Middle East or Europe before or during the time it was used in China except as a trace [Turner 1956b:175T] or in certain strong colors, especially for enamels [Biek and Bayley 1979:11-17; but see Henderson and Warren 1982].

It is also possible that glass technology was imported into China. Early historical texts state that glass came to China from India and/or Syria. However, these texts refer to periods which are too recent to figure into the debate on the first introduction of glass. Engle believes that glassmaking was brought to China by nomadic craftsmen, successors to the Hurrians who came from Central Asia in the Middle or Late Chou periods. Iron and gold, Scythian motifs in bronze objects, and possibly related motifs on early glass beads are cited as evidence for this position [Engle 1976], which has been called interesting but likely unprovable [Liu 1985a:34].

The importation of glassmaking technology into China leaves the question as to why the Chinese relied so heavily on lead glass, while other glassmaking centers of the world did not use it. Perhaps soda-lime glass was introduced from outside, and the Chinese independently recognized the utility of lead glass, possibly because of their early use of lead glazes [Caley 1962:89-90].

In conclusion, there is not yet enough archaeological or historical evidence to pinpoint the origins of Chinese glass. It may have developed as a by-product of metallurgy or ceramics, or have been an alchemical discovery by a Taoist looking for the elixir of life. Both Taoism and the glazing of ceramics post-date the introduction of glass, however. The technology may also have been introduced by other peoples, the Indians, Hurrians, or other neighbors. The early dates for some Chinese glasses and the wide use of lead glass suggest, but do not prove, a Chinese origin. Modern Chinese scholars are inclined to accept an indigenous origin for glass but the question remains open.

As a last consideration, we may forgive the Chinese scholars who failed to mention glass and who almost never described glassmaking procedures. It must be recognized that this was simply not part of their job. Their concerns lay elsewhere. They rarely described native products of any type, much less manufacturing techniques. Glass is not alone in this regard; even silk was largely ignored by the ancient Chinese scholars, despite its great importance [Yetts 1934:732].

SECTION TWO:

THE CONTINUITY OF CHINESE GLASS BEAD PRODUCTION

Introduction

One of the problems in understanding the history of Chinese glass beads has been the lack of data indicating whether they were produced for any length of time. Two well known groups of Chinese glass beads have been the subjects of several studies: late Chou-early Han beads, similar to those from Loyang, and ones made in the last century or so. Because glass objects of all kinds are scarce, there is a widespread assumption that China simply did not produce glass beads in other periods. This assumption is incorrect.

It is possible to cite evidence for the production of glass, and often of glass beads, throughout Chinese history from about the 9th or 8th century B.C. The evidence is scanty, to be sure, but enough exists to show that glass was always produced in China and that beads were one of the products commonly made from it.

A problem we face in tracing glass and glass bead production is that it was always a minor material and its production was never of great importance. Lamm was probably correct when he asserted that people who excelled in the making of ceramics seldom were very skillful at making glass [1939:2593]. Why this should be so is difficult to say, but we have already noted that many objects which we take for granted to be made of glass, such as vessels, windows, and beads, were more commonly made of other materials in ancient China.

In this section we consider the evidence for glass beads and production through Chinese history. In the following section we shall detail the production of beads as is known at particular periods.

The Chou Period (1025-221 B.C.)

We have already noted that the earliest glass excavated in China can be dated from the Western Chou period, or at least the 9th or 8th century B.C.: an inlaid axe and small light green beads found in graves at Sian [Chêng 1963:58-9] and at Chung-chou-lu [Ibid.:96]. Eastern Chou (ca. 771-453 B.C.) graves at Chung-chou-lu had beads which were apparently polychrome and described as, "two glass beads composed of three colors, light green, copper brown and blue" [Ibid.:100]. Other contemporary glass beads were found in burials at Kou-tung [Ibid.:51].

Glass objects were also excavated at Shang Ts'un Ling in the Huangho (Yellow) River Valley. This was a city of Kuo, a small principality destroyed by the rising power of the Chins in 655 B.C. [Lin 1978:15]. Unfortunately, no full report on this find is available in a Western language, so it is not possible to tell what sort of glass this was.

Beads of glass became quite common during the later Chou dynasty -- the Warring States (Chan-kuo) period beginning 453 B.C. -- and have been found at sites all over China. Often they are not well described, but their distribution and numbers indicate that they were not uncommon. From this period they have been found at Shih-chuang-t'sun and Chia-k'e-chuang in Hopei, Changsha in Hunan (numerous at this site), Kou-

MAP ONE



MAP OF CHINA
Showing Modern Provinces
(Conventional form of name followed by Pinyin)

- | | |
|--|----------------------------|
| 1. Sinkiang or Hsin-chiang-wei-wu-erh [Xinjiang-Uygur] | 15. Liaoning [Liaoning] |
| 2. Tibet [Xizang] | 16. Hopei [Hebei] |
| 3. Kansu [Gansu] | 17. Peking [Beijing] |
| 4. Chinghai [Qinghai] | 18. Tientsin [Tianjin] |
| 5. Inner Mongolia [Nei Monggol] | 19. Shantung [Shandong] |
| 6. Ninghsia Hui [Ningxia-Hui] | 20. Honan [Henan] |
| 7. Szechwan [Sichuan] | 21. Kiangsu [Jiangsu] |
| 8. Yunnan [Yunnan] | 22. Anhwei [Anhui] |
| 9. Shensi [Shaanxi] | 23. Hupeh or Hupei [Hubei] |
| 10. Shansi [Shanxi] | 24. Hunan [Hunan] |
| 11. Kweichow [Guizhou] | 25. Kiangsi [Jiangxi] |
| 12. Kwanghsi-chuang [Guangxi-Zhuang] | 26. Shanghai [Shanghai] |
| 13. Heilungkiang [Heilongjiang] | 27. Chekiang [Zhejiang] |
| 14. Kirin [Jilin] | 28. Kwangtung [Guangdong] |
| | 29. Fukien [Fujian] |
| | 30. Hainan [to Kwangtung] |

PLATE ONE



Figure One: Two elaborate flush eye beads, late Chou. The originals are in the Toledo Museum of Art, about 2.2 cm. in diameter. After Blair 1951:347.

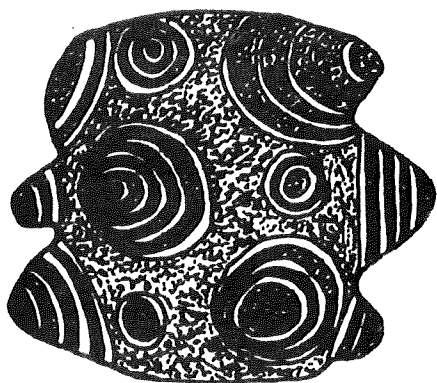


Figure Two: A horned eye bead, late Chou. The original is in the Royal Ontario Museum, Toronto, about 2.2 cm. diameter. After Blair 1951:348.

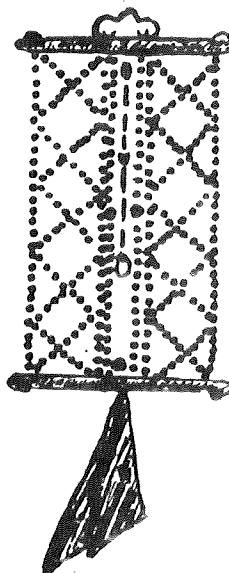


Figure Three: A bead seller's sign c. 1920. Signs displaying a store's goods were placed in the street in Chinese cities; this one is of a glass bead seller. Many of the beads came from broken up court chains; they were green, yellow, blue, red, and black. In the center is a pendant held by long tubular (drawn?) beads. After Crane 1926: No. 41.

tung and Pan-p'o-ts'un in Shenshi (green beads were found at the latter site), Shao-kou and Erh-li-kang in Honan near Loyang, and Yang-tzu-shan in Szechwan [Chêng 1963:44, 53, 64, 101, 111, 125, 168, 173].

Also from late Chou times, Ku-wei-ts'un in Honan yielded glass beads and small inlays placed on the inside of a coffin and held in place by a thick layer of lacquer. They were described as glass "flakes" with composite eyes in blue, purple, white, and green. In the same burial chamber a niche in the northern wall contained a large hoard of jade ornaments, including one bead, and 56 glass beads [Ibid.:86-8].

In Szechwan at Chia-shan-chai the slate tomb burials typical of the Li-fan culture (500 to 100 B.C.) contained some unusual beads which have been described in some detail. Among them were translucent blue, bubbly glass tubes, even in size, but with sharp rather than smooth ends. Chêng reported that "Traces of grinding and drilling [were] observed," and thought they may have been ground to shape and bored with a tapering drill [1963:178]. In 1946 he also reported flat oval beads he referred to as having cowrie-like outlines made of the same glass (although the mollusc identified as a cowrie in plate VIII.2 was clearly a cockle-like bivalve). There were also better made brown discs produced four to five in a series and later cut apart. The glass had no barium, and he concluded that the beads might be Western in origin. However, the unusual manufacturing technique (if described correctly) might suggest local production [Chêng 1946:72; 1963:178-80, 198].

In addition to beads, typical Chinese objects (dragons, cicadas, and pi) of glass have been found from the Warring States Period and later. These virtually prove that indigenous glass was known at this date in China [Needham 1962:102]. At a recent symposium it was asserted that glass was independently invented during the Chan-kuo (Warring States) period [U.P.I. 1984]. The archaeological record confirms this or even an earlier date for Chinese glass. We may be at the beginning of an important new chapter in the history of glass in China.

The Glass Finds at Loyang

In the 1930s a revolution in the opinions of Chinese glass occurred as tombs near the ancient capital of Loyang, near modern Honanfu in Honan province, drew attention. Though some earlier writers had maintained that Chinese glass was more ancient than was thought [Mueller 1930], this material convinced everyone. The glass from royal and noble tombs around Loyang was astonishing in its variety and workmanship. Bishop White, who catalogued the material, correctly predicted: "From the evidence of these finds it is abundantly clear that current opinions as to glass in ancient China will have to be revised." [White 1934:148]

And so they have been. Unhappily, though opinions have been revised, there is no scholarly consensus on the date of this material because it was not scientifically excavated. The beads were found by villagers, as have some later finds of similar beads [Karlbeck 1955:pl. 63], and controversy has never ceased concerning their age. (Plate One: Figs. 1, 2)

Loyang has long been an important city in Chinese history. Off and on, it was the capital of China from about 770 B.C. until A.D. 960. It has also long been celebrated for its charms. The Emperor Ch'ien Wen-ti in the 6th century wrote a poem to Loyang that began:

A beautiful place is the town of Lo-yang:
 The big streets are full of spring light.
 The lads go driving out with harps in their hands:
 The mulberry girls go out to the fields with their baskets.
 [Waley 1964:103]

Some scholars believe the Loyang beads are as early as the 6th century B.C., but that most are from the 4th and early 3rd centuries, [Watson 1963:78]. Yetts thought that they may be as recent as the Late Han, or from the first two centuries A.D. [1934:732]. Watson noted that the eye beads from Loyang have never been scientifically excavated from Han period tombs, leading him to opt for the earlier date [1963:79]. Though similar glass eye inlays on typical Han bronzes have been found [Blair 1951:349], recent excavations do point to a late Chou date for the beads. They have been uncovered from tombs at Changsha, Hunan, and in Kwangtung [Guangdong]; horned eye beads were found at Ku-wei-ts'un, Honan [Guweicun, Henan] [Dohrenwend 1980/1:429]. In Hupeh province, the tomb of a nobleman from 433 B.C. contained some of the smaller eye beads often found with this group [Yoshimizu 1980:95]. These eye beads are distributed from Sinkiang [Xinjiang] to Shantung [Shandong], and from Honan [Henan] to Kwangtung [Guangdong], and seem to center in the old state of Chu (Yangtze Valley) [Dohrenwend 1980/1:429].

In sum, after all of these years, there remains a dispute about the dates for the Loyang material, although a late Chou date now seems most likely. For the time being we shall still date it late Chou-early Han, noting that it represents the finest flowering of Chinese glass beads.

The Ch'in Dynasty (221-207 B.C.); the Han Dynasty (202 B.C.-A.D. 220)

Few artifacts can be dated to the Ch'in period, which was short-lived, even though it gave us the name China for the country. Several graves found at Tung-sun-pa and Pao-lun-yuan in Szechwan with Ch'in dynasty coins contained glass beads and pottery beads with gold (?) and green glazes [Ibid.:175]; they may also have been early Han. A list of the treasures of the kingdom presented to the First Ch'in Emperor included objects which are taken to be glass pi and pearls [Harada 1962:58-9].

Han literary references are few. Nesbitt cited *Mémoires concernant les Chinois* (1770) quoting Han annals saying that Emperor Ou-ti (Wu-ti; 141-87 B.C.) had a glass factory that may have used fern ash, liu-li herb (lieou-li-tsao) [1879a:134-5; 1879b:651]. Ayers could not find this reference (it was only given in full in Nesbitt 1879b), and said that there was probably a misinterpretation of the Han chronicle, *Ch'ien Han Shu*, by Pan Kuh and later members of his family which says glass was imported from Chi-Pin (Gandhara, eastern Afghanistan) and the south [1965:18, n.3]. Why the Han emperors would have sent buyers for glass when China had been making it for centuries is unclear. Needham suggested these were rare objects rather than jade imitations [1962:105]; they may also have been blown vessels, which were not then made in China. On p. 6 we cited the work of Wang Ch'ung who described glass beads and ear reels [Taylor 1974:27] as well as glassmaking.

In Han times jade imitations used for burials became common [Dohrenwend 1980/1:431]. Glass ear reels are found on Han sites, such as Lolang, Korea; they are smaller and were more widely used than in Chou

times [Blair 1951:349; Dohrenwend 1980/1:431; Francis 1985a:10]. As for beads, eye beads from Han tombs in Schezwan have been uncovered, but they were more simple than those from Loyang. Melon beads have been found from the Eastern or Later Han period at Changsha in Hunan, in Kiangshu, and in Honan [Dohrenwend 1980/1:429].

Excavations in Annam in northern Indo-China have uncovered a number of glass beads. The excavator presumed some were locally made; some evidence was cited that glass was manufactured at the time in that part of China [Janse 1947:49-52]. The question of a glass industry in south China in Han times is of interest, and we shall discuss it when we consider the problem of Chinese glassmaking centers in Section Five.

The Three Kingdoms and The Tsin Dynasty (A.D. 220-420)

After the collapse of the Han Dynasty, the rest of the 3rd century was dominated by struggles between three small kingdoms. During this period there are two literary references to glass. The *Wei Lüeh*, written about 264, mentioned only Western glass, marveling at its ten colors [Bushell 1914:259; Needham 1962:107]. At about the same time the Taoist writer Ko Hung, writing as Pao P'u Tzu, who lived from about A.D. 260 to 340, reported that glass was being manufactured in southern China. He wrote, "The 'crystal' bowls from abroad are really made by compounding five sorts of ashes; and to-day this method is being commonly practiced in Chiao and Kuang" (parts of southern China) [Waley 1930-2:13].

China was briefly reunified in the Tsin period, especially under the Western Tsin (A.D. 265 to 317). There seem to be no written records of glass during this period. Archaeologists have uncovered glass beads from a tomb at Fu-kuei-shan near Nanking dating from the Eastern Tsin Dynasty (317 to 420), although no specific information on the types of beads involved is yet available [Rudolph 1978:324].

The Ten Dynasties (420-588)

Two chronicles by Li Yen-shou in the 7th century state that glassmaking was introduced to China about the year 450. *The Northern History (Pei Shih)*, relates that in the reign of T'ai Wu (424-452) of the Northern Wei, traders from Ta-yieh-ti showed the Chinese how to make glass. Although Harada says there was no state by this name [1962:62], it is usually taken to be near the border with India. At nearly the same time, the *Southern History (Nan Shih)* says that during King Wên Ti of Sung's reign (424-54) Westerners introduced glassmaking at his capital of Nanking; they were probably Syrians. [Hirth 1885:230-2].

Since glass beads were found near Nanking in the Tsin Period, as noted above, it is possible that beadmaking existed there before the Sung Dynasty made the city its capital. However, from the end of the Eastern Tsin (420) to the beginning of the reign of Wên Ti (424), when Li Yen-shou said glassmaking was introduced, is not very long.

In the Northern Wei Kingdom, archaeological finds suggest that glass was being produced even before the time the histories tell us that it was introduced. A stone coffin from Tinghsien contained a number of Persian coins which help to date the deposition of the deceased; they were of Yazdegerd II (reigned 438 to 457) and Peroz (457 to 483). The

grave goods included glass, mostly opaque. Among the objects were strings of beads and other ornaments and glass vessels of distinctly Chinese design, including a *po* bowl and *p'ing* vessels [Rudolph 1978:308]. The only glass beads found were two relatively large (2.0 cm. and 1.7 cm. in diameter) ribbed blue "melon" beads described as pierced, and a hollow gourd-shaped ornament, presumably blown. The tomb has been dated to 481 [Pinder-Wilson 1970:67].

The *Northern History* relates that the Emperor T'ai Wei (424 to 452) had outsiders make glass and build him a portable glass palace which held 100 people. The history commented, "After this, articles made of glass became considerably cheaper in China than they had been before and no one regarded it as particularly precious." [Needham 1962:108]

Bushell has commented on these sources: "The glass industry, established. . . in two widely separated localities, has been carried on with indifferent success ever since, and many notices of the craft might be cited from the native encyclopedias." [1914:2 60] We are unfortunate that he did not choose to cite these many references; they may well have given us a fuller picture of this period.

In any case, it appears that glassmaking and glass beadmaking were found in both southern and northern China at this time, and there is archaeological evidence for production a bit earlier at Nanking.

The Sui Dynasty (589-617)

The short-lived Sui Dynasty was a brilliant episode in Chinese history, in many ways prefiguring the succeeding T'ang. The *Northern History* claims that glass was revived during this time: "By the time of the Sui there had been for a long time no more glass-makers and no one dared to attempt it. But Ho Chhou [Ho Ch'ou] succeeded in making it like glaze on pottery and it was the same as of old." [Needham 1962:109]

If glass had been as commonplace as we have been led to believe in the preceding period, the absence of glassmakers by the time of the Sui does not seem likely. However, the turbulent period between the Tsin and Sui dynasties may have accounted for the disappearance of glass-making skills at least in some areas. It is clear that glass was not a major product of Medieval China, particularly between Han and T'ang times [Blair 1951:349], and that we are dealing with the "dark ages" as far as glass is concerned. That Ho Ch'ou could "reinvent" glassmaking by employing glazing techniques indicates that the art had not been entirely forgotten, but was in abeyance, at least in the the north.

The T'ang Dynasty (618-906)

The T'ang Dynasty was one of the more successful periods of Chinese history. A number of glass objects have been found dating from this time, and glazing was a lively art. Unfortunately, data on beads as such is very scanty.

T'ang glass ornaments include molded glass hairpins topped with butterfly, cloud and flower motifs, and metal hairpins decorated with glass inlays. There are also bracelets with coiled bodies of two dragons facing each other holding a sacred jewel between them.

Pendants, buttons, and small ornaments, many of them light in weight and delicately colored, are also recorded. Some glass vessels in the Japanese Shosoin treasury have been ascribed to T'ang China, but this ascription is not universally accepted [Blair 1951:350].

Several literary references to glass in the T'ang period exist. Chang Yüé in *Liang-ssü-kung-ki* reported on glass mirrors brought from Fu-nan [Indochina]. Presents of red glass from Fu-lin [Syria or west of Syria] (643) and Tokharestan [Northwest Afghanistan] (742) are chronicled in the *T'ang Shih* [Hirth and Rockhill 1911:227-8 n.]. The manufacture of Chinese glass was noted by Yen Shü-ku, a 7th century commentator on the *Han Shu*. He reported that it was bubbly and brittle and not as clear as its foreign counterpart [Ibid.:227-8 n.].

The archaeological evidence for T'ang period glass has been reviewed by Pinder-Wilson. The only beads he mentioned were the two melon beads from the pre-T'ang site of Ting Hsien in Hopei we discussed on p. 12 [1970:67]. In addition to the 11 excavated pieces of T'ang glass he discussed, some other T'ang glass objects are known or suspected. An "opaque glass-like vase containing 14 sarira relic beads [made from the bones of the Buddha]" was uncovered from a stone coffin at Ching-Ch'uan County, Kansu [Rudolph 1978:349]. Some Chinese glass ornaments at the Toledo Museum of Art were identified some years ago as T'ang: an imitation carnelian ring (#26.29) and two beads: a clear wound one and a slightly barrel translucent green bead which had been drawn and pinched off from the tube (#26.31, 26.36) [Laufer 1929].

Needham commented that the general impression of the glass industry during the first millennium A.D. in China is that local production ran parallel to foreign manufacture and importing. The ancient Chinese scholars apparently felt that only the foreign imports were worth noting, and we are left in the dark about local production. He also stressed that Chinese production was "often distinctly localized," and that here and there it had to be revived from time to time [1962:111].

The Five Dynasties (906-959); The Sung Dynasty (960-1279)

During the Five Dynasties Period there is slight archaeological evidence of glass beadmaking. A tomb which contained grave goods characteristic of the time and region was excavated near Ch'angsha, Hunan. These included colored glass beads, apparently of recognizable Chinese style [Rudolph 1978:391].

The Empire was once again united under the Sung, but this unity was not as strong as under the Hans or T'angs. Late in the period only southern China was controlled by the Sung as the Mongols of the north grew in strength. This period has been summarized as one of "political weakness but cultural brilliance" [Latourette 1964:175].

In the 12th century we have several literary references to glass-making in China, some of which are informative because they tell us about the processes used or the Chinese attitude toward glass. In 1133 the *Cloud Forest Lapidary* (*Yün Lin Shih Phu*) described glassmaking near Kaifeng: "At the western capital, in the Lo River, they find pieces of bluish white stone with spots of five colours in it. The whitest of these are compounded with lead, and mixed with other minerals, then

after heating it is all changed into "false jade" or *liu-li* glass for use." [Needham 1962:109] The nature of the stone used here remains an enigma. Although bluish-white chalcedony could have survived rolling in a river bed, the spots of five colors are rather mysterious.

Chau Ju-kua wrote in the *Chu-fan-chi* in the 12th or 13th century that the Chinese made opaque glass by burning oxide of lead, potassium nitrate, and gypsum [Hirth and Rockhill 1911:227]. Both this and the preceding reference described lead glass. This strikes one as unusual because, although small amounts of lead glass have been found which were made after the Han period, most post-Han glass is of the silica-soda-lime type, and not lead glass.

The Muslim traveler, El Idrisi, in 1154 mentioned glassmaking in his chapter on China saying, "Djan Kou is a celebrated city. . . the Chinese glass is made there." Unfortunately, Djan Kou has not been satisfactorily identified [Jenys 1965:130], although Hirth and Rockhill suggested that it was Khanfu, that is, Hangchow [1911:228 n.], an important manufacturing and exporting center, with a large jewelry trade. Hangchow was the capital of China during most of the Sung period [Gernet 1962:85-7].

The Chinese observed differences between their local glass products and those from outside. In 1175 the *Yen Fan Lu* said, "The *liu-li* which is made in China is different from that which comes from abroad." [Needham 1962:110] In the next century, Chau Ju-kua said Western glass was not merely different from but superior to the Chinese product [Hirth and Rockhill 1911:227]. In both of these cases, the fact that differences are noted show that glass was made in China at that time.

In addition to human ornaments, one important use of glass beads in China was for the decoration of lanterns, particularly for use during the Festival of Lanterns in the middle of the first month. The finest were from Soochow made of glass [Gernet 1968:188]. The decoration of Chinese lanterns in our time consists mostly of plastic beads, but they echo those of an earlier age when the beads were made of glass.

Among the archaeological finds during the Sung period, tombs in Kwangtung have yielded glass copies of the popular jade flowers. These ornaments were perforated and generally sewn onto clothing. The glass petals and leaves had been cast into shape and then carved by lapidary techniques. Also found were glass hair pins [Chêng 1969:296-7]. Some glass objects once attributed to the Sung are now known to be from the 17th or 18th centuries [Jenys 1965:127-8].

The Yüan or Manchu Dynasty (1260-1368)

The fall of the Sung Dynasty marked the first time that China came to be ruled by foreigners. The advance of the Mongols culminated in the establishment of the Yüan Dynasty by Kublai Khan. Medieval Europe formed its first impression of China from the reign of this Emperor, as he was the patron and friend of Marco Polo.

The Yüan, like the Sung before them, were greatly interested in commerce, and their trading activities extended to Arabia, Persia, and Central Asia, Java, India and Ceylon. Chinese engineers were employed in the construction of canals along the Tigris and Euphrates, and there were Chinese colonies in Moscow, Novgorod, and Tabriz. Marco Polo often commented on foreign ships and foreign traders in various Chinese

ports; the majority of them were from India. The trade was unfavorable to China's balance of payments; copper and silver were drained from the realm [Latourette 1964:215-6].

During this time we know little of glass beads, though it is certain that China was making glass. Marco Polo was not interested in beads, although he often noted precious stones. He only mentioned glass once when describing Kublai Khan's summer palace: "The glazing of the windows is so well wrought and so delicate as to have the transparency of crystal." [1953:128] It was apparently better glass than he had seen even in his native Venice, an important glass center of Europe.

There is a popular story that Marco Polo brought the art of glass beadmaking with him back to Venice from China. However, the story was only an invention of a Venetian pseudo-historian named Rizzi in the early 19th century [Zecchin 1955:5-17]. Marco Polo had no more to do with the introduction of glass bead technology to Venice than he had with the debut of playing cards or pasta to Europe, both also ascribed to him by various authors.

A new use for glass was introduced to China during the Yüan dynasty: the art of cloissoné enamel. This consists of soldering wires to a metal surface to form small partitions (*cloison* in French), and filling the resulting cells with a powdered glass paste. Then the object is heated to melt the glass into place. Finally, it is smoothed and polished. Often more than one filling of enamel is required because of shrinkage during the firing process; in China the exposed wire cell walls were commonly gilded.

The process was apparently introduced from Byzantium during the Yüan period, although it did not reach its height until Ming and Ch'ing times [Latourette 1964:220]. The Chinese for enamel, "Fa-lan," is their name for Byzantium [Swann 1963:189]. The earliest surviving piece of Chinese cloissoné enamel dates from the reign of the Ming emperor Hsuan-te, 1426 to 1435 [National Palace Museum n.d.].

The Ming Dynasty (1368-1644)

The Mings re-established Chinese rule in the Middle Kingdom. The term "ming" means "brilliant" or "glorious," and to some extent the dynasty fulfilled its implicit promise. Among the fine arts, the period is best remembered for the excellence of its porcelain and enamels [see Liu and Loh 1979]. Glass was not among its highest achievements.

We have notices of Chinese glassmaking in the late Ming Period, especially from Jesuit priests, who played an important role in the glass history of China. Father Matteo Ricci, who lived in China from 1583 to 1610, wrote in a letter home that, "At the present time they [the Chinese] are making glass, but very inferior to ours." [Ayers 1965: 21] In his diary he praised porcelain highly, then commented, "These people have also acquired the art of glass blowing, but their workmanship here falls far short of what we see at home." [Gallagher 1942:23; 1953:15] After Ricci's death, Nicholas Trigault translated his diaries into Latin on his return voyage from China. When they were published in Europe they caused a sensation, opening European eyes to China, establishing that Cathay and China were one and the same, and bringing China into the realm of reality (Marco Polo was widely dis-

believed). It was once thought that the first book of Ricci's diaries was actually written by Trigault [Gallagher 1942:v], but it is now recognized as being entirely Ricci's work [Gallagher 1953:xviii].

A few years later, Martinus Martini, who was in China from 1643 to 1661, wrote in his description of China, *Novus Atlas Sinensis* (1655), "They have long since learnt to make from rice a wonderfully clear glass, which is however liable to crumble, and is certainly not to be compared with ours, yet comes very near to it." [Ayers 1965:21]

The phrase, "liable to crumble," was written *sich zerreiben läst*. Ayer points out that an alternate rendering of this phrase is "can be ground," which he says seems unacceptable in this context [Ibid., n. 18]. However, the alternate phrase does make sense when we recall that one of the more important ways in which the Chinese have treated glass was by lapidary techniques:

It is in carving that the Chinese have been at their best in their use of glass; for this they have brought the technique acquired in the cutting of the stones and gems with which they have long worked. Here they have shown craftsmanship equal to the best of its kind in any other part of the world. [Latourette 1964:634]

Martini's comment that Ming glass was made from rice requires some consideration. Although it is possible to make glass from rice, due to its high silica and ash content, this fact is not mentioned by any other writers on Chinese glass [Ayers 1965:21, n. 17]. Hence, it is difficult to form any definite opinions about this, although chemical analyses of late Ming glass may eventually solve the riddle.

What objects were made of glass during the Ming Dynasty? From a Chinese writer, Sun Ting-ch'uan, who lived at the close of the Ming Period in the mid-17th century, we learn that glass was often used to imitate precious materials. He mentioned amber cigarette holders made of glass, and he also said that jade ornaments, which we know have been made for a long time in China, and carnelian jewelry or beads were being simulated with glass [Jenys 1965:136].

The Ch'ing Dynasty (1644-1911)

It is during the reign of the Ch'ings, the last dynasty before the establishment of the Republic, that we have our fullest accounts of Chinese glass and glass beadmaking. We shall not discuss the details of production here, as it will be covered in Section Three.

Under K'ang-hsi, the brilliant second Manchu Emperor, it is reported that 27 workshops connected to the Imperial Household were established, including one for glass. They were devoted to producing Western-style products, and many of them were directed by Jesuits. The opening of the workshops reflected the influence on K'ang-hsi of the Jesuits. It seems "extremely probable" that Ferdinand Verbiest (1623-1688) was made the administrator of the royal glassworks [Bushell 1909:61-2].

Our information about the workshops comes exclusively from Bushell, an accomplished Chinese scholar who lived in Peking for 30 years. Bushell did not cite any references for this information, presumably because it was in Chinese and he listed no Chinese sources in his two volume work, written for general readers. Nonetheless, Bushell's word

has been taken as absolutely authoritative on the subject [Warren 1977: 87 n. 7]. From that standpoint, later scholars have identified vessels made in the Imperial Workshops [Honey 1937; Ayers 1965:22], and the role of Verbiest, now assumed to have been positively identified as the director of the glass workshops, has been elaborated [Engle 1980a]. As important as the workshops are to the history of Chinese glass, it would be gratifying to learn more genuine details about it rather than this relatively tenuous thread that so much has hung upon. Although there is no reason to question Bushell's scholarship, it seems strange that other sources (except perhaps Macartney, see below) do not mention the 27 Imperial workshops [Hibbert 1941].

Aside from the Imperial workshops, which probably produced few if any beads, there is abundant evidence for the production of beads at Poshan (modern Boshan) in Shantung Province, just south of Peking. It has several advantages for being a glassmaking center, including abundant good quality quartz pebbles and an important coal industry; railroads were also built there early [Jenys 1965:136].

Poshan has long been the center of glassmaking. Several visitors a century or so ago described its activities, which included the making of beads. Williamson in 1870 was the first, and his description was quoted at length by Bushell [1909:61-2; Warren 1977:101]. Others accounts were published in the *North China Herald* for 27 January 1903 [Warren 1977:102], and by Ferguson [1972:126-7]. Glass beads are still made there today, though apparently on a reduced scale and primarily for sale to minority peoples [Kan and Liu 1984]. We shall describe the beadmaking at Poshan and elsewhere in more detail in Section Five.

In the late 18th century Lord Macartney, England's ambassador to China (1793-4), made the startling statement that "There was formerly a glass manufactory established at Peking [sic] under the direction of some of the missionaries, but it is now neglected and no glass is made in China." He went on to say that only in Canton was European glass pounded and remelted to be blown into large "balloons" to make into small mirrors and a few toys: "they do not seem to understand the manufacture of glass from the crude materials, nor to know exactly what they are. The glass beads, and buttons of various shapes and colours, are imported to them from Europe and chiefly from Venice." [1963:299]

Macartney's short stay in China prevented him from seeing many of the factories of the most important products he discussed: "I had no opportunity of seeing the manufacture of the china porcelain There are mines of rock salt in some of the provinces, but these I did not see . . ." [Ibid.:298-9]. While there is no reason to doubt his account of glassworking in Canton, which he certainly visited, it seems likely that he missed glassmaking and beadmaking elsewhere. Only a half century before, Father Du Halde reported on glass made at Yen-ching; Ayers has identified the town as Poshan [1965:21-2]. A century later Poshan was flourishing and Canton was also manufacturing glass: "The importation of broken glass for remelting has entirely ceased...." [S.W. Williams 1895:21].

SECTION THREE:

THE MANUFACTURING OF CHINESE GLASS AND GLASS BEADS

Introduction

We shall now consider Chinese beads and other glass products in terms of the techniques used for their manufacture. The production of glass itself will be surveyed in the next section when we discuss analyses of Chinese glass. Because we lack details on beads from the Chou period, save the rather peculiar methods described for those from the Li-fan culture (p. 9) we shall begin with the beads from Loyang.

The Beads from Loyang

Beads and glass inlays in a number of colors were discovered at Loyang. Opaque bright green, black, white, light blue, and a yellow which sometimes weathered to orange were found along with translucent deep blue, commonly used for the body of the eye beads, and a pale green [White 1934:154-7; Blair 1951:347-8].

The initial classification of these beads was made by Seligman and Beck, who divided them into three groups. Class A, Group 1 (A1) are monochrome beads with no added decoration, including those molded or incised into various shapes. Class A, Group 2 (A2) is for beads with applied patterns such as eyes. Class B beads have composite structures made of a quartz or glass faience core and a glazed surface. These were often elaborate in design, sometimes with knobbed eyes [1938:19].

The monochrome glass objects (A1) include medallions and plaques, some pendants, pi discs, and a number of inlays. Small disc beads, mostly of white and green, and a number of small melon beads of various but unreported colors were also found. [White 1934:147-58; Liu 1975a].

The most spectacular beads found at Loyang and related sites are the polychrome eye beads (A2 and B). They come in great varieties, and the best among them are some of the most complex beads ever made anywhere. Some eye beads of Western provenance have been found in China [Liu 1975:19, fig. 33], and these may have inspired the Chinese to produce such beads. However, the Chinese eye beads are of a distinctive and unusually elaborate style and are unmistakably native products.

One characteristic of these eye beads is what White called the "revolving eye," formed by the slight offset of the "pupil" [1934:147]. Revolving eyes are sometimes seen on Western beads as accidental by-products of manufacture. The Chinese, however, seem to have made them purposely; on a given bead they are all offset in the same direction.

Another trait that distinguishes Chinese from contemporary Western eye beads is that they frequently have rows of tiny dots, fine lines, or dots on lines connecting the eyes. The designs on Chinese eye beads are extremely elaborate, and very little surface area is left plain [Liu 1975a:11].

The eyes used on a single example of one of these beads has been classified into four types by Blair [1951:347-8]:

- 1.) circular eyes at the four corners of yellow lozenges,

2.) a large blue pupil surrounded by white, always wider at the same side, that is, a revolving eye,

3.) complex circular eye made of four layers of blue and three of white, and

4.) a rosette of six revolving eyes surrounding a white spot.

The description of only one of these beads indicates how complex they are; this list by no means exhausts the styles found on the whole group of these eye beads.

The most unusual beads are those of compound or composite construction consisting of a core and a glazed surface (Group B). The core is made of glass or quartz particles which have not been fused but sintered, that is, melted together only where they touch. The surface is nearly always elaborately decorated, usually with eye designs. Another unique feature of these beads is that many (if not all) of them have one or two fine gold threads in the core surrounding the perforation. It seems rather unlikely that the customers for whom the beads were made did not know about the encased gold, since it serves no decorative or practical function. It has been suggested that the wires were magical in intent, especially since gold was believed to insure long life in China [Seligman and Beck 1938:40, 44].

Rosettes (six spots surrounding a central spot) were common devices on many of the eye beads. The rosette has been stylistically linked to Western glassmakers and its use in China put forward as evidence of the people who brought glassmaking to China. Engle has perceived a relation to rosettes in the Middle East, especially as a symbol of the Earth Goddess of Elam (modern Iran). She argues that the motif and the knowledge of glassmaking were brought to China by the Hurrians [Engle 1976:5-15; 1980a:42-46]. However, this connection and the importance of the rosette remain to be proven. The Chinese recognize the same device as the *sitiyo* or "seven suns" [Ukai 1984:5].

The most enigmatic objects in terms of function are spool shaped glass tubes with flaring ends and a central perforation. White identified them as ear ornaments, either put into pierced lobes or suspended by a string passing through their hole [1934:158]. Seligman and Beck called them "spool" or "capstan" beads [1938:19], but White has been proven correct. Similar ornaments uncovered from burials in Lolang, a Chinese province in northern Korea, were found at the sides of heads, indicating that they were worn in the ears [Blair 1951:349].

Blair distinguished two classes of these ornaments (in Chinese, *erh tang*). One is made of good quality dark translucent blue glass, sometimes stubby but often elegantly long; usually only one end is flared with an even, beveled rim. The others are of lighter blue glass of a lesser quality, often showing much weathering. They have larger perforations, are shorter, and have both ends flared, though often not evenly [1948:199-200]. Liu suggested that the holes through the *erh tang* were not for suspension but produced during manufacture; they may have been wound around a mandrel (a metal rod) like a bead [1975a:10-11]. While that may be true, the holes also served to hold strings which had glass pendants on them [Harada 1962:60-1, fig. 3].

In addition to the beads of Chinese origin, a few appear to have been imports from the West. There are Loyang beads which imitate Western ones: melon beads, long cylindrical beads with chevron or zig-zag designs, eye beads, and horned eye beads [Liu 1975a:11].

Beadmaking Techniques

Glass was worked in a variety of ways to produce the Loyang objects. Many small decorative pieces were molded and apparently perforated while in the mold and the glass was still warm [White 1934:153-4]. Several surface treatments were applied: gilding, decorating with glass of different colors, and even painting, although the yellow, red, green, and black paint is now mostly worn away [Ibid.].

The manufacture of the polychrome eye beads has not been adequately discussed in the literature. There is rarely any mention of how these complex designs were made. Shortly before his death, the Japanese glass bead master, Kyoyo Asao, reproduced some of the early Chinese glass eye beads after studying examples of them. He wound a glass bead on a wire and then decorated it with canes (rods) which he sliced while cold. He put the slices on top of each other to build up stratified eyes and the rosette motif [Ukai 1984:4]. As intricate as some of his creations are, they do not quite match the complexity of the most elaborate ancient Chinese beads. The technique may have approximated the old one, but molten glass may also have been used.

Engle has described the making of these rosette motifs by invoking bundled millefiori or mosaic canes. These are made by bundling cold canes together to make a pattern on cross section, then fusing them and pulling them out to produce long thin rods which would later be sliced and placed onto the bead [1976:12]. However, a close examination of such beads shows that the millefiori/mosaic canes were not used by the ancient Chinese for these decorations [pers. observ.].

Apparently all the beads were wound around a metal rod or mandrel. Blair noticed a white coat inside the perforations of some erh tang and at first thought it was corrosion. When she published this conclusion in the catalogue of an exhibition of East Asiatic Glass at the Toledo Museum of Art, some people attending the exhibit questioned her as to how the erh tang could be corroded inside and not outside. Upon reconsideration she realized that the coating was a powder, put on the mandrel on which the erh tang were made to help the glass slip off the rod after it had cooled. Some contemporary beads had similar perforation deposits [1948:200].

This observation is of great technical interest, as these beads are the earliest recorded examples of mandrel coatings. Such coatings are widely employed today and their use is important in our understanding of the manufacturing of beads [Francis 1983:202].

Beadmaking Between the Han and the Ch'ing Periods

Because we lack data about Chinese glass beads for 1500 years after the Hans it is difficult to say how they were made. Analyses of the glass reveal something about the materials used, as we shall see later, but there is relatively little evidence available for the manufacturing of the beads. We know that small glass objects were often molded, and the carving of glass reached a highpoint during the Ming period.

A small group of beads in the Toledo Museum of Art may be typical products of this period. They were purchased by Edward Drummond Libby in the early 20th century and given to the museum in 1926. Dorothy

Blair, the assistant curator, sent them to the Curator of Anthropology at Chicago's Field Museum, the highly respected Sinologist, Berthold Laufer. Laufer's letter to Blair of 8 April 1929 is on file at the Toledo Museum of Art.

Laufer noted that, "No investigations of the history of Chinese glass have ever been made, and we have to await further material until we can reach definite conclusions [about their dates]." He warned that his ascriptions were tentative; "Please note that the periods I give are controversial and more or less guess work, but nevertheless they are suggestive." [Laufer 1929] With these caveats in mind, and being aware that Laufer gave no reasons for his ascriptions, we can examine these beads for how they were made and how they may represent bead-making techniques in the periods he suggested: T'ang and Ming.

Two beads he considered T'ang in date are small and made of clear glass. One (#26.31) is nearly spherical and was made by winding. The other (#26.36) is slightly biconical and was made from a drawn out glass tube which was pinched to form and detach a bead. Beads made in this way are also known from royal Silla tombs in Kyongju, Korea of the 5th to 7th centuries and were no doubt imported, quite possibly from China [Francis 1985a:13]. This is a distinctive way of making beads and if it were to prove Chinese from this period it would be of great importance to our appreciation of Chinese beadmaking techniques. A pin for the hair made of hollow glass of T'ang date was figured by Salmony [1930:21], but no explanation of how it was made was suggested.

Laufer also identified a molded lion plaque (#26.27) as being Ming. As for two elliptical beads of green and blue (#26.37, 26.38), he said that he had never seen these types of beads from China, and although they might be Chinese, they might also have come from Western Asia.

Glass and Beadmaking at Poshan under the Ch'ing

We are much better informed about how beads were made during the Ch'ing dynasty because of the eye-witness accounts of the process. Some of the techniques are still used today.

Glassmaking at Poshan was described by Ferguson in the early 20th century. First, quartz pebbles were crushed into a fine powder. Then an alkali was added and the mixture fired in furnaces which resembled pottery kilns. These were large kilns constructed of stone and locally fired bricks, some 20 feet (6.2 meters) high with an outer port 15 feet (4.6 meters) and an inner port eight feet (2.5 meters) high. These kilns were used for making utensils and glass bars, while smaller ones were used for remelting the bars and making toys [1972:126]. It must have been these remelting furnaces where women and children made beads; they so dominated the hills around Poshan that a visitor in 1850 said that the area looked as though it were on fire [Chu and Chu 1973:138].

Some objects were made by being cast in iron molds. These may have included beads or other ornaments such as jade imitations; many of them were probably subsequently finished by lapidary techniques.

The glass bars (similar in function to canes in Europe) were shipped to Peking. They were there used as raw material for the finest glass objects [Ferguson 1972:126-7] or to form venetian blind-like windows, "made of thin blue glass rods strung together," as Edkins observed them in Peking in the 1860s [Homel 1937:305].

Beads were also made around Canton. An informant of Chu and Chu recalled that his aunts were engaged in this activity there. They first dipped thin bamboo rods into water in which clay was suspended and after withdrawing them, set them aside to dry. The coating would aid in the removal of the bead after it had been wound around the rod, incidentally leaving a perforation deposit. To make the beads, two people held the bamboo and twirled it as a third allowed molten glass to trail at spot on the stick to build up a bead. After the stick was filled with beads, it was laid on a bed of dried clay to cool. Once cooled, the beads were shaken off into a tub of water, which helped clean them. After the beads had been strung on hempen cords, 100 to the string, they were taken to a contractor, who paid for them and gave the beadmakers another batch of glass with which to work [Chu and Chu 1973:138-9].

Chinese Glass and Glass Decorating Techniques

The colors used in Chinese glass are often considered distinctive, if not diagnostic, although they have been imitated, especially in Bohemia [Liu 1975b]. The translucent colors are said to have a "tinted prettiness," with the opaque colors possessing an "unaccustomed directness." These are contrasted to the norms of Chinese art, though they match the colors of Chinese and foreign enamels [Ayers 1965:18].

Among the translucent colors are clear, dark blue, light and dark green, amber, amethyst, and ruby red. The opaque colors include white, a greenish white resembling jade, yellow, several blues, a soft green, brown, and a "surprising 'boudoir' pink" [Bushell 1914:64-5; Ayers 1965:25-6; Chu and Chu 1973:130-2].

Understanding how the Chinese produced these colors is important because it indicates their skill at handling various ingredients. Among the translucent colors, cobalt was used for the dark blue and a deep purple blue was made from manganese added to the cobalt. In recent times, cobalt was initially obtained from Persia for use on the blue-on-white porcelain, but later the Chinese found deposits of their own, though they were of lesser purity [Swann 1963:183-4]. Turquoise blue needed copper with the addition of large amounts of nitre, found in Shantung province. Copper was also used for some greens, while a grey green and a brownish red were made with iron. Manganese was used for amethyst, and iron (and probably some manganese) for amber. Ruby red was at first made by adding a bit of gold to the glass batch and later by using copper in a special technique employed for that shade [Bushell 1914:64-5; Ayers 1965:25-6; Chu and Chu 1973:130-2]. The clear glass was no doubt made by adding the proper amount of manganese.

As for the opaque colors, most were formed by adding an opacifying ingredient to the translucent colors; for example, opaque pink was made by adding an opacifier to the ruby red. Ayers said that he did not know what the opacifier was [1965:25], but Bushell [1914:65] and the Chus reported that it was arsenic [1973:132]. The Chus also reported that the yellow was colored with antimony [Ibid.].

With these colors the Chinese were able to imitate precious stones. Imitation jade had long been made in China, as well as imitation carnelian and amber. Additionally, lapis lazuli, realgar, and coral

could be simulated with single colors. When colors were combined by being swirled together or layered, malachite, sardonyx, agate, and pudding stone (conglomerate) were mimicked [Ayers 1965:26; Chu and Chu 1973:130].

The combining of colors is an important technique in glassmaking, and the Chinese learned to do it well. Among the methods they used was casing or placing one color over another. These pieces were often worked by lapidary methods in which the top layer was cut or ground away to expose the bottom layer.

One of the more important glasses which the Chinese learned to make was aventurine glass, a difficult process because it requires the colloidal suspension of tiny copper crystals in clear glass. It was first invented in Venice, Italy, and was for some time considered to be an exclusive monopoly of that city. However, Ayers reports a box of aventurine in the Ch'ien Lung style (perhaps late 18th century) [1965:27], and Chinese made aventurine bangles are in the the Muzeum Skla a Bižutérie (Museum of Glass and Jewelry) in Jablonec, Czechoslovakia [cat. no. BS 657; pers. observ.].

The Chinese also learned how to draw thin rods or canes of glass for decoration. Among the products of this art are vessels with latticino glass, a clear glass with opaque white threads often twisted around each other [Honey 1937:pl. IV.A; Ayers 1965:23]. The Chinese also made paperweights. The Chus said they were rare but made in the same way as European weights, that is with millefiori canes [1973:132]. R.W. Lee reported that the millefiori used in Chinese paperweights were larger and of somewhat different colors from those used in Europe [1938:169]. Those which I have seen, including one probably made before World War II and another of current make, do not resemble European canes at all, as they contain a great deal of clear glass as layers in the canes. The millefiori (Italian for "a thousand flowers") used by the Chinese later were molded to shape the designs of the canes.

Another method for making a millefiori-type of decoration was apparently used earlier on beads. This is distinctive, consisting of short lines of colored glass in a tight spiral. These may have been produced by making a ribbon or plaque of glass with longitudinal stripes which was rolled up like a jelly-roll and then sliced cross-wise. Alternately, it could have been produced by building a gather of glass spirally, alternating clear and colored rods of glass. No date has yet been fixed for beads with such decorations, but some antique beads being sold from China in recent years are so decorated.

The molding of glass pendants and other small objects was practiced, and occasionally beads were molded, although most of the final shaping of such ornaments was done by the stonecutting techniques which were used on glass for a long time in China, as we have seen. These techniques reached their zenith during the reign of Ch'ien Lung (1736 to 1796), one of the greatest of all Chinese emperors [Ayers 1965:27-8].

Controversy exists over whether the Chinese ever made drawn beads. The process of drawing beads consists of pulling out (or drawing) a long tube of glass which is then cut into short segments. Often these segments are heated and tumbled to round off the sharp cut ends. It was once thought that the Chinese never made beads in this way, but the evidence shows that they did.

If our supposition is correct about monochrome glass beads being made in T'ang China by pinching them from a hot tube, then the tube-drawing process in China is centuries old. Certainly in the Ch'ing dynasty tube drawing was quite possible, as it is basically the same technique as that used for latticino glass and the standard millefiori decoration. Since the Chinese knew how to use a blowpipe at this time, the process was well within their grasp.

Fenstermaker and Williams figure long thin drawn "straw" beads which they said were taken off Chinese beaded curtains [1979:pl XXIV.1]. Similar beads decorate a box which holds a crystal ball of Ch'ing date in the National Palace Museum; they are somewhat shorter but otherwise identical in blue and brown [pers. observ.]. It is by no means certain that these long tubular beads were actually made in China. However, a variety of older drawn beads have been imported from China; many look like typical wound beads, but with an examination elongated air pockets become visible. Some have been pinched from tubes, others have been tumbled, and some have been worked by lapidary methods [Harris 1984-5].

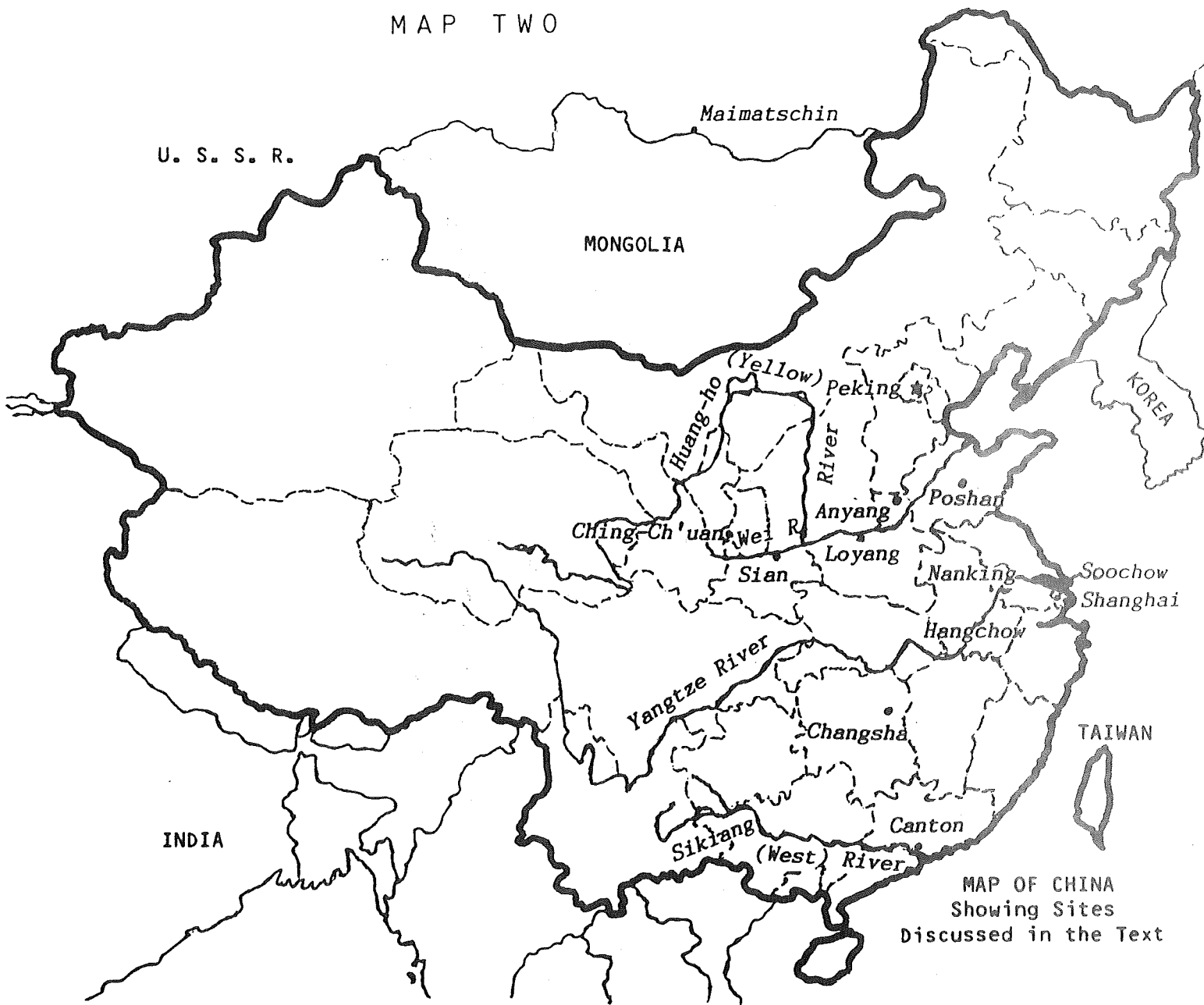
There is no question, however, that the vast majority of Chinese glass beads were made by winding molten glass around a metal or bamboo mandrel. It has been assumed that the characteristics of Chinese glass beads include distinctive colors, a bubbly glass, large holes, clay perforation deposits, and irregular outlines [Chu and Chu 1973:141].

Generally, these rules of thumb hold true, but an examination of six types of glass beads on three different Court Chains in the National Museum of History, Taipei, indicate that they can not be regarded as universal. All the glass was bubbly, but the beads had no perforation deposits, and their outlines were fairly regular. The size of the perforations ranged from 1.2 to 2.0 mm., comparable to wound beads made in Venice, though larger than those on most Bohemian beads, the primary imitator of Chinese beads. The sizes of the beads ranged from 14.1 by 13.7 mm. (bore of 1.6 mm.) to 8.0 by 7.1 mm. (bore of 1.2 mm.) [pers. observ.]. The fact that these beads were put on Court Chains and not used in more prosaic ways may account for their better craftsmanship.

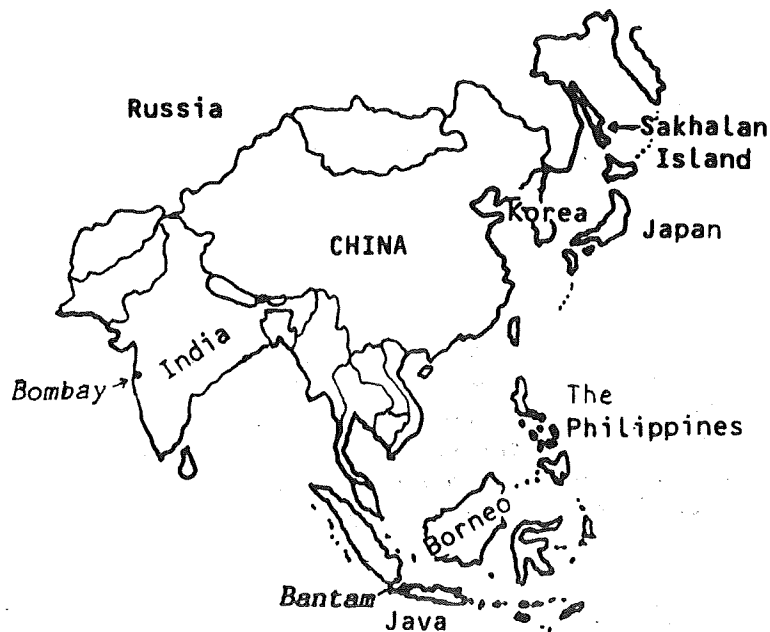
Court chains (erroneously dubbed "Mandarin Chains" by British and American residents during the Ch'ing Dynasty) were strands worn by nobles and officials attached to the court and their wives. (Plate Two, Fig. 4) The Chinese call these strands *ch'ao chu*, "court beads." The form of the necklace was probably inspired by the Tibetan rosary and retained 108 beads on the main strand, though somewhat rearranged for court use. Glass was only one substance used for these strands; many had beads of semiprecious or even precious materials [Comstock 1924]. The custom of wearing them appears to have begun in the reign of the second Ch'ing (or Manchu) Emperor, K'ang hsi [Cammann 1979:23]. They were sometimes derided by foreign visitors. Ball, in a chapter called "Topsy-turvydom" said, "a string of beads round his neck completed the 'great man's' effeminate appearance." [1926:669]

In the years of the Republic, and especially since the beginning of the People's Republic, many of these strands were broken up and sold to collectors as individual beads [Crane 1926:75-6; Cammann 1979:28]. Beads from these chains were strung upon wooden frames to make signs which designated the shop of a bead seller (Plate One, Fig. 3) [Crane 1926:fig. 41].

MAP TWO



MAP OF CHINA
Showing Sites
Discussed in the Text



MAP OF ASIA
Showing Places
to which Chinese
Beads Were Exported.

PLATE TWO



Figure Four: A Court Chain of Glass Beads. These were worn by dignitaries of the Imperial Court to indicate their rank. The 108 small beads are of amber glass; the beads on the counter strings and the disk in the center of the string which hangs down the back are rose, and the remaining beads are green. The dividing beads are 2.5 cm. diameter. After Casanowicz 1909;Pl. 24.

SECTION FOUR:

CHEMICAL ANALYSES OF CHINESE GLASSES

The chemical analyses of glass is an important tool of the researcher. The composition of glass furnishes clues about its ingredients, and this in turn may help us conclude or draw hypotheses about how it was made. There are certain elements or group of elements which are most important in the analyses of glass. Among these are:

1. The amount of silica (Si) and the associated major components. Most common glass contains 60 to 70 % silica, with the balance being lime (CaO) and an alkali, either soda (Na) or potassium (K). The other important type of glass is lead glass (flint glass, crystal, etc.), which contains by weight a large amount of lead (Pb) and reduced amounts of the other constituents.

2. The ratio of the two alkalis: soda and potassium. This may well furnish clues as to their source and to the materials used by the ancient glassmakers to produce the alkalies.

3. The elements used to color the glass. These reveal the state of technology and the raw materials known by and available to the ancient glassmakers. Iron (Fe) is a universal impurity in glass, and under different conditions can impart a blue, green, or yellow color. Copper (Cu) is a common coloring element and can produce a light blue, green, opaque red, or orange. Manganese (Mn), Antimony (Sb), Tin (Sn), and, especially in China, cobalt (Co), are common coloring agents.

4. The pattern of trace elements can be important in distinguishing various glasses. Some elements like magnesium (Mg) and aluminum (Al), are virtually universal impurities. Others such as gold (Au), silver (Ag), selenium (Se), nickel (Ni) and uranium (U) are important trace elements. Impurities can be introduced to the glass batch at nearly any time and may be present in the sand, the alkali, the coloring agent, the lime, the lead, in the furnace, on the tools, or in the clay used for a crucible.

The Loyang Glass Beads

The chemical analyses of the glass beads from Loyang indicate that it is quite different from glass used in contemporary Western manufacture. H.J. Plenderleith conducted some of the earliest tests, and found that its specific gravity was relatively heavy (3.1 to 3.5), and that many of the beads contained significant quantities of lead. Two fragments of green glass which he examined, however, had specific gravities of 2.7, and did not include lead [Yetts 1934:732].

The work by Seligman, Beck, and Richie confirmed that much ancient Chinese glass contained lead, but also revealed the presence of barium [Beck and Seligman 1934; Richie 1937; Seligman and Beck 1938]. This was an important discovery. At that time no Western glass was known to contain barium in any appreciable amounts until it was experimentally introduced by J.W. Döbereiner in 1829 [Turner 1956a:48T] and made commercially by the Schott Co. of Jena in 1884 [Seligman and Beck 1938:8], though it seems it was used earlier in America [Honey 1937:212 n. 10]. The large concentrations of barium in these glass specimens appeared to be a very significant fact.

In north China barium and lead are often found associated in deposits. There are two major ores of barium, barite (commonly spelled baryte or barytes in earlier texts), a sulphite, and witherite, a carbonate. The original investigators believed that the barium was an accidental introduction to the glass. They noted that only some glass and no Han pottery glaze contained barium. This suggested to them that more than one factory, using different lead sources, were producing similar glass products at the same time or (they thought less likely) all the glass came from one factory but at different times [Seligman and Beck 1938:21-22]. On the other hand, Needham believes that the lack of barium in some lead glasses of the period indicates that it was purposely introduced into the batch [1962:103, 105].

So unusual was the presence of barium in this glass that Seligman and Beck made it a point to state that although the absence of barium in a particular glass specimen has no significance, its presence offers good evidence that it is Chinese and of some antiquity. This appraisal has generally stood the test of time, even though barium has been found in some other glasses from Medieval Georgia [Engle 1976:1] and India in amounts of 3 to 5 % [Dikshit 1969:160-1]. The presence of barium is not by itself absolute proof of the ancient Chinese origin of glass, but it remains a very important indication.

To date, the most thorough analyses of Chinese glass were conducted by Ritchie using arc spectography. This method of analysis, new at the time, has a limitation in that it does not furnish precise amounts of the elements detected. On the other hand, it has the advantage of analyzing a large group of glasses by using only small samples of each without the tedious and painstaking labor that quantitative analyses requires [see Bhardwaj 1979:178-81].

Another disadvantage is the difficulty in interpreting the alkali sources for the glass. Ritchie showed that soda (sodium) was the major alkali, and that potash, which contains potassium, was hardly ever used [1937:tables I, II]. This must be tempered a bit; Ritchie admitted that there was a tendency to underestimate the amount of potassium by the spectograph. Some specimens analyzed both this way and quantitatively show that small amounts (1 % or less) were not detected by the arc spectograph [Seligman and Beck 1938:6-7]. It should also be kept in mind that sodium is a widespread impurity and produces a very bright line on the spectograph, thus slightly overstating its presence.

Ritchie's analyses indicate that potassium and phosphorus were rarely present in Loyang glass. A trace (less than 1 %) of potassium was found in only ten of the 43 specimens analyzed, and only one had a bit more than a trace. In contrast, sodium was present in all the glass analyzed, and usually in more than trace concentrations. As we have just noted, however, this may have been a bit erroneous. A trace of phosphorus occurred only in two of the 43 specimens.

Bushell reported that the Chinese exploited two sources for alkalis. One was the burning of plants, either ferns or seaweed at the coast, to obtain ashes [Bushell 1914:264]. The lack of potassium and phosphorus in early glass appears to rule out plant ash as a source of alkali. The 15 plant ashes, including fern and kelp, recorded by Turner [1956c:287-291] had large amounts of both of these elements with one important exception: the kelp had less than 1 % phosphorus.

The other alkali source Bushell mentioned was nitre, a rock which is usually potassium carbonate. The analyses show that nitre itself could not have been used by the ancient Chinese because there is virtually no potassium in the glass. However, sometimes the inexact term "nitre" has referred to calcium carbonate, rather than potassium carbonate. A mixture of calcium carbonate with calcium bicarbonate is known as natron, an important alkali source for ancient Egyptian glass.

It appears that the alkalies used by the early Chinese glassmakers were natron or other soil-derived material. If so, the Chinese used a source similar to that employed in both ancient Egypt and India for several millennia.

As to the additives which imparted colors to the glass, green and red glasses were produced by the addition of copper, while the blue glass shows the purposeful introduction of cobalt. Most, but not all, of the white glass had tin added to it, as does some of the other glass; this may have been used to opacify the glass [Caley 1962:91].

Among the trace elements, silver was universal, while lithium and vanadium were quite common. Antimony and bismuth were also present in many specimens. The presence of these heavy metals may suggest that metal smelting residues were used to produce glass [Caley 1962:91]; another hint of an alliance between glassmakers and metalsmiths. Gold, cadmium, thallium, and, except for one specimen, mercury, were absent.

A few unusual specimens also call for discussion of their analyses. The composite beads were made of a surface glaze of glass and a core which has been called "quartz-faience," for lack of a better term. This core is of two types; a hard variety consists of about 50 % silica and 17% barium, while a soft variety consists of about 68 % silica and contains no barium [Seligman and Beck 1938:40].

Early in the investigations, some black beads were identified as obsidian inlaid with glass [White 1934:157, citing J.C. Ferguson]. This, however, does not seem very likely, and the possibility has not been mentioned by later writers. The "obsidian" beads may or may not be similar to the "thin, black laquerlike coating" reported on some beads by Blair [1948:198].

Analyses of 3rd to 5th Century Glass

Richie analyzed ten pieces of glass he said were "approximately" dated to the 3rd to 5th centuries or the Tsin and Ten Dynasties Periods. They show considerable changes in the materials used to make glass [1937:table III].

The first thing we note is the lack of barium in glass of this time. Barium was present in 35 of the 43 specimens he analyzed of pre-Han and Han glass, and in all but two instances in moderate amounts (1 to 10%). However, in 3rd to 5th century glass it is present only as a trace in three of the ten specimens analyzed, and two of those were of doubtful date. Barium had disappeared as a glass ingredient. Why this was so is not known. As mentioned earlier, the lack of barium may indicate an exhaustion of certain lead mines, a change in factories, or a conscious decision to exclude barium from the batch.

Lead was still being used, but not as often. Only one of the 43 pre-Han and Han specimens had no lead, while two of the ten later glasses lacked it, and three others had only a trace. Thus, 97.7 % of

the early specimens were lead glass, but only 50 % of the later ones were, four of which were dated with reservations by Bishop White, from whom they were obtained; they might have been earlier. If they are of the same date we have some glassmakers using lead and other not. If there were both northern and southern industries, the differences may have been geographic.

Among the trace elements, silver is present only in glass with lead, except one with only a trace of lead. Tin was only in lead glass, and bismuth was found only with three of the lead glasses. Again, this suggests that the lead may have been a by-product of metallurgical operations and that the lead glass of this period was produced by a group of workers different from those who made the non-lead glass.

Antimony was found only in three small molded figures, perhaps of Buddhist inspiration, made of lead glass; they clearly form a group of their own, though unfortunately without provenance. Blair assigned what may be a similar molded figure to this period, but remarked that it may have come from the West [1951:349]. Jenys mentioned a molded glass figure from the T'ang period, which would be too late to match these three [1965:132]. Small molded figurines were uncovered in the tomb of King Muryong of Paekche in Korea [Francis 1985a:12], but they are unlike those pictured by Seligman and Beck [1938:pl. VII, 6], presumably the ones analyzed by Ritchie.

Sodium continued to be the dominant alkali. Potassium was found as a trace in three specimens and in slightly larger amounts in another three. The absence of phosphorous appears to rule out the use of plant ash (except kelp) as the source of alkalies.

The Analyses of T'ang Glass

The nine specimens of T'ang glass Ritchie analyzed were not as well attested as those listed by Pinder-Wilson, but they likely belong to this period. The most important conclusion from his analyses is that chemically T'ang glass is nearly all of the soda-lime-silica type. During this period the lead glass of early Chinese make was abandoned.

Of the nine specimens examined by Ritchie [1937: Table IV], only two were of the lead-silica type; one of these was doubtfully dated, though the other was said to be "definitely T'ang" [Ibid.:218]. Barium was not used as a major ingredient in any of the specimens. Neither of the lead glasses contained any antimony, suggesting that neither were made with lead from the source used for the molded figures mentioned above. Silver accompanied the lead, including both the lead glasses. The alkali source appears to have been the same since pre-Han times, as soda with few traces of potassium and no phosphorus was detected.

SECTION FIVE:

THE LOCATION OF THE BEADMAKING INDUSTRIES

General Considerations

Where in China was glass beadmaking carried out? At present, it is impossible to answer this question with certainty except for the last few centuries, when it was centered around Poshan. There have been no archaeological discoveries of glass beadmaking sites in China yet. The written record, as we have seen, is not especially generous in revealing the history of glass beads in China. The information we have is scanty.

In China there is an old tendency for industries to be centered in one or a few places [Latourette 1964:497]. However, it would be premature to say that there has only been a single glass or beadworking location throughout Chinese history. To do so would be to presume more of a solid, unified nature to the large area we call China than is historically justified. Independent states controlled various areas in China for long periods of time; they may well have supported more than one glass bead industry. Traditionally, glassmaking has been a decentralized and mobile industry in much of the world. Since glassmakers were not peasants tied to their farms, they were free to take up employment wherever the relatively common raw materials were available and to move on account of unfavorable economic or political climates or the exhaustion of materials, especially fuel [Francis 1983].

In short, we do ourselves a disservice if we attempt to identify any single place as the sole producer of Chinese glass beads. This is as true at present as in the past.

The Ancient Industry

In late Chou-early Han times there may have been more than one glass beadmaking center which produced the magnificent beads from Loyang. The unusual composite beads strongly suggest a second beadmaking center. The plain monochrome glass beads may have come from a third. After the destruction of the Shang dynasty, potters moved to the lower Yangtse basin, which became the center of the Chinese ceramic industry. The subsequent invention of glaze by these immigrants might have played an important role in the development of glass, in which case this area may have been the location of glassmaking in the late Chou period [Chêng 1963:199-215].

Concurrently, there is evidence that non-Chinese minorities in the southwest produced glass as early as the former Han period (last two centuries B.C.). The *T'ai-Ping-Yü-Lan* asserts that the southwestern "barbarians" made glass and that Emperor Wu-ti (140-87 B.C.) sent envoys to them to learn the techniques [Janse 1947:52]. This is the same Wu-ti we discussed above who was said to have had a glass industry [Nesbitt 1879b:651].

A southern glass industry is also suggested by a passage in Wan Chen's *Strange Things of the South*, written about 300 A.D.: "The basic substances of *liu-li* glass are minerals. In order to make vessels from

them they must be worked by means of soda-ash . . . It is found on the shores of the southern seas . . . Without these ashes (the other minerals) will not dissolve." [Needham 1962:107-8] At the same time, the alchemist Ko Hung stated that artificial crystal, that is, glass, was being made in Chiao and Kuang in the south [Yetts 1934:732; Seligman and Beck 1938:16]. Chiao and Kuang refer to the southwestern portion of China, the provinces of Kwangtung, Kwang-hsi and Annam.

Engle believes that the glass coming from this area was Western in origin [1976:36]. But it is not necessary to assert this, given the notices of glassmaking in the southern regions. The fancy and no doubt expensive beads found at Loyang did not penetrate the hinterland of China; none have been found in the excavations in Annam [Janse 1947; 1951], and they were evidently not made in the south. But many other sorts of glass beads have been found in this region. Could they not have been locally made?

If this were the case, it may explain why when T'ai Wu (424-452) was king of the Northern Wei his people learned glassmaking from merchants of Ta-yieh-ti in the southwest. At virtually the same time, the Sungs learned glassmaking at Nanking from the Syrians. Because the Northern Weis controlled the Silk Route and the Sungs the southern seaports [Taylor 1974:27], the Weis may have had better access to and more contact with the southwestern glassmakers.

The southwest was not always considered part of China, but whenever the empire was strong, as under the Hans, the T'angs and in more recent centuries, it has been. This might explain why there was a revival of glassmaking whenever central power was reasserted.

The More Recent Centuries

The center of glassmaking in China in the last hundred years has been in the north at Poshan. Williamson described the industry in 1870:

Long ago it was discovered that the rocks in the neighbourhood of Poshan-hsien, when pulverized and fused with nitrate of potass [potash], formed glass; and for many years the natives have applied themselves to its manufacture. I found them making . . . lanterns, beads, and ornaments in endless variety. They also run it into rods about thirty inches long, which they tie up in bundles and export to all parts of the country. The glass is extremely pure, they colour it most beautifully, and have attained considerable dexterity in manipulation. . .

[Bushell 1914:2 61-2]

While the glass industry was concentrated around Poshan, neither glassmaking nor beadmaking was exclusively located there. Nor was all Poshan glass worked into final products there. Unworked glass in the form of canes and cakes were shipped to Peking and other parts of China to be finished [Warren 1977:101-3]. Such an arrangement survived at least until very recently [Blair 1951:368].

Canton was a beadmaking center of some importance. Late in the 18th century, glass objects made at Canton were apparently limited to small looking-glasses and toys. At that time, glass was not manufactured

there, but European glass was remelted and worked [McCartney 1963:299]. Within a century, Canton began to manufacture glass. S.W. Williams said, "The manufacture of glass is carried on chiefly at Canton. . . The importation of broken glass for remelting has entirely ceased. . . The furnaces are small, and from the ignorance, on the part of the workmen, their products are not uniform." He mentioned a number of products, including "beautiful ornaments," ear-rings and wristlets, made from *liao-li*, "the old native name for a vitreous composition like strauss, between glass and porcelain." [1895:21] Though Williams did not specifically mention beads, an eye-witness account of beadmaking at Canton was reported by Chu and Chu [1973:138].

The possibility of a southwestern glass manufacturing center surviving into more recent times is suggested by Homel, who said that a customs official told him that in Szechwan a "native glass industry flourishes." The products of the industry seem to have been mostly utilitarian glass, including bottles and windows [1937:304], although nothing rules out the production of other glass objects.

A number of larger cities may also have made glass beads during the last few centuries. To date no specific information has been located about them, but Peking, Hangchow, Nanking, Soochow, Shanghai, and some other centers are candidates for glass beadmaking, either because of the existence of older industries or because of their commercial and trading importance. There also appears to have been a glass bead-making industry in Manchuria [Harrison 1954:289], as we shall discuss in the following section.

Glass beads imported from China today show enough variety in the way they were made that it seems unlikely that they were all manufactured at the same place. If the report by Kan and Liu [1984] is complete in regards to Poshan glass beadmaking, then it is quite clear that not all modern Chinese glass beads are exclusively produced at Poshan, because of the variation among them [pers. observ.].

SECTION SIX:

THE EXPORT OF CHINESE GLASS BEADS

Introduction

Considerable debate has centered around on how much trade was carried on in Chinese glass beads. Those who have considered the problem have taken varying positions on the issue. One extreme was taken by van der Sleen, who denied that the Chinese ever exported beads [1975:99, 102].

Most of those dealing with this question have looked at the problem from the standpoint of the American trade. The debate was opened by Woodward who noted that William Clark of the Lewis and Clark Expedition (1804-1806) said that the blue and white beads so important in the Pacific northwest had come from China. He believed this was in error, though he cited no evidence for his contention [1965:14-5]. Jenkins, studying beads in Alaska, agreed with this position, saying that these beads were European and were transshipped through China [1975:6].

Others have dissented. Chu and Chu [1973:138], Liu [1975b:14], and Ross [1975:3-4] maintain that Chinese beads were traded to America in the 19th century. Chu and Chu even believe that the common "pony" bead and the "padre" bead of the west were Chinese in origin [1973:138].

Implicit in these arguments are two attitudes. Those who deny any trade in Chinese beads apparently take it for granted that, except for the late Chou-early Han period, China did not make glass beads until very recent times. Most of those who argue that Chinese beads were imported to America from about 1850 also seem to presume that China did not make or at least export beads before that date. Though these assumptions are only occasionally found in print, discussions with many people interested in the history of beads indicate that they are common attitudes.

However, this is clearly wrong. The mistake appears to arise because many of those who have written about Chinese glass beads are most familiar with trade on the American West Coast. The 1850 date for the beginning of Chinese bead production reflects more about the settlement of the American Pacific than it does about the activities of Chinese glass beadmakers. When we recognize the extent of trade in Chinese glass beads elsewhere, among her neighbors, a picture emerges of China being engaged in a lively bead commerce for many centuries.

Chinese Glass Bead Trade in Asia

As early as Han times the Chinese were busy trading many goods with the "barbarians" who lived on their borders, as well as overseas [Yü Ying-shih 1967]. Glass beads found at that date and a bit later in both Korea [Francis 1985a:12-16] and Japan [Blair 1973:44-5] include some which are most likely from China. We must look at later dates, however, to confirm the trade in Chinese glass beads.

Chau Ju-kua (12th-13th centuries) was the chief customs official of Hangchow. In his book, *Chu-fan-chi*, he recorded what was known by the Chinese concerning trade throughout the world, as far afield as Spain

and Zanzibar. His work is divided into two parts: one deals with materials and the other with the mechanics of trade. In the materials section he noted that China was making glass in his day, as were the Westerners [Hirth and Rockhill 1911:227].

In the trading section he discussed products exported to different countries and those to be imported from these countries. These lists were drawn up to help Chinese traders know what goods they should take to the countries they were going to visit. In three cases -- Borneo and two areas which are now parts of the Philippines -- Chau specifically mentioned beads. Is it possible that the beads came from outside China and were re-exported? It is, but because all the other items on the lists were clearly Chinese products, it is far more likely that the beads were Chinese-made as well.

To Borneo, traders were told to take: "trade-gold and trade-silver, imitation silk brocades, brocades of Kién-yang, variegated silk lusterings, variegated silk floss, glass beads, glass bottles, tin, leaden sinkers for nets, ivory armlets, rouge, laquered bowls and plates, and green porcelain." [Ibid.:156] In the Philippines traders bartered with "porcelain, trade-gold, iron censers, lead, coloured glass beads, and iron needles." [Ibid.:160] And in the southern Philippine islands, "porcelain, black damask and various other silks, (glass?) beads of all colours, leaden sinkers for nets, and tin" were desired [Ibid.:162]. There is no reason to doubt that the glass beads were Chinese.

The Chinese became great sea traders, beginning in the 10th century, and expanding in the 13th during Yüan times. Many Chinese settled in countries with which they traded, and when the Europeans reached south-east Asia they found Chinese living in many of the major ports. John Saris at Bantam, Indonesia wrote in a letter of 4 December 1608 that the Flemings (Dutch) bought "blue glass beads which the Chinese make" to sell to Sukadana on Borneo at a great profit [Danvers 1896:22]. In another passage written by Saris in his journal, he lists the commodities which are wanted at Sukadana and these included, "all sorts of small Bugles [tubular glass beads], Bugles which are made in Bantam, of colour blue, and in fashion like a Tunne [shaped like a barrel], but of the bignesse of a Bean. . ." [Purchas 1625:3 513-4]. He continued by describing its cost and mark-up, and it is clear that this is the same bead referred to in his letter. Saris lived in Bantam several years and was a careful and keen observer. Apparently Chinese glass bead-makers were living on Java and exporting their products at least to Borneo [Francis 1985b:].

At Maimatschin, the primary trading post on the Sino-Russian border, the Englishman William Coxe reported in 1780 that "glass corals and beads" from China were among the products that the Russians exempted from all duties. They were apparently used in the Alaska trade which the Russians controlled, and the exemption from duty shows that the Russians were anxious to obtain them [Coxe 1780:241].

Another trade which was profitable to China because of its virtual monopoly was conducted by the Ch'ing with the Ainus, the aboriginal folk of the northern Japanese islands, through Sakhalan Island. One of the most important components in this trade was blue beads. The value of these beads depended upon their size and the current market, but an

average price was 14 martin skins for 100 of the small beads or 20 skins for 100 medium sized ones [Harrison 1954:290].

These blue beads found their way into Japan, as the Ainus, who greatly valued them, often included some of them in the annual tribute to the Shogun. The Japanese used them for ojime and apparently at times for netsuke, both ornamental beads associated with the box-like inro worn with the kimono. The Japanese tried to bypass the Chinese trade with the Ainus; one attempt in 1760 is recorded in which goods they shipped to the Ainus included "prized clothes and beads." Mamiya Rinso mentioned the role of beads in this trade in 1806 [Ibid.: 284]. Harrison's description of them is worth quoting at length:

The ornamental beads were called blue beads, *Karafuto* beads, or insect nests. They came in various sizes -- round, cylindrical, large and small, and in snow white and varying shades of blue -- purple, bluish purple, indigo, light blue and dark blue with an occasional reddish yellow listed on the invoices. The predominant color gave rise to the general term "blue bead". . . [Another type was called *aomushi* or "blue insect nests"] because the beads were often thought to be the nests of small coral-like insects found in the sea. *Aomushi* was the common name in Japan for these trade beads and may have come from the fact that they were so crudely pierced that no one thought they were made by human hand. These beads were made in Manchuria and were known in China as *kitan* beads (from the land of the Khitan Tatar). These beads, considered as indispensable ornaments by Ainu women, were traded by size. Large ones were bartered individually, while small ones were sold by strings.

[Harrison 1954:288-9]

By the 19th century the Japanese had begun to make these beads and started to displace the Chinese trade in them [Ibid.].

To complete our short survey of the Asian trade in Chinese glass beads, we shall consider the case of India. By the late 19th century British policies had effectively destroyed the once thriving Indian glass bead industry, forcing India to import beads from other places, especially on English ships [Francis 1982:6-7]. A source from China of the mid-1860s states that glass beads were sent entirely to India or Indonesia, and that those sent to Bombay were often resold into Africa for ivory [S.W. Williams 1966:120]. Chinese glass beads were recorded as being imported to India in 1871 [Balfour 1871:1 365] and in 1889 [Watt 1889:1 428].

S.W. Williams also said the Chinese exported, "The material called *liáu* [which] resembles glass more than porcelain; it is a sort of strass that is colored in imitation of precious stones, and is one of those branches of the ceramic arts that the Chinese used to excel in more than they do now." [1966:120] This is the same material he noted was made in Canton which we discussed in Section Four. It seems it was sent to India and cut at Cambay, the lapidary center: "The Cambay Blue Stone is not the true *piroja* [turquoise], but a composition imported from China in flat pieces of not more than a half a pound in weight. Like blue glass in appearance, though soft, it takes a high polish." [Campbell 1880:201]

SECTION SEVEN:

CONCLUSIONS

To conclude this study we can do no better than restate the questions which we originally set out to answer and to review the evidence which we have gathered in considering them. It must be recognized that we have not solved all of the problems inherent in the discussion of Chinese glass beads. It is possible that all of them will never be solved. However, this survey should serve as a reference to the evidence which is now available and highlight the unanswered questions which must still be the focus of research in the future.

One: What is the Origin of Glass and Glass Beads in China?

While we may never be able to identify the origin of glassmaking in China any more than we can in most other parts of the world, it appears that China emerged as an independent glassmaking power by the early first millennium B.C. We cannot rule out the possibility of foreign influence at this time, but soon China was an autonomous glassmaking nation, much as was India at about the same time.

By the time of the Warring States period the distribution and numbers of glass beads are significant enough to indicate that they were locally made and were not (at least not all of them) imports. The prevalence of lead glass with heavy concentrations of barium found in the Loyang material strongly supports the supposition of an independent glassmaking tradition in pre-Han and early Han times.

How it was that the Chinese first began to make glass will probably never been ascertained. It may have been a by-product of metallurgy, ceramic glazing, or the result of Taoists seeking the elixir of life. There may also have been several origins of Chinese glass. Of these, metallurgy most strongly suggests itself because of the historical precedence of glassmaking over glazed ceramics and Taoism and the possibility that by-products of metal working were used to make glass.

Foreigners may have introduced glassmaking to China, but whether Hurrians, Indians, or others, it is unlikely ever to be demonstrated. Nor is this of central importance. What is significant is that China must be recognized as becoming a glass beadmaking center at an early date, incorporating indigenous technologies and ingredients and reflecting local aesthetic sensibilities.

Two: Is There Evidence for the Continual Production of Glass and Glass Beads from the Date of its Origin to the Present?

The answer to this must be "yes." It is possible to trace Chinese glass products, many of them beads, throughout the nearly 3000 years since the introduction of glass in China. It is clear that glass was never considered a major product by the Chinese. They had less use for glass for ornaments, windows, or vessels than did other people, but it was apparently always there.

Several historical records mention later introductions of glass-making or the reintroduction or rediscovery of glassmaking at various

times in Chinese history. This more likely reflects the loss of glassmaking techniques in some parts of China rather than in the entire country or the desire of local areas to produce glass where it was not made before. However, as scanty as our data is at the moment, it is clear that glass and glass beads have a long unbroken history in China, taken as a whole.

Three: What Sorts of Glass Beads Have Been Produced in China and What Techniques Were Employed to Make Them?

There has clearly been a great variety of glass beads produced in China over the ages: from the simple monochrome wound beads found early in the first millennium B.C. to the late Chou-early Han multiple eye beads, which are some of the most complex beads ever made anywhere. An important use of glass beads was their ability to imitate jade and other semiprecious materials. In more recent Ch'ing times, the variety of glass beads was truly amazing, including cased beads, some of them cut to reveal lower levels of glass, latticino, millefiori and "spiral millefiori" decorations, aventurine, and beads made to imitate a wide variety of other substances.

Winding on a mandrel appears to have been the chief method for making glass beads in China throughout its history. However, the casting or molding of glass was used very early, as were lapidary techniques. If it is demonstrated that beads pinched from glass tubes were made in the T'ang period or before, then the drawing of glass tubes to make beads in China is much older than had been thought. The making of drawn beads from tubes was certainly attained by Ch'ing times.

Four: Where Have the Major Production Centers of Glass Beads Been Located?

Here we know less than we do about other aspects of the problem. It is most likely that several glass beadmaking centers, rather than only one, have operated in China throughout time. The material from Loyang is of such different construction (particularly the composite beads) that more than one center may be postulated for that period.

The historical records mention kings of different areas in China fostering glassmaking, sometimes simultaneously; this strongly points to multiple centers. Nanking and Hangchow were possibly beadmakers at different times. The southwest was often cited as a glassmaking area, and an Szechwan industry in the 1930s may have been heir to that tradition; it is imperative that we learn about the industry in this region.

In more recent times, Poshan has been renowned as the glassmaking center of China, but it is clear that Canton also carried out beadmaking in the last century, while Peking and other cities may have as well. The differences seen in the perforation deposits and manufacturing styles of beads coming from contemporary China strongly suggest more than one beadmaking center at present.

We must keep in mind that China is an enormous land and has not always been politically unified. Even when unified, there have always been significant differences between the various regions of China. It is logical to assume that Chinese glass beadmaking was as decentralized as Indian glass beadmaking [Francis 1982].

Five: To What Extent Have Chinese Glass Beads Participated in International Commerce and Been Traded or Sold to the Outside World?

Succinctly put: to a large extent. To such an extent, in fact, that the export of Chinese beads was clearly more important than has hitherto been imagined. The international commerce of China from as early as the Han period has not been as widely appreciated as it ought to have been except among specialists in Chinese history. However, the Chinese have long been leaders in maritime inventions and important explorers and traders in much of the world by sea as well as by land.

Where the Chinese went, their glass beads went with them. Chinese glass beads appear in Japan and Korea from the Han period. By the Sung period, Chau Ju-kua was advising Chinese traders to take glass beads with them along with silk, porcelain, lacquer, gold, silver, tin, and lead -- all Chinese products. In the early 17th century Chinese glass beadmakers settled in Java and sold their beads to Borneo and probably other places. The Russians and the Ainu in the 18th century and the Indians, East Africans, and Americans in the 19th century were buying Chinese glass beads.

The more we learn about Chinese glass beads the more we begin to recognize their widespread commerce. They were traded far more widely than had hitherto been believed. It is possible that as we learn more about the production of Chinese beads that some of the "mystery beads" of southeast Asia and elsewhere, such as those from Korea [Francis 1985a:13-16], Indonesia [Liu 1985b], and Taiwan [Chen 1968:222-30; M.C. Liu n.d. 137-42], may prove to be Chinese in origin.

The Task Ahead

This survey cannot, must not, be taken as the final word on Chinese glass beads. There is much more information which must be tapped and many more avenues which must be explored before we can draw definite conclusions about the problems involved. The two things needed most desperately at the moment are: a thorough examination of the literature in the Chinese language to uncover more written information, and the examination by a qualified bead researcher of the artifactual material in China itself.

There is no way of telling when these projects may be completed. In the meantime, it is hoped that this survey will prove of use in drawing some of the boundaries and clarifying some of the issues involved in the problems of Chinese glass beads.

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A D D E N D U M

The advice on p. 37 concerning a research tour to China and further archival work has been partly fulfilled by the author's own unexpected opportunity to visit China and expand research in Hong Kong libraries. More needs to be done to fully understand the history of Chinese glass beads, including more work in China. However, although some new material has emerged, and some earlier opinions can be refined, the basic conclusions reached in the text have been substantiated. The significant new material is added here, grouped according to the questions posed in the text. The Pinyin transliteration system is used here alongside the Wade-Giles system.

1. What are the origins of Chinese glass?

Two white beads found near Louyang (Loyang) from the eleventh century B.C. are the earliest glass now known in China, followed by over 1000 beads from nearby Baoji. Analyses show them to be lead glass containing barium. This confirms that they are of Chinese manufacture, and strengthens the hypothesis that metalworkers made the first Chinese glass [Yang 1985:26].

2. Was glass continually produced in China?

Although data remains scanty from the end of the Han to the beginning of the Sui dynasties (200 to 586 A.D.), glass beadmaking has now been confirmed during the Song (Sung) dynasty, as discussed below. The complex beads dated variously to the late Zhou (Chou) or early Han [pp. 9-10] should be assigned to late Zhou. All excavated examples date to that period.

3. What were the techniques used to produce glass beads?

The question of whether glass beads were pinched from tubes in Tang times [p. 21] rested on two propositions: a.) the Chinese could make glass tubes then, and b.) pinched beads of that date are Chinese in origin. The first proposition appears to be true. A tomb near Xian (Sian) of Li Jingxun (died 608), daughter of the Sui Emperor Xuan, contained several bright green glass objects, including a tube about 12 to 15 cms in length, housed in the Museum of Chinese History in Beijing. Ornamental tubes (*guan*) are known from the Warring States period; glass ones were being made before Tang times. The second question is not yet answered. Pinched beads are known from a number of Southeast Asian sites during the first millennium A.D. [Francis n.d.]. Their origin, however, is not known, and the possibility of multiple centers of manufacturing these beads cannot yet be ruled out.

Ming beads in the Museum of Chinese History, Beijing, have perforation deposits different from each other. Some have white powder to separate the bead from the mandrel, used since Han times [p. 20]. Others have black iron oxide traces from the mandrel. There were clearly at least two wound bead-making techniques used during the Ming Period.

4. Where were the centers of beadmaking?

An important piece of evidence confirms Suzhou (Soochow) as a beadmaker in the Song period (960 to 1279). Translucent blue, bright green, and opaque red beads dangle from an elaborately carved wooden pillar housed in the Suzhou Museum. The beads are similar to those used in the later bead trade: wound from bubbly glass with white powdery perforation deposits. The pillar

was encased in two wooden boxes in the third story cellar of the pagoda at Ruiguangsi, Suzhou. Inside the outer case is an inscription dated 1013. It has been described [Yue and Liao 1985:1813], but its importance to glass beadmaking history had not been recognized.

The Imperial Glass Workshop founded by Qianlong (K'ang-shi), has been confirmed [pp. 16-17]. French Missionaries mentioned it, and said that an unnamed Jesuit was in charge [1777 2:477-9]. Yang said that a palace glass workshop begun by missionaries had only a small furnace until the mid-1700s, when a larger one was built; beads were not listed as a product [1985:27-8].

Beadmaking in Shantung (Shandong) Province can be dated as early as 1637 [Sung 1966:308]. However, Boshan (Poshan) was not the only city to make beads. In Yenshing, Shantung, beads, ornaments, and glass rods and bricks were made and shipped all over the country [Markham 1870:10-11]. Bangles, which are often allied to beads, were made at Ta-tung Fu (Guizhou) and Chinnan Fu (Shantung) [Mesney 1899:51-2]. Woodhead listed glass factories from 1922 to 1927, but not at Boshan; he said glass ornaments were made at Chefoo or modern Yantai [1922:773-4; 1927:187-9].

Chu and Chu's report on glass beadmaking around Guangzhou (Canton) [p. 30] could not be confirmed. Gray's walking tours of Canton took his readers to glass factories (including those for mirrors and bangles), but to no bead-makers [1875]; maybe the hillside factories were just not on his itinerary.

5. What is the evidence for the export of Chinese glass beads?

De Morga (ca. 1605) said 30 to 40 Chinese junks went to Manila annually with "[cloth goods] decorated with glass beads or pearl trimmings... tacleys, which are beads of all kinds, strings of cornelians, and other beads and stones of all colours." [1971:306] This another case of exporting Chinese beads, and a second early reference to the trade with the Philippines.

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