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HARVARD UNIVERSITY

VOL. X, No. 2

METALS FROM THE CENOTE OF SACRIFICE CHICHEN ITZA, YUCATAN

BY

SAMUEL KIRKLAND LOTHROP

WITH SECTIONS BY
W. C. ROOT AND TATIANA PROSKOURIAKOFF
AND AN APPENDIX BY
WILLIAM HARVEY

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PREFACE

The following pages describe and illustrate objects of metal which were dredged from the Cenote of Sacrifice at Chichen Itza, Yucatan, by the late Edward H. Thompson. The work was principally financed by the Honorable Stephen Salisbury and Mr. Charles P. Bowditch, who later presented the collection to the Museum.

Professor A. M. Tozzer is preparing a companion volume which tells the story of Chichen Itza and the barbaric rites practised therein and also relates how the rich offerings which lay beneath the water and mud of the Cenote of Sacrifice were brought to the surface and preserved. Artifacts of jade, alabaster, pottery, wood, copal and rubber, as well as textiles, will eventually be published. A preliminary account of the human bones found in the Cenote has already appeared.[1]

Over thirty-five years ago, when I first saw the material from the Cenote of Sacrifice at Chichen Itza in the Peabody Museum, I was fascinated by it and by its romantic story but had no intuition that I would ever have a hand in its publication. At that time, further efforts at dredging had been abandoned several years previously. The laborious task of repairing mutilated specimens was then in the capable hands of the late Samuel Guernsey under the guidance of Director C. C. Willoughby, and Miss Helen Gleason was engaged in the task of drawing them.[2]

Since that time, many individuals have worked on restoration and illustrations. My thanks are due to Mr. William Baake, who has prepared the bulk of the drawings in this volume. I am also indebted to Miss Tatiana Proskouriakoff [3] and Miss Kisa Noguchi [4] for complex and difficult drawings of certain gold disks. Miss Proskouriakoff has written the text on glyphs. Miss Adela Breton, who visited Chichen Itza while dredging was in progress, painted the water colors in figure 53. In recent years, Mr. Frederick Orchard has been in charge of repairs and of removing the age-hardened soot of copal and rubber incense which encased many specimens. Mr. Orchard is also responsible for most of the photographs, but a few were taken by Mr. Guernsey.

This volume could not have been written without the aid of Professor William C. Root of Bowdoin College, who, at the suggestion of Professor A. M. Tozzer, started analyses of Cenote metals over twenty years ago. Not only has Professor Root made several hundred analyses of Chichen Itza specimens but, in the course of years, his researches have been extended to cover all New World metallurgy.[5] Many thanks are due to him and to the fourteen institutions listed on page ix which have supplied him with material for the analyses now printed in these pages. Professor Root has also written the sections on Mexican copper-tin (bronze) and copper-lead alloys and on the metals of Arizona, New Mexico and Chihuahua. Dr. William Harvey has contributed Appendix I which gives the results of microscopic examination of metals.

Professor A. M. Tozzer, as Curator of Mexican Archæology, has been in charge of the Cenote collection since it reached Cambridge. Publication is the result of his initiative. Over the course of years he has collected pertinent data for this purpose which he has most generously turned over to me. I have consulted him at every stage in the preparation of this report and many of his ideas are incorporated therein.

My thanks are also due to ex-Director Donald Scott and Director J. O. Brew, both of whom have placed the full resources of the Museum at my disposal.

I also am indebted to my wife, Eleanor B. Lothrop, for help in the preparation of the manuscript and to Miss Cordelia Galt and Mrs. Melville Smith for editing and seeing the manuscript through press.

S. K. LOTHROP

Cambridge
September 1, 1950

[1] Hooton, 1940.
[2] Some of Miss Gleason's drawings were published in Tozzer, 1930. In this volume she made the drawings for figures 12–16, 18–20, 22–24, 26, 28 and 29, *c*.
[3] Miss Proskouriakoff has drawn figures 1, 34 and 35.
[4] Miss Noguchi has drawn figures 29, *a*, 30–33, 36, 37, 40–44, 45, *a–c*.
[5] See list of references.

CONTENTS

LIST OF FIGURES IN THE TEXT

LIST OF TABLES IN THE TEXT

All specimens unless otherwise acknowledged come from the Cenote of Sacrifice, Chichen Itza, Yucatan, and are now in the Peabody Museum, Harvard University. The following abbreviations are used for other institutions –

AMNH – American Museum of National History
ASM – Arizona State Museum
CIW – Carnegie Institution of Washington
GM – Götenborg Museum
GP – Gila Pueblo
MAI – Museum of the American Indian, Heye Foundation
MN, Mex. – Museo Nacional, Mexico City
MNA – Museum of Northern Arizona
MNM – Museum of New Mexico
R & A – Rivet and Arsandaux, 1946
SAR – School of American Research
UMP – University Museum, Pennsylvania
UNM – University of New Mexico
USNM – United States National Museum

METALS FROM THE CENOTE OF SACRIFICE
CHICHEN ITZA, YUCATAN

FIG. 1. Disk H, representing Tula-Toltec warriors extracting the heart of a Maya captive. Actual size.

METALS FROM THE CENOTE OF SACRIFICE

INTRODUCTION

Chichen Itza is an ancient Maya city located in northern Yucatan. In its prime it was the largest and most sumptuous metropolis of that region and also, both architecturally and politically, one of the most important settlements of aboriginal America. Furthermore, like Pachacamac in Peru, it was a sacred city to which for centuries pilgrims flocked to consult the gods and to make rich offerings of copper and gold, of jade and textiles, of weapons, pottery and incense.

THE CENOTE OF SACRIFICE

Chichen Itza was holy because it embraced the famous Cenote of Sacrifice, known to the Maya as *chen ku*, "sacred well." This is a great cup-like depression some 50 by 60 meters (164 by 200 feet) in diameter with vertical or overhanging walls, filled with water to within 20-odd meters (ca. 70 feet) of its rim. The water averages 10 meters (35 feet) in depth and covers an equal depth of silt. The color of the water usually is a murky green but each year it turns blood red for a few days due to seed pods of the algæ it contains. Here, it was believed, dwelt gods and the souls of the dead ancestors. Hence for centuries, in order to appease its inhabitants, all kinds of offerings were cast in the Cenote including living victims who, if they survived, were thought to have received prophecies. Mainly in the years from 1904 to 1907, the late E. H. Thompson, then owner of Chichen Itza, dredged the southern part of the Cenote. It is the metal objects from its depths which we describe in this volume. Few other specimens recovered from the Cenote have yet been described.

Nearly four hundred years ago, Diego de Landa wrote of the Maya,[1] "they held Cozumel and the well at Chichen Itza in the same veneration as we have for pilgrimages to Jerusalem and Rome, and so they used to go to these places and offer presents. . . ." To this he added,[2] "they threw into it (the Cenote) many other things like precious stones and things which they prized. And so, if they had possessed gold, it would be this well that would have the greater part of it, so great was the devotion which the Indians showed for it." Landa was right, as these pages will show.

Dr. Alfred M. Tozzer will discuss in a separate volume the history of Chichen Itza, the archæological remains found there and the nature of its cults. It will be well here, however, to emphasize certain facts and to anticipate certain conclusions in order to form a proper background for the discussion which is to follow.

In the first place, Yucatan is a limestone country. This means that there is no running water on the surface, but underground flows carve out natural caverns and these, when the roofs collapse, form cenotes. It also means that there are no ores or minerals in Yucatan. Hence everything of this nature must have come from other lands. The objects we describe originated in the highlands of central Mexico, in Guerrero and Oaxaca, in Honduras and British Honduras, in the Provinces of Veraguas and Coclé in Panama, and even in Colombia. Since the looting of Aztec and Inca capitals, the Cenote of Sacrifice has produced the most diversified if not the largest known miscellany of aboriginal metal artifacts. Their importance is archæological, however, not monetary, for their bullion value is relatively small (table XXXVI).

Under normal circumstances such mixed finds would be an archæologists's dream. But the objects in the Cenote lay under 10 meters (35 feet) of water and were embedded in mud and silt to an additional depth of over 10 meters (35 feet). Hence the normal archæological controls of association and stratigraphy are valueless. As the Cenote cult was in existence for centuries, the offerings might well have provided a method of cross-dating native cultures over a wide area, but, as things are, the story they tell must be based largely on the internal evidence afforded by their intrinsic nature. As aids we have the results of investigations in other regions and the facts brought out by chemical analyses.

HISTORY OF CHICHEN ITZA

The vicissitudes which befell Chichen Itza for the past fifteen centuries are known to us in dim outline if not in detail. This story is drawn in part from Spanish historians such as Landa, but information about the far past is derived from the so-called Books of Chilam Balam. Our chronological framework also comes from this source.

The Books of Chilam Balam [3] were the sacred books of the Maya. Written in Spanish characters but in the Maya language, they supposedly are transcriptions of the aboriginal codices with interpolated Christian ritual. Individually they are known by the names of the towns where they were composed or discovered. For historical data dealing with Chichen Itza the important sources are the Books of Chilam Balam of Chumayel,[4] Tizimin [5] and Maní. The Tizimin manuscript, as noted by Martínez Hernández and Roys, is apparently an abstract of the Maní.

Time is expressed in the Books of Chilam Balam by a count of *katuns*. A *katun* is a period of 7200 days or 20 *tuns* (20 x 360 days). Each *katun* ended on the day *Ahau* and was identified by a series of

[1] Tozzer, 1941, p. 109.
[2] Tozzer, 1941, pp. 181–182.
[3] *Chilam* means prophet. *Balam* means jaguar but it also is a family name. Roys (1933, p. 3) translates, "Book of the Prophet Balam."

[4] Published in part by Brinton (1882, pp. 152–85), Martínez Hernández (1912 and 1913). Published in full, Médiz Bolio (1930) and Roys (1933).
[5] The Tizimin and Maní are translated in Brinton (1882) and Martínez Hernández (1927).

numbers running from 1 to 13. The same number did not repeat until 93,600 days (13 x 7200 days) had elapsed. This is a period of 256 years plus 160 days. An event placed within a given *katun* therefore is only approximately stated and there has even been difference of opinion as to the *katun* in which specific episodes occurred.

Maya and European calendars are both reasonably accurate and several schemes for correlating them have been advanced. In this volume we shall use the Goodman-Thompson-Martínez correlation.[6] If the Spinden correlation is followed, approximately 256 years must be subtracted from long-count dates and 3 years from *katun* dates. We shall later discuss a third correlation in the light of what the Cenote metals reveal.

TABLE 1: HISTORICAL SUMMARY OF CHICHEN ITZA WITH TRADITIONAL DATES

(After Roys, 1933)

Katun Count	Long Count	Date A.D.	Event
6 Ahau	9.1.0.0.0	455	Chichen Itza discovered
11 Ahau	9.5.0.0.0	534	Chichen Itza occupied
8 Ahau	9.13.0.0.0	692	Chichen Itza abandoned
13 Ahau	9.17.0.0.0	771	Chichen Itza occupied by the Xiu (?)
10 Ahau	10.5.0.0.0	928	Xiu leave Chichen Itza (?)
4 Ahau	10.8.0.0.0	987	Chichen Itza re-occupied by the Itza and Kukulcan. Tula-Toltec period
8 Ahau	10.19.0.0.0	1204 (?)	Chichen Itza conquered by Hunac Ceel
4 Ahau	11.1.0.0.0	1244 (?)	Chichen Itza re-occupied and Mayapan captured by the Itza
8 Ahau	11.12.0.0.0	1461	Destruction of Mayapan
2 Ahau	11.15.0.0.0	1520	Contact with the Spanish

A summarized outline of legendary events at Chichen Itza is given in table I.[7] The European dates are *katun* endings so that the episodes recorded may have taken place at any time during the preceding twenty years. The long-count dates will be used in making comparisons between Chichen Itza and the Maya cities of the south.

Uuc-Yab-Nal. Turning now to written records, in the Chilam Balam of Chumayel there are three chronicles of historical interest. The first of these[8] is entitled, "A record of the count of the katuns since the discovery of Chichen Itza occurred." This gives an unbroken list of 55 katuns prior to the arrival of the Spaniards in 1517 as well as some outstanding historical events.

From this source we learn that Chichen Itza was "discovered" or "learned about" in the katun 6 Ahau which terminated in 455 A.D. In the long count this date is 9.1.0.0.0 which is twenty years before the earliest carved date now known in Yucatan. The actual settlement did not take place, however, until seventy or eighty years later. We do not known who the colonists were, where they came from or whether they made offerings in the Cenote of Sacrifice. Roys[9] concludes that the city at this time was called *Uuc-yab-nal*. *Uuc* means "seven" and *Abnal* is still a well-known family name in Yucatan.

Quite possibly the name Uuc-yab-nal simply indicates that seven members of the Abnal family settled at a place where there was a good water supply. The number seven, however, is associated with the starting point of Nahua migration myths and here it may also have some symbolic significance.

Champoton. During another katun 8 Ahau which terminated in 692 A.D. the inhabitants of Uuc-yab-nal abandoned their city and moved en masse across the peninsula of Yucatan to Chakanputun, probably the modern Champoton. Here "those of Itza, holy men, had their houses." Evidently the Itza family, who came from the west, possibly from central Mexico, had already settled at Champoton. At this time they were accepted as rulers by a group of roving Mayas who thereafter until the seventeenth century were known as the Itza nation.

The Itza remained in Champoton for 256 years and then, after forty years of wandering, they returned to Chichen Itza. This event took place in a katun 4 Ahau which is dated between 968 and 987 A.D. The long-count date is 10.8.0.0.0. It is important to us because it marks the introduction of metal.

From an archæological viewpoint, just what went on at Chichen Itza during the first occupation is not certain. Buildings and artifacts of this epoch have not been identified – at least in print. Publication of the architectural studies of the complex edifice known as the Monjas may shed light. Until, however, identification of early objects has been made in the ground, it will not be possible to do so in the Cenote, nor can we say how far into the past the Cenote cult extended.

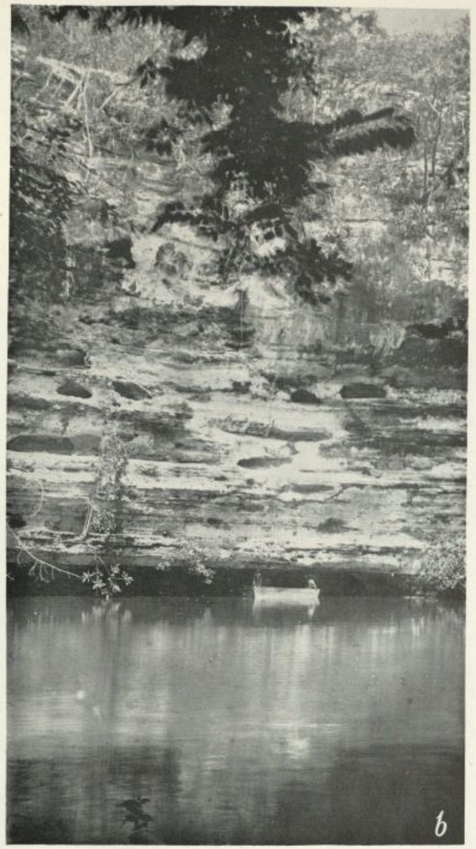
During the so-called period of abandonment, Chichen Itza probably did not exist in a vacuum. Doubtless, part of the original population did not migrate and, according to tradition, the city may have been occupied between 771 and 928 A.D. (katun 13 Ahau to katun 10 Ahau; 9.17.0.0.0–10.5.0.0.0) by the Xiu dynasty, also rulers of the great city of Uxmal. Whether the Xiu and their followers moved to Chichen Itza en masse is doubtful and whether the Xiu governed through deputies is not clear. It is evident, however, that the final form of many buildings in "old" or "Maya" Chichen Itza were completed at this time. The architectural style of Uxmal and neighboring cities is known as Puuc; the typical style at Chichen Itza is recognized as local but closely related to Puuc.[10] One building at Chichen Itza, however, is of pure Puuc style[11] and there may have been others which have fallen.

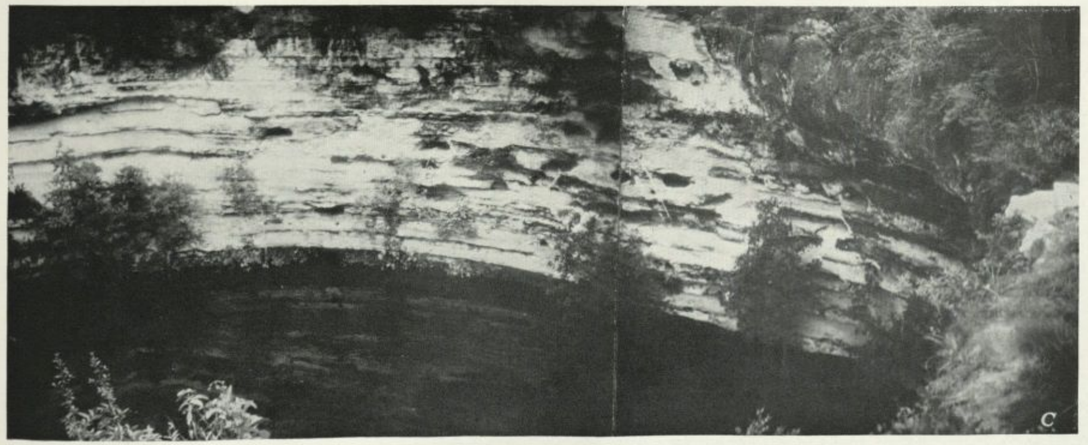
It is probable in the writer's opinion that offerings were cast in the Cenote of Sacrifice during the so-called period of abandonment. This does not mean that the full ritual as described in later times had been established. Our opinion is based chiefly on the discovery of large numbers of jade ornaments carved in definite Great period style. One piece is even dated and the style is attributed to Piedras Negras.[12] In years past, when another correlation of the calendars was in vogue, there was thought to be a long gap between the Great period and the erection of "Maya" Chichen Itza, and the jades from the Cenote were then explained as heirlooms. With the correlation herein employed, we believe it follows that the jades and buildings of "Maya" Chichen Itza were contemporaneous. Confirmation comes from certain gold disks found in the Cenote and from various bas-reliefs which combine Great period features with those of the Tula-Toltec period and thus prove that no time gap existed between them.

Tula-Toltec Occupation. When the Itza and their followers arrived at Chichen Itza in katun 4 Ahau (968–987 A.D.), they brought with them a legendary personage called Kukulcan by the Maya and Quetzalcoatl by the Nahua. Ruling first at Chichen Itza and then at Mayapan, he is said to have introduced new arts,

[6] Thompson, 1927.
[7] Based on Thompson, 1927, 1941, 1945, and Roys, 1933.
[8] Roys, 1933, chapter XIX.
[9] Roys, 1933, p. 153.
[10] Thompson, 1945, pp. 8–9.
[11] Gilpin, 1948, pp. 14–17.
[12] Proskouriakoff, 1944.

FIG. 2. The Cenote of Sacrifice at Chichen Itza. *a*, Small temple on the edge of the Cenote from which an elevated causeway lead to the ceremonial center of the city during the Tula-Toltec period. At the right is a platform from which human victims were thrown. *b*, Interior of the Cenote while dredging was in progress. Photograph from A. M. Tozzer. *c*, A general view of the Cenote taken a few feet east of the platform. In certain lights, reflections make it appear that there are caves far beneath the water.





industries and forms of government and thus initiated the Toltec or Tula-Toltec period in Yucatan. This individual is said to have come from Tula in the State of Hidalgo in central Mexico. The very complex problem of coordinating traditional Mexican and Maya dates of his journey has been examined by Mr. J. E. Thompson [13] who writes, "Is it not significant that what is probably the most acceptable reconstruction of Yucatan history makes the Yucatan Quetzalcoatl settle with his Itza followers at Chichen Itza somewhere within a decade of the year in which one of the two most acceptable emendations of the Annals of Cuauhtitlan make him leave Cuextlan (Vera Cruz)?" This reconstruction of history is confirmed by the gold disks of which we have spoken, which show that the Tula-Toltec and Maya Great periods were partly contemporaneous.

The most important act of Kukulcan in Yucatan was to establish Itza supremacy throughout the Peninsula which continued for over two hundred years. This was the golden age of Chichen Itza, probably then the most flourishing city in the New World. Sumptuous and resplendently painted buildings were erected. Bas-reliefs and frescoes appeared in profusion. The ruler of Chichen Itza received gifts and tribute not only from Yucatan but even from such distant regions as Guatemala, Chiapas, central Mexico and Panama. Trade routes to remote regions were established at this time, over which passed the metal which ultimately was thrown into the Cenote of Sacrifice.

Kukulcan and his followers did not found a metallurgical industry in Chichen Itza. Mining was impossible owing to the nature of the country. Cold hammering, annealing, smelting, casting and gilding probably were never mastered. The only techniques learned by the local Maya were embossing designs on imported sheets of metal and trimming them to shape. Within these narrow limits, nevertheless, they developed great artists.

Conquest by Hunac Ceel. We come now to the legendary conquest of Chichen Itza by Hunac Ceel, ruler of Mayapan. In this victory he was aided by Mexican allies who are identified by name. The fighting apparently was the result of the theft of a bride from the lord of Izamal by the ruler of Chichen Itza. Whatever the reason, the Itza and their followers were driven from Chichen Itza and fled southward to settle at Tayasal on Lake Peten in Guatemala, where they maintained their independence until the end of the seventeenth century.[14]

Chichen Itza Reoccupied. It is probable that all the Itza did not flee or that some soon returned because, forty years later, it is said that they not only dominated their own city but were powerful enough to attack and capture Mayapan. Landa states [15] that Mexican mercenaries who had fought for Hunac Ceel had settled in this city and their descendants lived there until 1461 when it was again captured and completely destroyed, after which they moved to the Province of Ah Canul.

It is important to understand clearly that there were at least two major influxes of Mexicans into Yucatan. The first took place in the tenth century and had its roots in Tula, as recorded by tradition and revealed by the facts of archæology.[16] It resulted in the gold disks portraying the wars of the Tula-Toltec and Maya which were found in the Cenote of Sacrifice. A second inroad occurred in the thirteenth century (or later?) and stemmed, according to Landa, from Tabasco and Xicalango. These Mexicans, Landa states,[17] at first overwhelmed the Maya because of their superior weapons which were, however, soon adapted by the Maya. The new weapons included the bow and arrow, axe, club set with obsidian blades and defensive armour. They were encountered by the Spaniards at the time of the Conquest but they are not shown in the metal, frescoes or reliefs of Tula-Toltec Chichen Itza.

We should add that any general explanation of Nahua migrations from Mexico cannot be considered solely in the light of Yucatan. It must also take into account and correlate Nahua settlements and archæological styles in each of what are now the five republics of Central America – a subject beyond the scope of this study.

The Itza, as we have shown, had not only reoccupied their city but had developed considerable military strength, but Chichen Itza never again became a strong political force. Nevertheless, it remained a great religious center to which pilgrims continued to flock until long after the Spanish Conquest. The Cenote cult also continued, as attested by Spanish priests who tried to eradicate it and by one of our specimens (fig. 61, *a*) which is dated katun 2 Ahau (probably 1520 A.D.).

We have followed J. Eric Thompson [18] and others in dating the Tula-Toltec period from 987 to 1204 A.D. Thompson calls the remainder of independent Maya history the "Mexican Absorption period" on the ground that Tula-Toltec influence in Yucatan was on the wane and that typical Maya elements of culture were again reasserting themselves. This is indeed true, but other and new cultural impulses from Mexico began to reach the Peninsula. These are reflected particularly at Mayapan and at such east-coast sites as Tulum and Santa Rita Corosal: in traditions of migrations, in pottery, weapons, architecture and frescoes, also in the metalwork from the Cenote. We therefore prefer the historical outline proposed by Dr. E. Wyllys Andrews [19] when coupled with Thompson's interpretation of dates, as follows.

1) Tula-Toltec period – 897 to 1204 A.D.
2) Mayapan-Tulum period – 1204 to ca. 1450 A.D.
3) Mixteca-Santa Rita period – ca. 1450 to 1550 A.D.

The Mayapan-Tulum period is dated by Andrews from ca. 1350 to 1450 A.D. We believe that it began earlier, at least at Tulum [20] where there were three or more different and successive architectural periods, two or more successive styles of frescoes, multiple coatings of plaster, repairs to sagging roofs and crumbling walls, and other evidence of long occupation.

At Tulum, stela 2 bears the short-count date of katun 2 Ahau. In our calendar this may correspond to 1007, 1263 or 1520 A.D. The second rather than the third date has been generally accepted because the stela had been re-used and was built into the side of a small platform mound. A katun 2 Ahau also ended in 1007 A.D. but it is improbable on stylistic grounds that the stela was erected at that time.

[13] Thompson, 1941, pp. 104–05.

[14] For a full account of these events, see Roys, 1933, Appendix C. Roys writes (p. 136, footnote), "Katun 8 Ahau recurred approximately every 256 years, and for a thousand years every time a katun of this name occurred, the Itzá were driven from their homes, no matter where they were living at the time. Late in the Seventh Century A.D. they were expelled from Chichen Itzá after their first occupation of that city. In the middle of the Ninth Century they were driven out of Chakanputun. At the end of the Twelfth Century they were again driven from Chichen Itzá by Hunac Ceel. At the middle of the Fifteenth Century Mayapan was sacked and destroyed; and strangely enough it was again in a katun 8 Ahau at the end of the Seventeenth Century that the Spaniards conquered the last Itzá stronghold at Táyasal, which was the end of this remarkable nation."

[15] Tozzer, 1941, p. 39.

[16] See Acosta, 1940, 1941, 1942–44, 1945; Caso, 1941; Reynolds, 1946; Thompson, 1945.

[17] Tozzer, 1941, p. 35.

[18] Thompson, 1945.

[19] Andrews, 1943, pp. 74–79.

[20] Lothrop, 1924.

The Mayapan-Tulum period witnessed not only new elements of culture but a shifting of population to the east coast of Yucatan where many new cities came into being. We suggest that this trend toward the sea may have been linked with a quickening of trade along the east coast of Central America and the establishment of contacts from Honduras to Panama which produced many of the metal specimens ultimately found in the Cenote.

A few Cenote specimens are definitely in the style of Santa Rita Corosal which combines Mixtec symbolism with Maya glyphs. We can say little about the background and development of Mixtec art because nothing is known about it except in obviously late phases.

Andrews, in discussing material he found in northwestern Campeche, notably at the ruins of Cilvituk, points out various links with Mixtec art as it appears in Mexican codices and frescoes, and also with the frescoes found at Santa Rital Corosal in British Honduras. "These similarities," he states, "are not of remote influence but bespeak some very specific contact."

BACKGROUND OF CENOTE METALS

Before discussing the metal objects actually dredged from the Cenote of Sacrifice, we shall describe the metalwork of other regions which have bearing on what was recovered at Chichen Itza. The background thus to be painted is far from satisfactory for several reasons. Most finds of metals have been accidental and have not been made by trained observers. Hence the data for establishing the chronology of metals are woefully weak. Furthermore, in Panama, where the associations of metalwork and pottery are well known, the stratigraphic sequence which includes metals covers only a brief period.

Inasmuch as the writer has already published detailed accounts of the metal industry which flourished in the Panamanian Provinces of Coclé and Veraguas,[21] we shall deal with them briefly in this volume, in spite of their importance in the Cenote finds. Chiriquí goldwork is well known through various publications, but it now appears that it was more the result of trade than of local manufacture. No comprehensive study of Costa Rican gold has yet been undertaken and it is not in the field of this volume. We can state, however, that local centers of manufacture functioned and that it would be possible to identify them by style. Gold objects were imported to Costa Rica from Panama and these often were of types which also reached the Cenote.

Several important metallurgical centers flourished in northern Central America and in southern and central Mexico. These have a direct bearing on the Cenote specimens and therefore will be reviewed in some detail. Finally, we shall cover the copper industry of northern Mexico and the southwestern United States. This is not directly linked with the Cenote but is of importance in the discussion of chronology owing to the developments of tree-ring dating. We advise the reader not interested in the techniques of metallurgy to omit this section.

THE METALLURGY OF MEXICO

Present-day knowledge of aboriginal metalwork in ancient Mexico is uneven and unsatisfactory. This is surprising in view of the booty secured by the Conquerors, the surviving historical records and the comparatively great amount of archæological exploration carried out in Mexico during recent years. Although we can write with assurance of certain alloys and technical processes, largely due to the analyses produced by Professors Rivet and Root, the fact remains that large archæological finds of metal have been rare. Hence we know little about regional styles and their sequence except in limited areas.[22]

ORIGINS

According to native legend, the Toltec introduced the use of metals to Mexico. There is no hint of metal in the early Toltec culture represented by Teotihuacan, however, nor has any metal object been recorded from Tula, which later became the chief Toltec center. At Texmilican, however, in the State of Guerrero, metal objects have been found in association with Plumbate and Fine Orange wares, which in turn have been discovered with the Mazapan pottery prevalent at Tula.[23] Farther south at Monte Alban no metals are known before the Fourth Epoch, which also embraces Plumbate ware. Both tradition and archæology are in accord then that the working of metals was not practised at an early date in Mexico.

Professor Paul Rivet [24] has made the interesting suggestion that the entire and fully developed Peruvian metallurgical complex, reinforced by borrowed Colombian techniques, was introduced suddenly to Mexico by sea. There are several points in favor of this hypothesis, particularly the fact that silver, tin and lead were known in both countries but not in the regions which separate them. Bronze artifacts have a very similar distribution,[25] also bimetallic objects partly of gold and partly of silver.

Many cultural traits were shared by the natives of Peru and Mexico and it often is possible to show that they had come into being at an earlier period in the south. Bird,[26] on the basis of physiographic changes in the Viru Valley, has demonstrated that a by-no-means primitive weaving and agriculture flourished on the Peruvian coast in 3200 B.C. and he places the beginning of pottery at 1800 B.C. On the basis of radio-carbon tests on a log found with classical Chavín pottery, a date of 715 ± 200 B.C. was reached.[27] This pottery has been found with many aspects of culture which developed at a later date in Mexico, such as well-cut masonry, monumental stone sculpture, mirrors, turquoise mosaics and metallurgy, including both gold and silver.[28] Metal apparently was unknown in Middle America until the end of the Maya Great period, the earliest date being 9.17.12.0.0 (782 A.D.) at Copan, Honduras. There can be no question then, if these dates are even approximately correct, that the Peruvians employed metals well over a thousand years before the Mexicans and Maya.

The probability that metallurgy came directly from Peru to Mexico obviously is increased if it can be shown that other inventions not recorded in intervening regions also reached Middle

[21] Lothrop, 1937–42, 1950.

[22] The present text is based on published material or specimens in United States museums. I was unable to obtain access to the metal collection in the Mexican National Museum. I did, however, see the Monte Alban gold when it was exhibited in New York.

[23] Acosta, 1940. Caso, 1941, p. 90.

[24] Arsandaux, 1946, and Arsandaux *and* Rivet, 1921a, 1921b, 1923a.

[25] Holmes (1888, p. 49) reports a few bronze bells from Chiriquí.

[26] Bird, 1948, pp. 37–38.

[27] Arnold *and* Libby, 1950, p. 14.

[28] Lothrop, 1941a, pls. XIX, XX, *c*.

America at approximately the same date. The double whistling effigy jar, typical of the north Peruvian coast, perhaps provides such a link, for it occurs occasionally in Mexico and Central America.[29] This device consists of two vessels connected by a tube at the base. One usually is in effigy form and is completely closed except for a whistle which functions when the vessel is partially filled and tilted. This complicated mechanism is easy to understand and copy, once it is seen, but independent invention seems improbable. It involves the principle of the inverted siphon which was used in municipal waterworks in Peru but not in Middle America.

On the other hand, there is much to be said against the Rivet hypothesis. On the ground of style, had metallurgy come directly from Peru to Mexico, we should expect the fact to be reflected very definitely in the products of the latter country. Only a very few specimens found in Mexico are of styles also known in Peru.[30] They are not of early date in Peru and may be trade pieces rather than local copies, a point which probably can be cleared up by analysis.

To anticipate our conclusions, we may state that the Cenote finds indicate that copper bells were cast in central Mexico and also Panamanian artifacts were imported to Yucatan before the end of the tenth century A.D. At that time the Mochica culture was the only Peruvian culture, either on the coast or in the interior, which is known to have developed metallurgical techniques at all comparable to those of Mexico (table XXXIX). The Mochica,

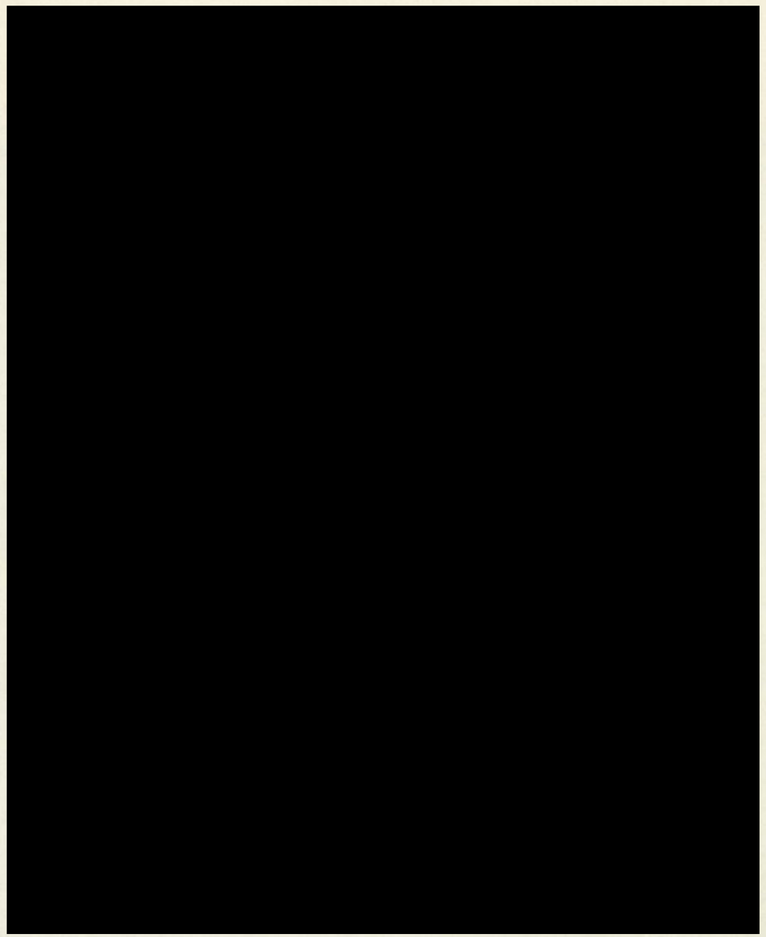


FIG. 3. Gold jewelry from Oaxaca, Mexico. Actual size. (Courtesy, Museum of the American, Indian, Heye Foundation.)

[29] Lothrop, 1936, fig. 92. Noguera, 1937, figs. 15–22. Kidder, Jennings *and* Shook, 1946, p. 238. Bennett, 1946, pl. 60.

[30] Lothrop, 1936, fig. 71.

however, like most of their Peruvian contemporaries, were not great traders and their products did not become widely distributed. It would have been entirely out of character for them to have wandered to Mexico as culture bearers. Certainly no trace of their culture has been detected north of Coclé.

The problem of sailing between Peru and Mexico involves a time element which does not favor the Rivet hypothesis. The *jangadas* or great balsa-wood rafts, provided with masts, sails, centerboards and cabins,[31] undoubtedly were capable of voyaging to Mexico, as one has recently crossed the Pacific. The northward journey would be favored by the prevailing southwesterly winds. These vessels were employed chiefly in the Guayas estuary in Ecuador and northern Peru – a region, we may remark, which has produced almost no metal objects either for Conquistadors or archæologists.

Just when the *jangada* was developed we do not know but there is good reason to believe that it was unknown to the Mochicas. This gifted people made detailed pottery models of their vessels and pictured them on the walls of their painted jars. They were reed rafts with pointed bows and square sterns. They were much larger than the *caballitos* used today off the Peruvian coast and they were shown with crews up to five in number. They did not, however, have the centerboards and sails necessary for a long voyage. Furthermore, such a vessel is inherently unsuitable for a long journey because it becomes waterlogged after a short time. To retain buoyancy it must spend approximately as much time on the beach as in the water. This would be impossible on long stretches of coast.

The Rivet hypothesis that all Mexican metallurgy came from Peru is further weakened because it can be shown that Panama exported gold to Mexico and Yucatan, and because some of these artifacts influenced Mexican styles. The gold disks illustrated in this volume almost certainly are of Panamanian origin on account of their shape and metal content. We shall show that they probably date as early as the end of the tenth century. Cast gold objects from the Isthmus also were found in the Cenote. In central Mexico, a Veraguas cast gold bell surmounted by an owl, such as is shown in our figures 99 and 101, was found at the Hacienda Tlahuilipa, State of Hidalgo.[32] Borbolla [33] illustrates two specimens in Coclé style from the Tarascan region and Caso [34] three others of unknown provenience.

A very characteristic type of Isthmian gold pendant is shaped like a frog with enormously enlarged flat feet. A few of these have been found in Oaxaca (fig. 3, *e*) [35] where they seem to be of local manufacture. The enlarged flat feet in that region were transferred to jewelry of Mixtec style, notably pendants representing a head and torso surmounting either one or two gold plaques (fig. 3, *h*).[36]

Knowledge of tin and a tin-copper alloy (bronze) in Mexico and Peru at present has little bearing on the Rivet hypothesis because so little is known about origins and chronology in either country. Bronze was not an early invention in Peru and did not come into common use until Inca times. We have no knowledge of when bronze appeared in Mexico. We do not know whether a copper age preceded it, as seems to have been the case in Peru. The implication of bronze bells in Chiriquí has not been explored. The same traders who carried gold from Costa Rica and Panama to Mexico may have introduced bronze bells to the Isthmus, or the Panamanians who voyaged to Peru and Ecuador may have imported them. There is no evidence that they were made locally.

We think it improbable that Mexican knowledge of silver was derived from Peru. In the latter country, in the centuries just before the Conquest, silver was extensively employed. It was alloyed (1) with copper (2) with gold or (3) with gold and copper. Alloyed objects containing copper were silvered on the surface by acid etching (*mise en couleur*). Articles of beaten silver – vessels, crowns, cuffs, disks, etc. – were turned out in great variety and large numbers. In Mexico, on the contrary, silver specimens have rarely been found in excavations and there is now no suggestion of pre-Spanish silver alloys, although future analyses may reveal their presence.

The scarcity of silver in aboriginal Mexico is emphasized by the accompanying figures for Mexico and Peru, which give the combined totals of Montezuma's personal fortune, plus the loot of Tenochtitlan, and Atahualpa's ransom, plus the loot of Cuzco.[37] These comparisons are fair, because in each case the Spaniards failed to secure all the available booty and they do not include gifts made directly to the King. They reveal that the Aztec were much less wealthy than the Inca in precious metals, especially silver.

TABLE II: COMPARATIVE WEALTH OF AZTECS AND INCAS AS INDICATED BY SPANISH LOOT

	Silver Marcs	Gold Pesos
Aztec	1,500	876,000
Inca	266,610	1,906,609

HISTORICAL DESCRIPTIONS

The loot secured by the Spaniards in Mexico is better known today than the booty acquired in any other part of the New World. For this there are several reasons. In the first place, there are excellent descriptions by eye witnesses of the Aztec economy as it functioned before heavy fighting started. In Peru, the Inca capital had been largely stripped of its riches before the Spaniards occupied it. Only five Spaniards saw Cuzco intact and living its normal life. None of them left a written description. Secondly, Cortés sought to impress his King with the splendor of the land he had conquered. To this end, he sent to Spain not only gold and silver but a vast array of all kinds of artifacts, some of which still exist. Meticulous inventories were prepared of all the objects shipped. And the treasure was seen and described by able historians in Spain.

Apart from some gilded objects of wood, a gold labret in Turin, a feather headdress with gold plaques in Vienna and a small jade figure with gold earrings in Florence, all the gold from the conquest of Mexico has disappeared. The inventories, however, survive and have been published.[38] These include the material secured by Grijalva and by Cortés along the coast of Yucatan, but this has not been segregated from what was acquired in Campeche, Tabasco and Vera Cruz. Hence the inventories are of little value to us in the present study of Yucatan, yet in their detail they testify to the skill of Mexican smiths. "I do not marvel at gold and precious stones," wrote Peter Martyr,[39] "But am in a manner astonished to see the workmanship excel the substance."

[31] Details of construction and performance are discussed in Lothrop, 1932.
[32] Peñafiel, 1890, fig. 114.
[33] Borbolla, 1944, fig. 14.
[34] Caso, *et al.*, 1946, facing p. 3.
[35] See also Pijoán, 1946, fig. 383.
[36] See also Saville, 1920, pls. XIV, XVI, XXI.
[37] Lothrop, 1938, pp. 51–62. It is well known that two of the three treasure ships dispatched by Cortés were captured by the French. Assuming that each ship carried booty of approximately the same value, I have multiplied the total of what reached Spain by three. Cortés claimed that he had acquired 700,000 pesos of gold before the *noche triste*, when a large amount was recaptured by the Aztec.
[38] Saville, 1920. Valle-Arizpe, 1941. Aguilar P., 1946. This list is probably incomplete.
[39] Saville, 1920, p. 197.

ARCHÆOLOGICAL FINDS

In Mexico there have been at least three finds of metal under circumstances which indicate a pre-Aztec date. One of these, described in this volume, consists of a group of gold disks from the Cenote of Sacrifice with relief decorations partly in the style of the Maya Great period, partly in Tula-Toltec style. Secondly, there are metal objects dated from Monte Alban IV which cannot be discussed until they are published. Lastly, there are gold objects from Texmilican, Guerrero, said to have been associated with Plumbate ware, which therefore are definitely pre-Aztec.

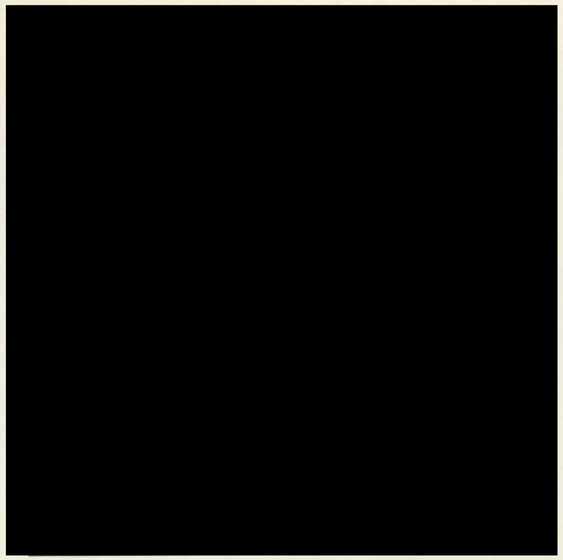


FIG. 4. Gold disk. Texmilican, Guerrero, Mexico. Museo Nacional de de Mexico. Diameter, 15 centimeters (6 inches).

In figure 4 we illustrate a gold plaque from Texmilican which can be placed in an early period by the technique of manufacture and style. It is decorated by feathered serpents with deities carrying spear-throwers issuing from the jaws. The workmanship, style and subject matter may be compared with the serpent and sky deity on one of the Cenote disks (fig. 1). The frets on both pieces recall so-called Totonac carvings and Xochicalco bas-reliefs. Beads and three gold ear spools from Texmilican have also been illustrated [40] but not enough detail is shown to permit discussion.

The best-known gold jewelry of Mexico is in the delicate Mixtec style (fig. 3) typified by the objects from the famous tomb 7 at Monte Alban. They date from just before the Conquest.[41] Practically all specimens were modeled in wax and cast but there are a few hammered pieces. In the Cenote of Sacrifice, Oaxaca metal is represented chiefly by a few copper rings (fig. 71–74). This is surprising in view of the fact that Oaxaca gold pieces were traded throughout central Mexico and even to Guatemala.[42] Probably the bulk of this trade came to the Aztec capital.

[40] Vivó, 1946, lám. 52.
[41] Caso, 1932a, 1932b.
[42] Toscano, 1944, p. 531. Oaxaca gold has recently been found at Zaculeu, Guatemala, by John Dimick.
[43] Illustrations will be found in the following: Aguilar P., Bliss catalogue, Forsyth, Keleman, Saville (1920), Toscano and Valle-Arizpe.

Apart from the Monte Alban discoveries, gold objects have been found sporadically, particularly in Oaxaca. Exact provenience usually is unknown and grave associations are unrecorded. We shall not describe these individual pieces because they have no bearing on the specimens from the Cenote of Sacrifice.[43]

Copper objects have been discovered in much greater quantity than gold in Mexico. By far the largest group consists of bells, many of which found their way to the Cenote. We shall discuss their form, composition and distribution in connection with the Cenote specimens. Copper axes and axe-moneys also are common in central Mexico but other tools are rare except in the State of Michoacan, which seems to have contained the only important tool-making center in Middle America. Gilded copper is found in this region. Two copper celts were the only tools found in the Cenote.

METALLURGY

The metallurgical knowledge of the peoples of central Mexico can be summarized as follows:

METALS	PROCESSES	ALLOYS
Gold	Hammering	Gold-silver-copper (*tumbaga*)
Silver	Casting	Copper-tin (bronze)
Copper	Welding	Copper-lead
Tin	Gilding	
Lead	Sheathing	
	Inlaying	

As a whole, the Aztec were not harsh in their demands for tribute and for the most part they received the produce of the country. This they were willing to remit in years of scarcity. In the case of Oaxaca, southern Vera Cruz and Soconusco, however, they ordered manufactured gold ornaments of definite types in definite quantities (fig. 3).

Gold

This was secured in Mexico by panning river sands. The Emperor Montezuma told Cortés that his gold came from three principal sources, Zacatula and Malinaltepec towards the Pacific and Coatzacoalco in the Mixteca. According to the surviving Aztec tribute lists,[44] the following regions made payment in gold dust; (1) eastern Oaxaca, (2) the valley of Oaxaca, (3) the Mixteca Alta, (4) the Mixteca Baja and (5) the Tlapanec area in Guerrero. In addition, manufactured articles of gold were delivered as tribute from northeastern Oaxaca, southeastern Vera Cruz and Soconusco.

All the analyses of Mexican gold we have been able to find appear in tables III and VII. There seem to be four classes of ore. The two objects at the top of table III are of pure gold with neither copper nor silver as impurities. This is unusual although a few examples have been found in southern Veraguas [45] and in Peru.[46] Oaxaca gold seems to be of two types. Assuming that Rivet's "notable" and "très notable" represent an average silver content of 7.5 and 17.5 per cent respectively, we find that eight Oaxacan specimens contain 6.7 per cent silver and seven others run 26.7 per cent silver. Six Tepic analyses show 16.6 per cent silver. Eliminating the two specimens in table III with no silver, the average amount of silver in Mexican gold is 16.1 per cent.

These figures are unsatisfactory. It is obvious that many more analyses are needed. Regional types of ores should be precisely

[44] The individual towns are listed in Toscano, 1944, pp. 523–24, and Saville, 1920.
[45] Lothrop, 1950, table II.
[46] Root, 1949, tables 3 and 4.

determined. It is known in Panama that very different kinds of gold were used for casting and for cold hammering. Mexican specimens should also be studied on this basis.

As compared to other lands, Mexican gold contains a large amount of silver. The Colombian average is 16.6 per cent for cast gold with a range from 3.6 to 36.6 per cent [47] but the Coclé average is only 3.5 per cent. No analyses of Veraguas sheet gold are available but the cast gold from southern Veraguas averages

TABLE III: ANALYSES OF MEXICAN GOLD

ANALYSIS	CATALOGUE NUMBER	OBJECT	PROVENIENCE	GOLD	SILVER	COPPER	AU./AG.	AG. × 100 / AU. + AG.
Rivet, 1946	.....	Sheets	Cholula	+	.....	....	....	....
Rivet, 1946	78.1.2267	Tooth	Tepito	+	.....	....	....	....
Root, 774*	30–6212	Rattle of foil	San Simon, Jalisco	97	1	2	97.0	1.0
Rivet, 1946	32.65.532	Zo-omorph	Oaxaca	+	Notable †	Tr.	....	
Rivet, 1946	32.65.508	Bell	Oaxaca	+	Notable	....	....	
Rivet, 1946	32.65.535	Bell	Oaxaca	+	Notable	....	....	
Rivet, 1946	32.65.540	Bell	Oaxaca	+	Notable	....	....	7.5 av.
Rivet, 1946	32.65.510	Hollow bead	Oaxaca	+	Notable	Tr.	....	
Rivet, 1946	32.65.509	Hollow bead	Oaxaca	+	Notable	....	....	
Root, 769	30.0–3370	Bead	Mitla, Oaxaca	96	3	1	32.0	3.0
Root, 777	30.1.–5242	Bell	Mitla, Oaxaca	82	5	3	16.4	5.7
Rivet, 1946	32.65.531	Zo-omorph	Oaxaca	+	Très notable ‡	Tr.	....	17.5 av.
Rivet, 1946	39.24.1	Ring	Oaxaca	+	Très notable	....	....	
Root, 775	30–10743	Mask	San Antonio del Alto, Oaxaca	40	9	51	4.4	18.4
Root, 776	30–10744	Mask	San Antonio del Alto, Oaxaca	30	10	60	4.0	25.0
Root, 778	30–10699	Bell	Valley of Oaxaca	67	30	3	2.2	30.9
Rivet, 1946	.....	Native gold	Oaxaca	64.2	35.8	....	1.79	35.8
Rivet, 1946	.....	Wire	Rio Santiago (Tepic)	75.3	24.7	....	3.05	24.7
Rivet, 1946	.....	Wire	Rio Santiago (Tepic)	79.0	21.0	....	3.76	21.0
Root, 771	30–7779§	Disk	Tepic	82	11	7	7.5	11.9
Root, 773	30–7999§	Wire-like bell	Tepic	82	14	4	3.5	14.6
Rivet, 1946	24.13.3699	Bead	Rio Santiago (Tepic)	85.7	14.3	....	5.99	14.3
Root, 772	30–7999§	Wire-like bell	Tepic	87	13	....	6.7	13.0
Rivet, 1946	.....	Native gold	Sinaloa	70.0	30.0	....	2.33	30.0
Rivet, 1946	.....	Native gold	Lower California	80.58	17.22	..	4.68	17.22
Root, 765	T.66–3	Saucer (?)	"Mexico"	68	12	20	5.7	15.0
Rivet, 1946	24.13.3702	Nose ornament	"Mexico"	+	Notable	Tr.	....	....

* Root analyses in this table are from specimens in the American Museum of Natural History.
† 5–10 per cent.
‡ 15–20 per cent.
§ Illustrated in Lumholtz, 1902, vol. II, p. 296.

10 per cent silver. The Bubí region in southwestern Veraguas has produced a small group of specimens with over 30 per cent silver.[48]

Analyses should be used with extreme caution in determining the source of individual objects, as there usually is much variation in local ores. In dealing with groups, however, they sometimes tell a definite story. For instance, Cenote disks of hammered gold contain only 2 to 3 per cent silver. This makes it improbable that they came from Mexico where hammered metal is known with 11 per cent silver plus 7 per cent copper, whereas metal exactly comparable to the Cenote disks has been detected in Coclé. Most of the cast gold from the Cenote is in Veraguas style. The average amount of silver is 12.8 per cent. The average in southern Veraguas is 10 per cent. This leads to the conclusion that the Cenote specimens came partly from the archæologically unknown north coast of Veraguas.

[47] Restrepo, 1908, pp. 30–31.
[48] Lothrop, 1950, table V.
[49] López de Gómara, 1852, p. 348.

Silver

These objects of Mexican manufacture are listed in the inventories of Spanish loot but very few have been brought to light by archæology. None was found in the Cenote of Sacrifice.

No aspect of Mexican metallurgy aroused the admiration of the Spaniards more than the objects made of two metals, usually gold and silver. Thus Gómara [49] writes, "(They) will cast a platter in a mold with eight corners and every corner of several metals, that is to say, the one of gold, the other of silver, without any kind of solder." Forsyth discovered a small head half of gold and half of silver near Teotitlan del Camino, Oaxaca.[50] No comparable specimen was recovered from the Cenote.

Silver apparently was secured in Mexico in part by mining, as was done in Peru and Chile. Mines dating from pre-Conquest times have been identified at Pachuca, Hidalgo, and near the Rio Grande in Tepic.[51] We have heard of others near Taxco.

Copper

This metal, like silver, was mined in Mexico, especially in the State of Michoacan. Copper artifacts are found all over Mexico but in largest quantity in the Valley of Mexico and the States of Michoacan and Oaxaca.

No ancient copper mines have been discovered. Analyses show that there must have been many sources. Table IV contains analyses of various objects from Oaxaca. All specimens are over

[50] Forsyth, 1909.
[51] Guillemin Tarayre, 1867.

TABLE IV: ANALYSES OF COPPER OBJECTS FROM OAXACA

Analysis Number	Object	Catalogue Number	Lead	Tin	Silver	Gold	Iron	Arsenic	Antimony	Bismuth	Remarks
107	Axe	C/26206	.0001	-4	.01	...	.0001	.1	.2	.01	Tlacoluca
108	Bell (wire)	C/3777	.01	1.0	.01	...	.01	.1	.1	.01	...
103	Axe money	C/28375	.0001	.1	.01	...	.01	.001	.001	...	Tlacoluca
783	Filigree mask	30–10805 AMNH	.01	>2.0	0.1	0.1	...	.01	...	...	Nochistlan
12	Axe	C/26206	.02	...	1.0	...	.0001	.01	.05	...	Tlacoluca
101	Axe money	C/8389	.01	.0001	.01	...	...	.01	.01	...	Tlacoluca
106	Axe	C/26023 (?)	.005	...	.01	...	...	.1	.2	.01	Tlacoluca
6	Axe money	C/47305	.01	...	.1	...	.01	.001	...	...	...
37	Axe money	C/26024	.001	...	.001	...	...	.1	.05	.001	Teotitlan del Valle
100	Axe money	C/8389	.005	...	.01	...	...	.01	.01	...	Tlacoluca
102	Axe money	C/8389	.005	...	.01	...	...	.01	.01	...	Tlacoluca
182	Axe	C/10094d	...	...	.1	...	...	.1	.05	.001	...
781	Fragment	30–317 AMNH	...	>2.0	0.1	0.1	...	...	...	...	Nochistlan
127	Axe money	30–368 AMNH	.001	-4	.1	...	...	...	...	...	Tlaxiaco
180	Axe	C/10094b	.001	...	.1	...	...	.1	...	...	...
157	Axe	C/10094b	...	.2	.001	...	...	...	...	...	...
782	Filigree mask	30–10804 AMNH	...	0.1	0.1	...	...	...	...	...	Nochistlan
158	Axe	C/10094c	...	...	.1	...	...	...	.05	...	...
179	Axe	C/10094a	...	...	.1	...	...	.1	...	...	...
181	Axe	C/10094c	...	...	.1	...	...	.001	...	...	...
159	Axe	C/10094d	...	...	.1	...	...	...	...	...	...
160	Axe	C/10094e	...	...	.1	...	...	...	...	...	...
128	Axe money	30–134 AMNH	...	...	.001	...	...	...	...	...	Ajutla
156	Axe	C/10094a	...	...	.001	...	...	...	...	...	...
538	Axe money	E 38–3 UNM	.001	...	...	...	...	...	...	...	Mitla
539	Axe money	E 38–2 UNM	.001	...	...	...	...	...	...	...	Mitla
540	Axe money	E 38–1 UNM	0.1	...	...	...	...	...	...	...	Mitla
784	Bird head	30–11534 AMNH	...	...	0.1	...	...	...	...	...	Zachila

99 per cent pure copper and those toward the bottom of the table are practically free from impurities. Many have a small amount of silver but only two have gold. Few have tin, iron or bismuth. The top of the table contains much more complex ores than the bottom.

Table V gives analyses of bells from the Valley of Mexico. All except numbers 130–132 are of copper alloyed with lead or tin. Like the Oaxaca ores, silver is present but in more stable quantities.

We have few other analyses of Mexican copper except the specimens from the Cenote of Sacrifice, most of which must be of Mexican origin. Chiapas, Guerrero and Michoacan probably supplied many of the Cenote specimens but at present we are unable to demonstrate it. In table VI we have assembled all available analyses from many Mexican states. The original specimens are now scattered in various museums. Few of them have been published and there is rarely any record of the circumstances under which they were found. Several hundred more analyses perhaps would make it possible to distinguish the ores and alloys of certain areas. At present, the only apparent pattern is that the copper alloys are found for the most part in the Valley of Mexico and the adjacent states.

Fig. 5. Lead bead. Actual size.

Lead

These ores are found in many places in Mexico and Central America, usually as galena or in combination with silver. Native lead occurs on the Pacific slopes of Guatemala where gravel beds contain 60–80-gram nuggets. A lead bead was found in the Cenote (fig. 5). As impurities it contained 2+ per cent silver, 0.1 per cent copper and .001 per cent iron.

TABLE V: ANALYSES OF COPPER BELLS FROM THE VALLEY OF MEXICO

Analysis Number	Source	Catalogue Number	Lead	Tin	Silver	Gold	Iron	Arsenic	Antimony	Bismuth	Provenience	Remarks
183	Root	C/10096a	>4.0	0.1	0.1	.001	..	0.4	.05	.01	.....	Style D
184	Root	C/10096b	>4.0	0.1	0.1	.001	..	0.4	.05	.01	.....	Style D
185	Root	C/10096c	>4.0	0.1	0.1	...	..	0.4	.05	.01	.....	Style D
186	Root	C/10096d		..	0.1	0.1	..	.001	.001	..	.....	Style A
...	A&R *	.....	13.2	..	..	...	..	...	...	..	Azcapotzalco	Style D
...	A&R	24756	17.8	..	..	...	..	...	...	..	Azcapotzalco	Style F
...	A&R	24762	19.2	..	..	...	..	...	...	..	.....	Style F
...	A&R	24753	...	7.0	..	...	..	...	...	..	.....	Style F
...	A&R	24752	...	4.7	..	...	0.1	...	...	..	Calixtlahuaca	.....
130	Root	30–223 AMNH	.01	..	0.1	...	0.1	0.1	...	..	Calixtlahuaca	Style A
131	Root	30–226 AMNH	0.1	..	0.1	...	0.1	..	...	..	Calle de Escalerillas, Mexico, D.F.	Style F
132	Root	30–9555 AMNH	0.5	0.2	0.1	...	..	0.4	.05	.05		

* Arsandaux and Rivet, 1921. Fifteen additional specimens for which no exact figures were given contained a large amount of lead.

TABLE VI: MISCELLANEOUS MEXICAN COPPER ANALYSES

Analysis Number	Object	Catalogue Number	Lead	Tin	Silver	Gold	Iron	Arsenic	Antimony	Bismuth	Provenience
165	Wire-like bell	99042 USNM	.001	>2.0	2.0	...	...	.001	...	...	Guerrero
...	Chisel *	(?)	.83	3.07	...	...	.53	...	...	...	Acatlan, Gro.
126	Bell	30–2475 AMNH	.001	...	0.1	...	...	...	...	...	Guerrero
125	Hoe	30–3872 AMNH	...	...	0.1	...	.01	...	...	...	Michoacan
...	Wire-like bell †	G.M.23.6.413	.02	6.95	...	...	...	...	>0.1	...	Nochistlan, Zac.
450	Bell	MN, Mex.	0.1	...	2.0	...	...	...	...	...	Iguala, Gro.
457	Copper frag.	MN, Mex.	...	...	0.1	.001	...	.001	.001	...	Texmilican, Gro.
435	Bell	Gila Pueblo	...	...	0.1	...	...	0.1	...	...	Michoacan
434	Bell	Gila Pueblo	...	...	0.1	...	...	...	...	...	Michoacan
796	Turtle bell ‡	30–2028 AMNH	.001	0.1	0.1	...	...	...	...	...	Zacapa, Michoacan
797	Turtle bell	30–2028 AMNH	.	0.1	0.1	...	...	...	...	...	Zacapa, Michoacan
452	Bell	MN, Mex.	...	...	0.1	...	...	>1.0	.01	.01	Teotihuacan
454	Bell	MN, Mex.	.01	...	...	.01	...	.0001	.01	.01	Teotihuacan
449	Bell	MN, Mex.	...	...	0.1	...	...	...	.01	.01	Cholula
455	Bell	MN, Mex.	.01	...	...	.01	...	.0001	.01	.01	Tenayuca
456	Bell	MN, Mex.	...	...	0.1	.01	...	.0001	.01	...	Calixtlahuaca
785	Filigree ring	30.0.16 AMNH	...	...	2.0	...	...	...	...	...	Calixtlahuaca
786	Filigree ring	30.0.15 AMNH	...	>2.0	0.1	0.1	...	.01	...	...	Calixtlahuaca
787	Mask	30.0.218 AMNH	>4.0	>2.0	0.1	...	...	...	...	...	Calixtlahuaca
788	Fragment	30–7277 AMNH	...	0.4	0.1	...	...	...	...	...	Calixtlahuaca
872	Wire-like bell	97782 USNM	.01	...	.001	...	...	...	...	...	Orizaba
873	Wire-like bell	97782 USNM	.01	...	.001	...	...	...	...	...	Orizaba
874	Mask	99045 USNM	...	0.1	.001	...	...	...	...	...	Tlaltelolco, Tlaxcala
453	Bell	MN, Mex.	.01	>2.0	.001	...	...	.0001	...	...	Carmen, Campeche
795	Small bell	30.0.1682 AMNH	...	0.4	.1	...	...	...	...	...	Huy, Yucatan
152	Small bell	30.0.1682 AMNH	.01	>2.0	.1	...	...	.001	.0001	...	Huy, Yucatan
794	Large bell	30.2.4518 AMNH	...	0.4	2.0	0.1	...	0.1	...	...	Jopoy, Vera Cruz
790	Wire-like bell	N.53(?) AMNH	0.5	...	0.1	...	...	...	...	...	Medellín, Vera Cruz
791	Wire-like bell	N.53(?) AMNH	0.5	...	0.1	...	...	...	...	...	Medellín, Vera Cruz
792	Wire-like bell	N.53(?) AMNH	0.5	...	0.1	...	...	...	...	...	Medellín, Vera Cruz
1369	Bell §	30.2–6816 AMNH	...	...	0.1	...	...	...	...	...	Las Flores, burial 7
1370	Ear spool	30.2–6813 AMNH	...	...	...	...	...	...	...	...	Las Flores
1371	Bell	...	...	...	...	...	...	...	...	...	Huasteca region
1372	Ear pendant ¶	30.2–6820 AMNH	...	...	...	...	...	...	...	...	Las Flores, burial 14
789	Wire-like bell	30–2689 AMNH	...	...	0.1	...	...	...	...	...	Atoyac, Jalisco
543	Wire ring	UNM	...	...	...	...	...	...	...	...	Zape, Durango
542	Celt	P 38–1 UNM	...	.01	...	...	...	...	...	...	Calle de Escalerillas, Mexico, D.F.
766	Bell necklace	T 66–5 AMNH	>4.0	>2.0	.01	...	...	...	...	...	"Mexico"
875	Bell	99036 USNM	...	...	.001	...	...	...	...	...	"Mexico"

* Phillips, 1925, p. 552.
† Hultgren, 1925, p. 208.
‡ Lumholtz, 1902, vol. II, p. 414.
§ Ekholm, 1944, fig. 51, *c*.
¶ Ekholm, 1944, fig. 51, *d*.

Tin

This is relatively scarce in Mexico. The most productive regions are in Guanajuato and San Luis Potosí. Cortés,[52] who needed tin to cast new cannon, wrote of the Taxco district, "I found among the natives of Tachco small pieces of tin, very thin and in the form of coins." The only object of tin now known from Mexico is the moon disk illustrated in figure 62, *a*. It contained impurities in the following amounts: copper, 0.1; silver, .001+; lead, 1.0; iron, .01; arsenic, 0.1; antimony, .001 +; bismuth, 0.1. Tin beads were among the artifacts secured by Grijalva in 1518.[53]

Alloys

The use of alloys is characteristic of regions where the art of metallurgy is highly developed. To be of value an alloy must have some quality not possessed by the individual metals which have been combined, such as hardness or lowered melting point. In Mexico the natives used three different combinations of metals: gold-copper (*tumbaga*), copper-tin (bronze) and copper-lead. We shall now examine the properties of these.

TABLE VII: MEXICAN *TUMBAGA* ANALYSES

Analysis Number	Catalogue Number	Object	Provenience	Gold	Silver	Copper	Ag. × 100 / Au + Ag.
Rivet	24-13-3704	Pendant	Oaxaca	40.3	29.1	30.6	41.9
Rivet	.....	Jaguar figurine *	Chichen Itza	35.0	3.0	60.0	8.0
Rivet	32.65-553	Zo-omorph	Oaxaca	+	+	ca. 20.0	...
Rivet	32.65-554	Zo-omorph	Oaxaca	+	+	ca. 20.0	...
Root, 775	30–10743 AMNH	Mask	San Antonio del Alto, Oaxaca	40	9	51	18.4
Root, 776	30–10744 AMNH	Mask	San Antonio del Alto, Oaxaca	30	10	60	25
Root, 765	T. 66–3 AMNH	Saucer (?)	"Mexico"	68	12	20	15

* This piece probably was imported from Panama.

Tumbaga

This essentially is a mixture of gold and copper but often contains silver as an impurity. We have discussed its qualities elsewhere [54] and pointed out its peculiarities. Smell, color and hardness may have made it desirable to the natives but its great advantage is a very practical one. Gold melts at 1063° C. and copper at 1083° C. but, when the two ores are combined in amounts ranging from 10 to 40 per cent copper, the melting point is lowered by at least 100° C. The eutectic alloy is 18 per cent copper and 82 per cent gold, which melts at 878° C. Sir Walter Raleigh was told by Indians of the Guianas that they were unable to melt gold unless copper were added. This was also stated by the Boruca of southern Costa Rica. *Tumbaga* can be made as hard as bronze by cold hammering.

Tumbaga was manufactured from southern Peru (Chincha Islands) northward to Mexico and in the Antilles (Haiti). It is most frequently found perhaps in Colombia. In Mexico it is not possible to say how important it was until more analyses are available. Rivet [55] has published four examples and Root has analyzed three specimens. We give their results in table VII. All these pieces are from Oaxaca except the Chichen Itza specimen which, from its form and silver content, probably was imported from Panama. At present then we may state that no Mexican *tumbaga* is known except from the State of Oaxaca. Of the seventeen analyses we present of Oaxacan gold artifacts, six are *tumbaga* alloys.

Mexican Bronze, By W. C. Root

Tin is soluble in copper up to 10 per cent. To this point tin hardens copper and makes it easier to cast as it reduces the tendency of the copper to form bubbles. This is analogous to the effect produced when lead is added to copper. Alloys with 10 per cent tin have the maximum expansion on cooling and consequently give the sharpest castings. There is an increase in brittleness along with the increase in hardness. For this reason 7–8 per cent of tin is the upper limit for the free working of the metal unless special annealing is employed.

Tables VIII and IX list Mexican bronze objects by their form and their origin. They indicate that bronze, like the copper-lead alloy, comes principally from the Valley of Mexico and Michoacan.[56] They also show that bronze was used in the manufacture of bells, axes, needles, lance points and awls, but disks, rings, sandals, ear plugs and axe moneys contain no tin. Table X shows the percentage of tin in various objects from the Valley of Mexico.

There is no doubt that the ancient Mexicans manufactured objects from bronze and that the objects were those in which hardness was a desirable feature. But it is not so certain that they knew how to manufacture this bronze from tin and copper. The chief evidence for supposing that bronze was accidental is the following statement by Herrera.[57] "There are very abundant copper mines in this district (Zacatula and Colima) more towards the East, and near the port of Santiago. The Indians make marvelous vessels of this copper because it is sweet. They have, however, still another kind of copper, which is hard, and which they use for tilling the ground, instead of using iron, for they were not acquainted with iron before the Spaniards came." This may mean that the natives used a stanniferous or arsenical copper that was much harder than ordinary copper, or that Herrera was ignorant of the native knowledge of bronze and mistook their bronze for another kind of copper.

Due to the lack of analyses of Mexican copper ores it is impossible to say whether stanniferous copper is found in Mexico or not. But because of the scarcity of tin ores it can be assumed that if stanniferous copper does exist it is of infrequent occurrence. The fact that only one Mexican bronze specimen contains over 7 per cent tin lends some credibility to the statement of Herrera.

[52] Cortés, 1843, p. 412.
[53] Saville, 1920, p. 17, quoting Gómara.
[54] Lothrop, 1937–42, part I, pp. 78–81. Rivet, 1946, pp. 47 ff.
[55] Rivet, 1946, p. 58.
[56] *See* p. 14, above.
[57] Herrera, 1730, p. 21.

TABLE VIII: FREQUENCIES OF ANALYZED COPPER AND BRONZE ARTIFACTS BY AREAS

Provenience	Number of Specimens	Number with >2% Tin	Percentage of Bronze
El Salvador	1	...	...
Honduras	20	2	...
British Honduras	6	...	...
Guatemala	10	...	...
Yucatan	112	2	2
Oaxaca	28	2	7
"Mexico"	62	11	18
Valley of Mexico	61	21	34
Michoacan	4	2	50
New Mexico	19	...	...

If this view is correct, the Mexicans probably discovered that the metal from particular mines was harder than ordinary copper and more suitable for making awls, needles, etc. They must have discovered this by trial, for the color of copper containing this amount of tin is only a little yellower than pure copper.

In favor of the belief that Mexican bronze was artificially made is the fact that tin was known and used as an independent metal (fig. 62, *a*). If a gold-copper and a lead-copper alloy were manufactured, why not one of tin-copper?

TABLE IX: FREQUENCIES OF ANALYZED MEXICAN COPPER AND BRONZE ARTIFACTS BY TYPES

Objects	Number of Specimens	Number with >2% Tin	Percentage of Bronze
Disks	1	...	...
Rings	12	...	...
Sandals	4	...	...
Ear plugs	3	...	...
Axe-moneys	43	...	...
Bells	161	7	4
Chisels	11	1	10
Axes	40	10	25
Needles	11	8	78
Lance points	7	6	86
Awls	4	4	100

Since 7 per cent is the maximum amount of tin that bronze can contain if it is to be cold worked, the fact that Mexican bronze averages about 4 per cent and does not exceed 7 per cent may be considered as evidence that the ancient Mexicans had a considerable knowledge of the properties of bronze and closely regulated its manufacture.

South American bronzes contain more tin than Mexican. Mathewson [58] has pointed out that Peruvian axes, etc., average only 5 per cent tin because this is near the limit of safety in cold working. The increased hardness resulting from a higher percentage of tin is less than that obtainable from hammering the 5-per cent alloy. On the other hand, Peruvian bronze ornaments, which did not have to be cold worked, contain up to 10 per cent of tin — the optimum amount for casting. The Mexicans, unlike the natives of Peru and Bolivia, were probably unaware of the desirability of adding tin to the copper from which ornaments were to be made but understood merely its hardening properties. It therefore seems that there was no relation between the use of tin in aboriginal Mexico and South America.

Rivet [59] states that forty-nine out of one hundred and fifty-three analyzed copper objects from Mexico contained tin in sufficient quantity to be considered bronze. This amounts to 32 per cent. The hitherto unpublished material in our tables IV, V, and VII indicates that about 15 per cent of the Mexican copper, apart from the Cenote finds, can be regarded as bronze. Such figures mean little, however, unless the exact provenience of individual specimens is recorded.

TABLE X: FREQUENCIES OF VALLEY OF MEXICO BRONZES BY TYPES

Object	Number of Specimens	Number with >2% Tin	Percentage of Bronze	Percentage of Tin in Objects
Bells — smooth	9	1	11	6 †
Bells — wire-like	28	2	7	4.7; 7.0
Axes	12	6	50	3; 3; 3; 3; 7.6; 6
Chisels	2	1	50	2.13
Lance points	7	6	86	2.5; 3; 3; 3; 3; 3.4
Awls	2	2	100	2.0; 3.6
Needles	2	2	100	6.0; 6.0

†In this table, Rivet's *** equals 6 per cent and his ** corresponds to 2 per cent.

Copper-lead Alloys, By W. C. Root

Bells of copper alloyed with lead have been found in central Mexico and in Yucatan.[60] Arsandaux and Rivet [61] have noted strong indications of lead in twenty-three out of forty-two bells from Oaxaca and the Valley of Mexico examined by them. Four of the analyzed bells contained 4.3, 13.2, 17.8 and 19.2 per cent of lead. No bell contained a considerable quantity of both lead and tin.

Three of the twelve bells examined by me from northern and western Mexico, the Valley of Mexico and Oaxaca contained as much as 2 per cent lead. Nineteen out of eighty-four bells from Yucatan contain 2 or more per cent of lead and of these thirteen had more than 4 per cent. None of the eight bells examined from Central America contained over 1 per cent of lead.

It is quite apparent that the region where lead occurs in bells is confined to the vicinity of the Valley of Mexico, although the exact boundary cannot be fixed with certainty. For instance, due to the small number of analyses available, is is not known whether lead was used in Oaxaca, Puebla, Guerrero, Chiapas, etc. Since Yucatan had no ore bodies, it seems certain that the plumbiferous bells found there originated in Mexico.

This is confirmed by table XII where bells are arranged by types — wirework or smooth. In the Valley of Mexico 92 per cent of plumbiferous bells are wirework and in Yucatan 83 per cent. This close agreement can only mean one thing — that the bells were imported from Mexico. If the bells had been made in Yucatan, it does not seem likely that lead would be confined almost entirely to the wirework type when the smooth type is three times as common.

[58] Mathewson, 1915, p. 538.
[59] Rivet, 1946, pp. 18–19.
[60] *See* table XII, p. 16.
[61] Arsandaux and Rivet, 1921a, p. 271; 1923a, p. 71.

The problem now is – why did the ancient Mexicans add a considerable amount of lead to the copper from which they made their bells, particularly of the wirework type? Copper alloyed with more than 0.1 per cent lead is unworkable. It is, however, easier to cast and the melting point is lower than that of pure copper.

TABLE XI: FREQUENCIES OF BRONZE AND COPPER-LEAD BELLS BY AREAS

Provenience	Number of Bells	Number with >2% Tin	Percentage >2% Tin	Number with >4% Lead	Percentage >4% Lead
Southwest U.S.	24	...	...	...	...
West coast, Mexico	3	2	66	...	...
Valley of Mexico and "Mexico"	61	21	34	25	41
Oaxaca	3	1	33	...	...
Yucatan	89	2	2	13	15
Chiriquí	8	...	...	...	...

Lead also gives copper bells a more pleasing tone. Arsandaux and Rivet assume that it was because of this improvement in tone that the ancient Mexicans added lead to the copper. This does not seem to me to be an adequate explanation, for the bells are small and cannot be compared with modern church bells. I think that lead probably was added to improve the casting qualities of the copper. If this explanation is correct, filigree-like copper rings and ornaments should contain lead. Two rings analysed by Arsandaux and Rivet contained no lead or tin. Two Yucatan rings examined by me contained 0.5 per cent lead but this cannot be considered intentional.

TABLE XII: FREQUENCIES OF COPPER-LEAD BELLS BY TYPES

Provenience	Type	Number of Bells	Number with >4% Lead	Percentage
Valley of Mexico	wire	40	23	57
Yucatan	wire	21	10	48
Valley of Mexico	smooth	11	2	19
Yucatan	smooth	68	2	3

Lead is sometimes found in artifacts from the high plateaus of Peru and Bolivia but the circumstances are unlike those in the Valley of Mexico because the South American objects contain a considerable amount of tin in addition to the lead. Mexican bells contain little or no tin. None of the South American specimens are bells; all of the Mexican plumbiferous objects are bells. The South American objects contain 6 per cent lead as a maximum; the Mexican bells contain up to 20 per cent. It is very probable that the lead in the South American artifacts is accidental. It is difficult to see, as Arsandaux and Rivet have pointed out, how the lead in the Mexican bells can be anything but intentional.

METALLURGICAL PROCESSES

The excellence of aboriginal Mexican jewelry evidently was due to the innate skill of the craftsmen who manufactured it, rather than local innovations in technique. The processes employed in Mexico were also employed in the Isthmus and South America. This is not to say that all methods flourished in each region nor that all techniques were known in Mexico.

Sahagún's Description. The only extensive and illustrated account of metalworking in aboriginal America was written by Fray Bernardino de Sahagún, and probably applies to the inhabitants of Azcapotzalco, a town near Tenochtitlan which was famous for its craftsmen. We reproduce in half-tone colored drawings which were made under Sahagún's direction by native craftsmen (fig. 6). The original text, written in Nahuatl, was translated into French by Seler.[62] We reprint an English translation of the French text made by Saville.[63]

1. Here is treated the manner of working of the goldsmiths, who make a mold by means of charcoal and wax, applying to it designs, and in this manner fuse gold and silver.

2. They commence their work in the following manner: First the master gives them the charcoal, which they grind very fine.

3. And when it is ground they add a little clay, the glutinous earth which they use in their pottery. They mix the charcoal with clay and stir it, and knead it in such manner that the two substances constitute one solid and compact mass.

4. And when they have the mass prepared, they shape it into thin discs which they expose to the sun, and in the same manner they shape still more discs consisting of clay alone, and they expose them to the sun.

5. For two days these objects dry, so that they become very hard.

6. When the charcoal is well dried and very hard, it is cut, then it is carved by means of a little scraper of copper.

7. That which is cut shall resemble the original and must have life, for whatever may be the object that is intended to be manufactured, the form resulting from it must resemble the original and have life.

8. For example, if they wish to manufacture an ornament for the Huastecans (who live on neighboring soil), with their great nose arch, the hole piercing the partition of the nasal passages, where an arrow is inserted which goes across the face, and having the body tattooed, decorated with figures of a serpent by means of obsidian needle points, they fashion the charcoal paste in this manner, cut it out and cover it with the above mentioned designs.

9. They are very careful to consider what animal they wish to imitate; how its being and its aspect must be represented.

10. For example, if they wish to imitate a turtle, they fashion the charcoal in this form. They make its shell, in which it can move, from the bottom of which its head looks out and from which its four feet extend and move about.

11. Or if they desire to give the shape of a bird, the charcoal is cut and carved in this manner with its bird plumes, its wings, its tail and its feet.

12. Or if they might wish to make a fish, they carve out the charcoal in the form of a fish covered with scales, and they mold its fins, its sides and its forked tail.

13. Or when they desire to make a crab or a lizard, its feet are molded.

14. Whatever may be the animal which they wish to imitate, it is carved out of charcoal in this manner.

15. Or if they wish to manufacture a gold collar besprinkled with precious stones, provided with bells on the lower edge and decorated with reliefs and with designs of flowers.

16. When the charcoal is prepared in this manner, and is provided with designs and is carved out, they boil the wax, and they mix it with white copal, by which it becomes very compact.

17. Then they clarify it by filtration, in order that the impurities of the wax, the dirt and the clay which are mixed with it, may be well settled out.

18. When the wax is prepared, they thin it out on a flat stone, and flatten it by means of a cylinder of wood which they roll over it by hand.

19. They thin it out and flatten it on a very smooth stone.

20. When the wax is very thin like the web of a spider, and is not more thick in any one place, they apply it on the charcoal, (which has been carved out) and they cover the charcoal with wax.

[62] Seler, 1892.

[63] Saville, 1920, pp. 125–41.

21. And they do not do it heedlessly, but they carefully cut a small piece nearly corresponding to the dimensions of the object.

22. They coat over the salient parts and cover the hollows, especially where the charcoal has been carved.

23. The wax is applied (to the charcoal) by means of a bit of wood.

24. And when all is done in this manner, and the wax is put on all parts of the charcoal, they put pulverized charcoal on the surface of the wax.

25. They grind the charcoal powder well, and they spread a rather thick layer on the surface of the wax.

26. And when all is prepared thus, they put on it another covering; the shell which encompasses the mold and encloses it all over.

27. The making of the shell is the last of the processes intended to give the gold its form.

28. This shell is also made of charcoal, mixed with clay, but the charcoal is not finely ground, only roughly crushed.

29. When the mold is enclosed and encompassed by the shell, they let it dry for two more days.

30. Then they put on the spout, which is made of wax also, (encompassed by a shell).

31. The latter serves as a drainage canal, by which the melted gold enters.

32. And then they place the crucible on the ground, which is also made of charcoal (and of clay) and which is hollow.

33. In like manner they set out the (mold, with its shell, both made of) charcoal.

34. It is there where the gold is melted, in order then to enter the spout, and being conducted by the latter, to flow below and run out.

35. And when it is melted and run into the mold, and when, for example, they have manufactured a collar, or one of the various objects mentioned in this chapter, they polish it by means of a stone.

36. And when it is polished, they put it in an alum bath.

37. They grind the alum, and they soak in it and wash with it the gold jewel which they have cast.

38. A second time they put it in the fire, and heat it inside.

39. And when it comes out of the fire, they bathe it a second time, and smear it with ointment of gold, which is composed of muddy earth mixed with a little salt, by means of which the gold becomes beautiful and very yellow.

40. And thus they rub and polish and make beautiful the jewel, so that it becomes very brilliant, resplendent, and radiant.

41. They narrate that formerly there was only the gold; that it was only the gold which they used and that the goldsmiths poured it in the mold and formed of it collars, and that the smiths hammered it, and flattened it and made of it the embossed work which serve for all kinds of military devices of which there was need.

42. Silver did not exist, except in the places where it was found (like natural silver), and it was greatly valued.

43. But now they use only silver (for trinklets), for the gold is too valuable.

44. Now, the goldworkers, the founders, and the smiths, if they manufacture some jewel, employ copper for it as well.

45. But they add to the silver only a moderate and measured quantity, which alloys itself with it.

46. And if the gold is cast without alloying the work is broken up.

47. And the reliefs which are welded on it are not attached on all sides nor without cracks.

48. Likewise the ancient goldsmiths neither worked nor hammered out any other metal than gold.

49. After they had beaten the gold, they polished it and furbished it and put designs on it, conforming to the tracings of the drawing.

50. In the first place they asked the feather-workers to trace the design for them.

51. Then they themselves put on the design by means of a stone point.

52. In putting on the design by means of the stone point, they followed the trace.

53. They made corrugations, keeping always to the model.

54. In the same manner they work today, especially where one has need of their works.

55. And if by chance they need a piece of feather-work, they address themselves to the feather-workers, who cut out all kinds of work in feathers which are presented to them.

56. Today the goldsmiths work in the following manner.

57. They wish to search for fine sand.

58. Then they grind it very finely and mix it with the clay.

59. They fashion the clay according to that which is to be represented, whatever may be the object that they wish to manufacture, and they put the pieces out on the ground.

60. They let them dry for two days.

61. When the piece is quite dry, they scrape the entire surface by means of a potsherd, so that it becomes very smooth.

62. Then the piece is shaped and cut out by means of a scraper of copper, as was related elsewhere.

63. In two or three days, they bring the indicated operations to an end.

64. When all is ready, they spill some pulverized charcoal on the surface, producing a smooth surface by means of the paste.

65. They boil the wax, and they add to it the white copal, as has been described before.

66. And when the wax has become cold and when it has become clarified, they thin it out and roll it out on a flat stone by means of a wooden roller.

67. Then they apply the wax on the surface of the clay mold which is to be cast in gold, whatever may be the object that they wish to manufacture, and they bind it to it.

68. It may be that they wish to make a jug or a scent box that is called a *perfomador*.

69. They furnish it with beautiful designs (worked in wax).

70. For the wax lends itself to this better (than clay), and it is more easily worked and modeled into designs.

71. For this reason they make, in the first place, a copy of the relief in wax separately, and when the body of the mold is made, they press (the replica of the relief in wax) on the mold.

72. For the wax is the material with which one can form each detail of design.

73. It may be a wing, it may be the tail of a bird, it may be a flower, it may be a leaf, a handsome ornament of some sort.

74. They press the wax against the surface of the mold and affix it there by means of a small bit of wood called *quauhuitztli* (thorn of wood, point of wood).

75. In about two days all is completed.

76. When all is done in this manner and the wax has been affixed on the entire surface of the mold, they coat it over with pulverized charcoal.

77. After it has become dry, they put the shell on it, made of charcoal coarsely crushed (mixed with clay), and enclose the mold with it.

78. For about two days, they let it dry.

79. Then they put on it the cylinder of wax, called *anillotl* (spout).

80. At first they roll it (to give it a cylindrical form); it serves as a drainage canal by which the gold enters.

81. And when the spout is so placed, they put the crucible in which the gold will be melted, out on the ground.

82. After everything is done in this manner they put everything in the fire, and they heat it.

83. It is at this point that the wax which is inside, comes out and is consumed.

84. When the wax has come out and when it has been consumed, they allow the mold to cool again and they place it on a bed of coarse sand.

85. Immediately afterward they turn to the melting (process). They put and place in the pot the charcoal (the mold composed of clay and charcoal).

86. The gold which it is intended to put in, they liquefy separately in a spoon.

87. Thus the work is ended, the task is done.

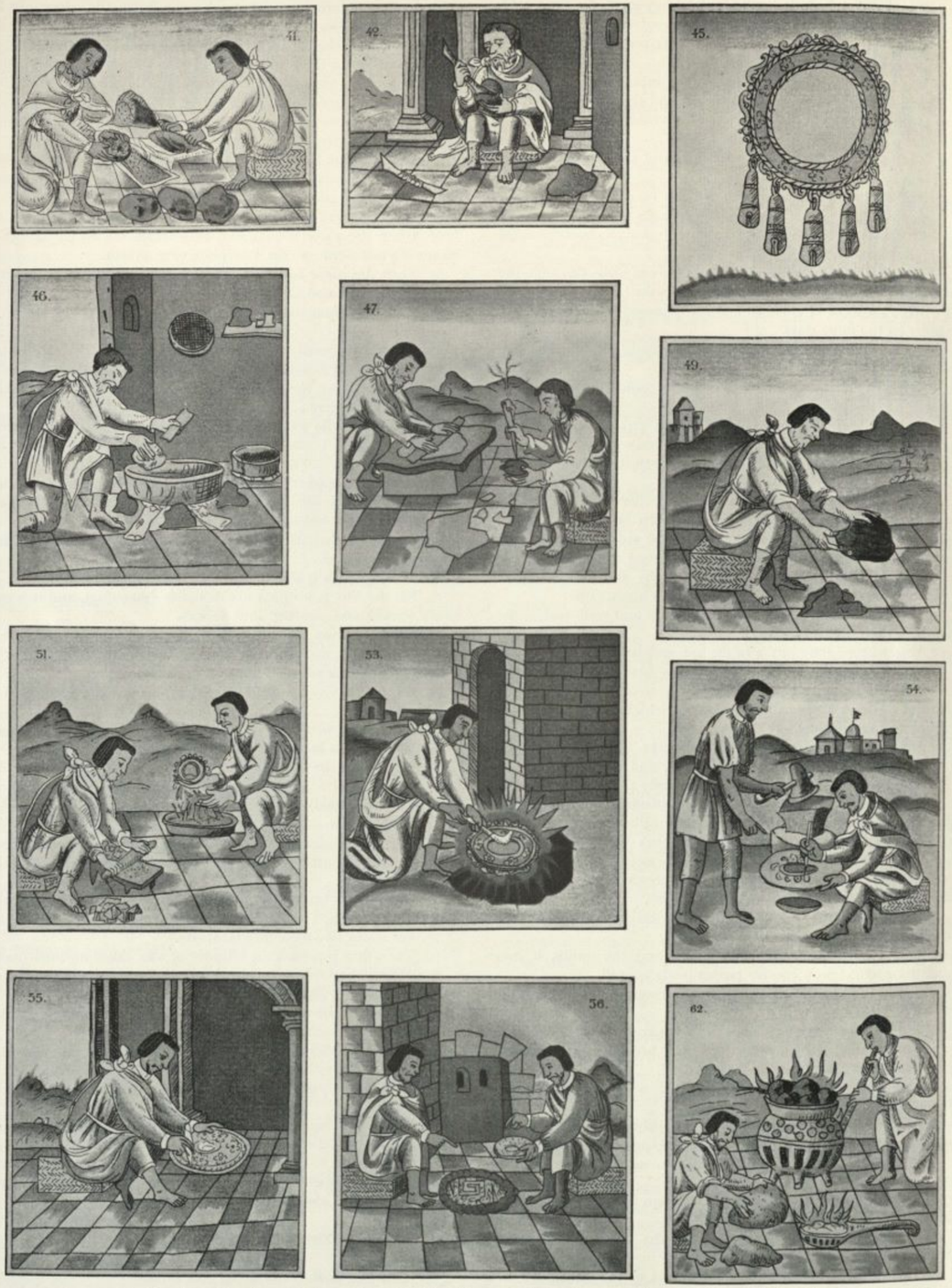


FIG. 6. Aztec goldsmiths. After Sahagún, 1938, lib. 9, vol. 3, pls. LV–LVIII. *41*, Grinding clay; *42*, making a mold; *45*, typical gold ornament; *46*, boiling in salt and clay solution; *47*, rolling wax and carving molds; *49*, placing outer cover of mold; *51*, alum bath; *53*, hammering hot metal; *54*, cold hammering and engraving; *55*, embossing; *56*, feather-worker submits design to embosser; *62*, smelting.

88. And when the object is made, in order that it be melted and flow out of the crucible, they put it in a bath, prepared with a solution of alum in a copper vessel and they boil it.

89. And if the object is broken in some part, or if it is cracked, they mend separately the damaged sections and they solder on the broken part.

90. Then they scrape it and polish it by means of an instrument of copper.

91. And they immerse it in another alum bath.

92. Finally they polish it and furbish it so that it becomes very brilliant.

Sahagún's account is so rambling and obscure that it is far from satisfactory. Careful reading brings out the fact that metalworking is described twice. One account, which includes paragraphs 1–42 and 48–53, applies to purely aboriginal techniques. The other, paragraphs 43–47 and 54–92, refers to processes used "now," *i.e.*, after the Conquest. The differences are not great, chiefly a new method of forming molds which probably was introduced by the Spaniards. The types of objects manufactured of course changed with the times.

Sahagún's illustrations are a disappointment because they lack detail. Perhaps they would arouse the memory of someone who knew exactly what they were intended to represent. For the most part, however, it is not possible to link them with the text. This is especially unfortunate in regard to the various tools employed. The subject of metalworking tools throughout the New World is discussed in Appendix II.

Sahagún [64] elsewhere in his text makes it clear that the artisans who worked in gold and silver were of two basic kinds for he writes: "Some of them are called beaters. These worked gold with the hammer, pounding with hammers to make it thin like paper. Others are called *tlataliani*, that is, those who fuse gold, or anything else in it, or silver. They are the true artisans, who are also called by another name, *Tulteca*, but they are divided into two classes, because each one works the gold according to his manner."

Hammering. The most primitive type of metalworking is hammering objects of the desired form from nuggets of native metal. In parts of Peru, where archæology reaches far into the past, hammering is the only technique and gold is the only metal. In paragraph 48 quoted above from Sahagun, there is a suggestion that this was also true in Mexico. If so, the Cenote battle-disks (figs. 29–37) may belong to such a golden age. We doubt it, however, because bells which seem to be of types cast in Mexico are worn by some of the warriors. Also the specimen in figure 4 may be of early date, as well as a conventionalized bird of sheet gold illustrated by Aguilar.[65] At present, we know of no cast metal from Mexico other than bells which seems of equivalent age.

Paragraphs 49–52 tell of a curious division of labor. It seems that the workers in embossed sheet metal did not make their own designs but called in the featherworkers to draw a pattern which the metalworkers then executed with a pointed stone tool. If the designing was assigned to others, we would expect it to be entrusted to sculptors or painters. That the featherworkers assumed this task is an unspoken tribute to the esteem in which they were held for their artistic ability.

We have already quoted Sahagún's statement that the smelters rather than the hammerers were the "true artisans." Perhaps among the Aztec the individual with less artistic ability remained a hammerer and called in a designer to help him, while a more gifted worker advanced to the casting technique which brought him greater rewards.

Casting. The technique of casting described by Sahagun is known today as *cire perdue*. It apparently was employed wherever casting in closed molds was practised in the New World. Essentially it consists of making a wax replica of the object to be cast, enclosing it in a mold and replacing the wax with metal. Ingenuity and skill make possible complex filigree-like castings which give the impression that various elements have been soldered or welded together (figs. 3, *g*, *h*; 86).

Welding. In paragraph 47 Sahagún mentions welding but does not state how it was accomplished. Probably he refers to autogenous soldering, a process in which a metal with a slightly lower melting point is used to join two sections of metal. How bimetallic objects were made in Mexico we do not know. Peruvian disks of gold and silver we have examined had the contact edges sharply beveled to increase the bearing surfaces.

Gilding and Comparable Processes. Historical statements indicate that the Mexicans learned to make gold leaf from the Spaniards. As a matter of fact, however, leaf-gilding definitely existed in aboriginal times but the natives did adopt the Spanish technique after the Conquest. A number of gilded Aztec wooden objects, including spear-throwers and the frames of obsidian mirrors, are still in existence. We shall describe in this volume certain artifacts of sheet copper with a very thin surface of gold which seems to have been applied as leaf (Appendix I).

In addition, the Mexicans produced a golden surface on copper-gold alloys by etching away the copper in acid, presumably in the form of a plant juice.[66] This process, known as *mise en couleur*, is not a true gilding because no metal is added, but it produces a surface of nearly pure gold which can be renewed at any time if it becomes worn.

We have seen that Mexican gold ores usually contain a large quantity of silver (tables III and VII). In paragraphs 38 and 39 of the passage quoted from Sahagún (p. 17) there is a suggestion that surface silver may have been removed by a process comparable to *mise en couleur*, but this cannot be fully accepted until it has been detected under the microscope as has *mise en couleur*.

Silver normally is separated from gold by strong acids, which were not available to aboriginal Americans. Bergsøe,[67] however, describes a primitive process of eliminating silver from gold by means of clay, salt and heat. This was reported by W. Gowland, who went to Tokyo in 1872 to take charge of the assay work at the Imperial Japanese Mint. "The gold was coarsely ground, mixed with common salt and a certain proportion of clay. Piled up in the form of a cone on an earthen dish. Put into a charcoal furnace and kept at red heat; insufficient to melt the gold, for at least twelve hours. The silver was converted into chloride, which was absorbed by the clay."

The Sahagún text is none too clear, perhaps because of the multiple translations from Nahuatl to German to French to English, perhaps because Sahagún had not himself mastered the processes he describes. In paragraphs 38 and 39, however, he mentions the essential parts of the Japanese method, namely an ointment composed of muddy earth mixed with salt and a second heating of whatever was cast, "by means of which the gold becomes beautiful and very yellow."

[64] Sahagún, 1829, tomo II, lib. IX, cap. XV, p. 387.
[65] Aguilar P., 1946, pl. XVI.
[66] Saville, 1920, note 62.
[67] Bergsøe, 1938, p. 49.

Bergsøe points out that if the Aztec understood how to remove surface silver from argentiferous gold they may also have been able to remove it from a body of ore by grinding it up in the Japanese manner. Native gold without silver is very rare, but two Mexican manufactured objects of this nature appear in the top of table III. We must remember, however, that silver, like copper, in combination with gold materially reduces the melting point and the presence of silver facilitates casting.

In the Isthmus, both in Coclé [68] and Veraguas,[69] quite a number of gold artifacts containing no silver have been analyzed. One would expect to find such metal in worked sheets. As a matter of fact, most gold objects without silver happen to be of the gold-copper alloy known as *tumbaga* and most of them were cast rather than hammered. It does not seem probable that the natives of Panama would go to the trouble of eliminating silver from gold unless they intended to use it for some other purpose than alloying it with copper. It also seems possible that 24-carat gold is too soft to be desirable in sheet gold ornaments.

Another suggestion that American Indians could extract silver from argentiferous gold comes from Peru. When Pizarro divided the treasure secured from the ransom of the Inca Atahualpa and the loot of Cuzco, he first caused it to be reduced to "good gold." Garcilaso de la Vega [70] states that the gold averaged 22½ carats or 93.75 per cent fine. This indicates much purer metal than is revealed by most analyses of archæological objects of approximately the same age. The actual work was done by native smiths under the direction of a Spanish founder who, in the case of Atahualpa, received a fee of 3049 pesos – about 1.15 per cent. Did Pizarro have a metallurgist among his men who captured Atahualpa? Did such an individual instruct the natives how to extract silver? Or was some metallurgically ignorant favorite of Pizarro capriciously given the post of founder so that he might collect the legal fees of the office? No positive answer to these questions seems possible.

The Navaho Indians of Arizona used a method of blanching silver which may or may not be aboriginal but which may be compared with the Aztec process.[71] This consists of boiling the silver in a solution of almogen (hydrous sulphate of alumina) and salt. We clean silver today by boiling it in an aluminum pot containing a solution of salt and ordinary baking soda. Various commercial formulæ of similar nature are on sale, usually wrapped in aluminum foil on which the silver is to be placed when boiled. The soot of copal and rubber was removed by this means from some Cenote specimens of gold containing silver – long before we realized that the process had an aboriginal parallel. We should add that the normal native method of cleaning silver, from the Navaho to the Araucanians, is by polishing with wood ash.

Sheathing. Historical accounts of the conquest of Mexico speak of idols sheathed with gold or silver. There are no surviving major examples but a few small objects from the Cenote of Sacrifice were partly sheathed in gold (fig. 53).

Mosaic Inlays. The art of colored mosaics of turquoise, shells, pyrites, tortoise shell, etc., was more highly developed in Mexico than anywhere else in the New World. A few examples in metal have been found or are represented in codices.[72] The inlaying of one metal in another was practised in southern Peru but no examples are known from Mexico. Two inlaid specimens from the Cenote of Sacrifice were of Panamanian origin (fig. 92).

METALS IN THE UNITED STATES

Apart from the Southwest, copper was employed over much of the central and eastern portion of the United States. Occasional objects of gold and silver have also been found. Hammering and annealing were practised but casting and other more complex operations have not been established. Artifacts of copper are among the culture traits of the Southeast for which a Mexican origin has been claimed.

Much less is known about North American metals than one would expect, for they have never been the subject of a comprehensive technical study. Moore [73] published a number of analyses in order to refute the claim that the artifacts were of Old World origin and to establish the fact that the major sources of copper were near Lake Superior.

Many field reports in recent years have placed the stratigraphic appearance of copper in various local cultures. In general, it can be said that copper appeared in the Late Archaic or Early Woodland periods. A guess-date would be ca. 1000 B.C. If this is approximately correct, it means that metalworking in North America is much older than in Mexico and in Central America.[74] There is nothing on the ground of style or technique, however, to suggest that the use of metals in Mesoamerica was derived from the north. North America was the only continent where metal was used before the invention of pottery.

THE METALLURGY OF ARIZONA, NEW MEXICO AND NORTHERN MEXICO [75]

By W. C. Root

The analyses of thirty-two copper objects from the southwestern United States and thirty-three from northern Mexico are given in tables XIII and XIV. These specimens are of copper containing little but silver as an impurity.

Native copper ores mixed with cuprite have occasionally been found in archæological sites in the Southwest. Professor Palache of Harvard, who examined them, states that these specimens are similar to ores found today on the surface in Arizona and New Mexico, and are unlike native copper from the Lake Superior region which seldom contains cuprite. Table XIV includes the analyses of four samples of native copper from northern Mexico. They consist of a very pure copper.

Analyses of native copper from Lake Superior show that it also is pure except for a little silver.[76] No native copper from the west or east coasts of Mexico has previously been analyzed, but copper objects from these regions have been examined. In table XIV are seventeen analyses of objects from Guasave, Sinaloa, on the west coast. In table VII are four analyses of copper objects from the

[68] Lothrop, 1937–42, part I, tables IX and XVIII.
[69] Lothrop, 1950, tables II and III.
[70] Lothrop, 1938, pp. 51–52.
[71] Matthews, 1883.
[72] Saville, 1920, pls. I and VIII.
[73] Moore, 1894.
[74] Griffin, 1949, pp. 88 and 89.
[75] *See* p. 110.
[76] Phillips, 1925.

TABLE XIII: IMPURITIES IN COPPER ARTIFACTS FROM ARIZONA AND NEW MEXICO *

Analysis Number	Catalogue Number	Object	Silver	Gold	Tin	Lead	Iron	Provenience	Remarks
171	254495–USNM	Bell	2.0	.001	...	...	...	Casa Grande, Ariz.	...
166	157893–USNM	Bell	2.0	...	...	...	...	Chaves Pass, Ariz.	Stone clapper
169	177804–USNM	Bell	2.0	...	...	...	...	Four Mile Ruin, Ariz.	Stone clapper
168	173068–USNM	Bell	2.0	...	...	...	...	Tonto Basin, Ariz.	Stone clapper
432	1 Gila Pueblo	Bell	2.0	...	...	...	...	Livingston, Ariz.	...
433	2 Gila Pueblo	Bell	2.0	...	...	...	...	Livingston, Ariz.	...
1160	H–1206 ASM	Bell	2.0	...	...	...	...	Graham Co., Ariz.	...
109	C/4270 (?)	Bell	0.1	...	...	.001	0.1	Los Hornos, Ariz.	Stone clapper
549	5458 ASM	Bell	...	...	...	...	...	Miami, Ariz.	...
551	H–4270	Bell	...	...	...	...	...	Pueblo Grande, Ariz.	...
1161	A–1228 ASM	Bell	...	...	...	...	...	Graham Co., Ariz.	...
434	GP	Native copper	2.0	...	...	.01	...	Arizona	...
437	GP	Native copper	2.0	...	...	...	...	Arizona	...
438	GP	Native copper	2.0	...	...	...	...	Arizona	...
442	GP	Native copper	2.0	...	...	...	...	Arizona	...
440	GP	Native copper	...	...	...	...	...	Arizona	...
441	GP	Native copper	...	...	...	...	...	Arizona	...
174	335581–USNM	Bell	2.0	...	.001	...	...	Pueblo Bonito, N. M.	Clapper
172	334766–USNM	Bell	2.0	...	...	...	...	Pueblo del Arroyo, N. M.	...
175	335582–USNM	Bell	2.0	...	...	...	...	Pueblo Bonito, N. M.	Clapper
176	335583–USNM	Bell	2.0	...	...	...	...	Pueblo Bonito, N. M.	Clapper
163	98211–USNM	Bell	0.1	...	...	...	...	San Francisco R., N. M.	...
196	H–12755 AMNH	Bell	0.1	...	...	...	...	Pueblo Bonito, N. M.	Clapper
198	H–12754 AMNH	Bell	0.1	...	...	...	...	Pueblo Bonito, N. M.	Clapper
526	MNA	Bell	.001	...	...	...	...	Wupatki, Ariz.	...
528	MNA	Bell	.001	...	...	...	...	Wupatki, Ariz.	...
529	MNA	Bell	.001	...	...	...	...	Near Flagstaff, Ariz.	...
461	16336, Logan Museum	Bell	...	...	...	...	...	Mattocks ruins, N. M.	...
544	497 + K, UNM	Wire-like bell	...	...	...	...	...	Cox ranch, N. M.	...
545	498 + K, UNM	Bell	...	...	...	...	...	Cox ranch, N. M.	...
592	12–3896 MAI	Arrow point	...	...	...	...	...	Kechipaun, N. M.†	...
593	12–3897 MAI	Needle	...	...	...	...	...	Kechipaun, N. M.†	...

* No antimony, arsenic, bismuth, cadmium, platinum, nickel, chromium, germanium, zinc or cobalt.
† These specimens were excavated by the writer in 1923. They are probably both post-Spanish.

Huasteca region around Tampico on the east coast. They are all of pure copper except for a little silver.

Copper from central Mexico, as is indicated by the analyses in this volume, is usually impure, and frequently contains small amounts of one or more of the following metals as impurity or as an alloy – tin, lead, arsenic, antimony, bismuth, iron.

The metal in the copper objects from the Southwest is thus similar in composition to the native copper found both in the Southeast and in the Lake Superior region, and to the copper found in metal objects from both the west and east coasts. But it is quite unlike that found in central Mexico or regions farther to the south.

The metal objects so far found in the Southwest are comparatively few in number, and there has been no evidence of furnaces, crucibles or molds. The only processes involved in their manufacture are hammering and casting. There are no examples of soldering, alloying, plating, gilding or the other complex processes used in central Mexico or the regions to the south. Most of the objects are bells of a simple type, although some of them are of the wirework technique found in central Mexico (fig. 86).

Bells of exactly the same form have been found in Sinaloa [77] and to a lesser degree in the Huastec region.[78] These facts led Ekholm [79] to conclude that all of the Southwestern copper objects are trade pieces from Sinaloa. Since their composition is like that of the Sinaloan metal, this conclusion seems very probable, although a few of them may be trade pieces from the east coast.[80] There is little evidence that any of them, even the wirework bells, are from central Mexico.

The presence of cast copper in the southwestern United States has a definite bearing on chronological problems over a wide area because the comparatively accurate dendrochronology of that region indicates that copper was introduced during the Sacaton Phase at Snaketown, Arizona, which dates from 900–1100 A.D.[81] The implication of this dating in relation to Mexican and Mayan chronologies will be discussed after the Cenote metals have been described.

[77] Ekholm, 1942.
[78] Ekholm, 1944.
[79] Ekholm, 1942.
[80] Haury, 1947.
[81] Gladwin, 1937, p. 108.

TABLE XIV: COPPER ANALYSES FROM NORTHERN AND WESTERN MEXICO

Analysis Number	Catalogue Number	Object	Silver	Gold	Tin	Lead	Arsenic	Antimony	Bismuth	Provenience
367	4479–35 GP	Bell	2.0	...	...	...	...	...	...	Casas Grandes, Chihuahua
369	4479–37 GP	Bell	2.0	...	...	...	...	...	...	Casas Grandes, Chihuahua
372	4479–40	Bell	2.0	...	...	...	...	...	...	Casas Grandes, Chihuahua
558	1200 MNM	Bell	2.0	...	...	...	...	...	...	Casas Grandes, Chihuahua
559	1200 MNM	Bell	2.0	...	...	...	...	...	...	Casas Grandes, Chihuahua
370	4479–38 GP	Bell	0.1	...	...	...	.001	.05	...	Casas Grandes, Chihuahua
371	4479–39 GP	Bell	0.1	...	...	...	...	.05	...	Casas Grandes, Chihuahua
368	4479–36 GP	Bell	0.1	...	...	...	...	...	...	Casas Grandes, Chihuahua
373	4479–41 GP	Bell	0.1	...	...	...	...	...	...	Casas Grandes, Chihuahua
556	1200 MNM	Bell	.001	...	...	...	...	...	...	Casas Grandes, Chihuahua
560	1200 MNM	Bell	.001	...	...	...	...	...	...	Casas Grandes, Chihuahua
451	...	Bell	2.0	...	...	...	...	...	...	Culiacan, Senora
436	GP	Native copper	...	...	...	...	...	...	...	Cananea, Senora
1169	USNM	Native copper	...	...	...	...	...	...	...	Cananea, Senora
1170	USNM	Native copper	...	...	...	...	...	...	...	Descubridora, Durango
1171	USNM	Native copper	...	...	...	...	...	...	...	Concepción del Oro, Zacatecas
462	GP	Bell	...	...	...	...	...	...	...	Guasave, Sinaloa
463	GP	Bell	...	...	...	...	...	...	...	Guasave, Sinaloa
1208	30.2.5100 AMNH	Sheet	0.1	...	...	...	...	...	...	Guasave, skeleton 138
1209	30.2.5101 AMNH	Button *	.001	...	...	...	...	...	...	Guasave, skeleton 132
1210	30.2.5101 AMNH	Bead *	.001	...	...	...	...	...	...	Guasave, skeleton 132
1211	30.2.5105 AMNH	Bell *	.001	...	...	...	...	...	...	Guasave
1212	30.2.5107 AMNH	Bell	.001	...	...	...	...	...	...	Guasave
1213 †	30.2.5108 AMNH	Bell	0.1	...	...	...	...	...	...	Guasave
1214	30.2.5108 AMNH	Bell	0.1	.001	...	...	...	...	...	Guasave
1215	30.2.5108 AMNH	Bell	.001	...	...	...	...	...	...	Guasave
1216	30.2.5108 AMNH	Bell	0.1	...	...	...	...	...	...	Guasave
1217	30.2.5108 AMNH	Bell	0.1	...	...	...	...	...	...	Guasave
1218	30.2.5108 AMNH	Bell	.001	...	...	...	...	...	...	Guasave
1219	30.2.5108 AMNH	Bell	0.1	.001	...	...	...	...	...	Guasave
1220	30.2.5108 AMNH	Bell	.001	...	...	...	...	...	...	Guasave
1221	30.2.5108 AMNH	Bell	.001	...	...	...	...	...	...	Guasave
1222	30.2.5108 AMNH	Bell	.001	...	...	...	...	...	...	Guasave

* Ekholm, 1942, fig. 19, *c*, *d*, *f*.
† Analyses 1213–1222 are from a necklace of 111 bells.

METALS IN NORTHERN CENTRAL AMERICA

The most ancient metals now known outside of North and South America come from the southeastern part of the Maya area in western Honduras and El Salvador. They date from the end of the Maya Great period. At present, all the early finds apparently represent foreign imports but the picture may be changed when the result of Boggs' excavations in western El Salvador become available. It seems probable now that specimens of this epoch came by trade from the south, although no metal objects of comparable age have yet been identified in Panama or Colombia. In later times, metal artifacts were imported from Mexico.

Not long before the arrival of the Spaniards, however, a local copper-casting industry had been established on both sides of the Atlantic frontier between Guatemala and Honduras, extending to the Bay Islands. At the time of the Conquest, this region was inhabited by Aztec, Paya, Jicaque and Toquegua tribes. There is no positive evidence that the southern Maya tribes ever hammered or cast metals. Gold artifacts are so rare in all periods that they probably all were imported.

[82] Strómsvik, 1942, fig. 13, *b*, Morley, 1946, fig. 55, *c*.
[83] Kidder, 1948, p. 229.
[84] Joyce, 1924.
[85] Lundell, 1934, p. 185, pl. IX, *c*.

Great Period Metals. The earliest definite date for metal is the result of finding the legs of a gold figurine under stela H at Copan.[82] The date is 9.17.12.0.0 (782 A.D.). The fragments are small but almost certainly Panamanian in style. Analysis by W. C. Root indicated a *tumbaga* alloy of 51 per cent gold, 5 per cent silver and 44 per cent copper. This is a high silver content for Coclé but normal for Veraguas. Boggs [83] has encountered copper at Tazumal in western El Salvador which should be approximately the age of the Copan legs as indicated by the associated pottery.

Isolated metal specimens of questionable provenience have been reported at Palenque,[84] Yaxha [85] and Tikal.[86] The Palenque find was a wire-wound gold bell of Mexican manufacture. A Mexican copper (bronze?) axe was discovered at Yaxha and a copper bell at Tikal. A copper axe was also found at Lubaantun, British Honduras. It contained 98.93 per cent copper.[87]

Two gold disks from Zacualpa in the Guatemalan highlands may be of considerable age as they were found in a stone vaulted tomb.[88] Another gold disk of unknown provenience, past and

[86] Tozzer, 1934.
[87] Joyce, 1926, p. 229, note 1.
[88] Lothrop, 1936, fig. 68.

TABLE XV: ANALYSES OF GUATEMALAN METALS

Analysis Number	Catalogue Number	Object	Provenience	Lead	Tin	Silver	Gold	Copper	Arsenic	Antimony	Bismuth	Remarks
530	...	Disk	Zacualpa	...	... *	2	98	...	...	...	...	Gold (Lothrop, 1936, fig. 68, *a*)
531	...	Disk	Zacualpa	...	...	5	95	...	...	...	...	Gold (Lothrop, 1936, fig. 68, *b*)
467	Na–11430 UMP	Frag. of sheet	Chipal	...	.001	>2.0	+	1.0	...	...	...	Gold
667	20–6730 AMNH	Ring	Taxisco	...	...	...	46	57	...	...	...	Gilded
448	CIW	Sheet bead	Illom, Quiché	...	...	70	25	5	...	...	...	Gilded
1227	CIW	Ear plug	Zacaleu	...	...	1.6	22.0	76.4	...	...	...	Gilded
814	CIW	Frag. of sheet	San Agustín Acasaguastlan	...	...	tr.	13	87	...	...	...	Gilded
464B	Na–11318 UMP	Frag. of disk	Chipal	...	...	18	12	70	...	...	...	Gilded
666	20–6729 AMNH	Ring	Taxisco	...	...	...	6	94	...	...	...	Gilded
122	CIW	Frag.	San Miguel Ixtahuacan	...	...	0.6	5.4	94	...	...	...	Gilded
464A	Na–11418 UMP	Bell	Chipal	...	.001	0.1	0.1	+	...	...	...	Copper
466	Na–11321 UMP	Bell	Chipal	...	...	...	0.1	+	...	...	...	Copper
465	Na–11428 UMP	Frag. of sheet	Chipal	...	0.4	...	...	+	...	...	...	Copper
572–81, 585–91 1155	24–98/107–15, 40, 41 SAR	13 bells	Tajumulco, Dept. San Marcos	...	...	...	...	+	...	...	...	Copper *
1157	24–98/42 SAR	Ring	Tajumulco	...	...	...	...	+	...	...	...	Copper *
584	24–98/108 SAR	Bell	Tajumulco	...	...	0.1	...	+	...	...	...	Copper *
1156	24–98/41 SAR	Bell	Tajumulco	...	...	0.1	...	+	...	...	...	Copper *
1159	24–98/44 SAR	Bell	Tajumulco	...	...	0.1	...	+	...	...	...	Copper *
1158	24–98/43 SAR	Strip	Tajumulco	...	...	0.1	...	+	...	...	...	Copper *
114	3–3538 MAI	Celt	San Andres Usuma	...	...	1.0	...	+	0.1	...	...	Copper *

* Root, 1943.

present, may be the mate of the larger Zacualpa disk.[89] The difficulty in dating these disks is that the grave associations are uncertain and evidently are not all of one period. The contents of two tombs have been mixed and it is possible that the tombs were used on more than one occasion as was done in San Agustín Acasaguastlan burials.

The larger Zacualpa disk has certain stylistic features which suggest that it may have come from Peru and date from an early period. Dr. Caso [90] and Mr. J. E. Thompson [91] have pointed out that if this disk is turned around the face resembles the Aztec god Tlaloc. This is indeed true but unfortunately all Tlaloc-like faces cannot be assigned to the same period and culture. Maya examples of the Great period are known from Copan and Palenque. Tlaloc heads are very common in Plumbate ware which was traded widely during the Mexican (Tula-Toltec) period and, of course, they were manufactured during the Aztec period. In addition, Tlaloc-like heads occur both in gold and stone in Chavín art from Peru.

Since publication, two of the Zacualpa disks have been analyzed by Professor Root. They are of gold with no copper. The larger disk contains 5 per cent silver and the smaller less than 2 per cent. It is very unlikely that these are Mexican gold ores which often run over 20 per cent silver but they do correspond to analyses of early Peruvian gold and Cenote gold disks. We have no figures for comparisons with Guatemalan ores but on stylistic grounds it is improbable that the disks were made locally or that any object of gold was ever manufactured in Guatemala.

When the large Zacualpa disk was first published, it was pointed out that it came from the ground with a red coating which, at the time, was believed to be cuprous oxide. Analysis has now shown that no copper is present. The color therefore may have been paint, traces of which still remained after cleaning when we last saw this specimen.

At present only one other painted specimen of metal has been recorded from Central America.[92] Many examples are known, however, from northern Peru, especially the Lambayeque region. These include large gold mummy masks painted red or black,[93] crowns and gorgets of gold and silver painted green and other objects of the Late Chimu period.[94] In addition we have seen Chavín-style gold objects adorned with red or black paint.[95] No analysis of these pigments has yet been made.

Plumbate Period Metals. The distinctive pottery known as Plumbate ware appears on the archæological scene at the end of the Maya Great period (ca. 900 A.D.) and was traded throughout Mexico and Central America from Panama to Tepic for about 350 years, after which apparently its manufacture was completely discontinued. The effigy types of Plumbate ware are generally accepted as criteria of the Mexican period in the Maya area. No Plumbate has been found with Aztec remains.

Copper has been found with Plumbate ware at several archæological sites in Mexico and in Central America. Most specimens are globular- or pear-shaped bells. A few gilded objects have been discovered. It is clear, however, that no great metallurgical industry flourished in Central America when Plumbate ware was manufactured and it is possible if not probable, in view of the small number of specimens on record, that they all were imported, presumably from Mexico.

[89] Nottebohm, 1945, fig. 1.
[90] Letter dated, December 28, 1936.
[91] Thompson, 1943, pp. 124, 128.
[92] Woodbury, 1948, p. 122.
[93] Antze, 1930, taf. 13.
[94] Treviño de Sáenz, 1947, fig. 150.
[95] Bliss and Simkhovitch collections.

A definite association of gilded copper with a Plumbate sherd is recorded by Smith and Kidder [96] in the Motagua Valley (table XV, no. 814). The metal consisted of a small fragment of gilded sheet copper. The roof of the tomb was intact and the door sealed, so the contemporaneity of the grave furnishings is definite.

The ruins of Zaculeu, former capital of the Mam Indians, are located on the outskirts of the modern Huehuetenango. Excavations were made by Manuel Gamio in 1926 and by Flavio Rodas N. in 1928. The latter cleared a temple and pyramid on the north side of the main plaza which contained two lines of three rectangular masonry altars coated with plaster. A burial was discovered under the central altar nearest the door. Other tombs were opened near two small mounds in the plaza.

couleur, perhaps leaf gilding such as has been found in the Cenote (table XXII), Panama and Peru, or possibly amalgam plating. The former can be identified from sections under the microscope; the presence of the latter has been suspected but never detected in the New World.

Post-Plumbate Period Metals. Metal objects which can be dated after the dispersal of Plumbate ware had ceased have been found in various localities and, in one case, in considerable quantity. There is definite evidence of local manufacture both in Guatemala and Honduras.

All accounts of Columbus' fourth and last voyage tell how he reached the north coast of Honduras near Trujillo and how he

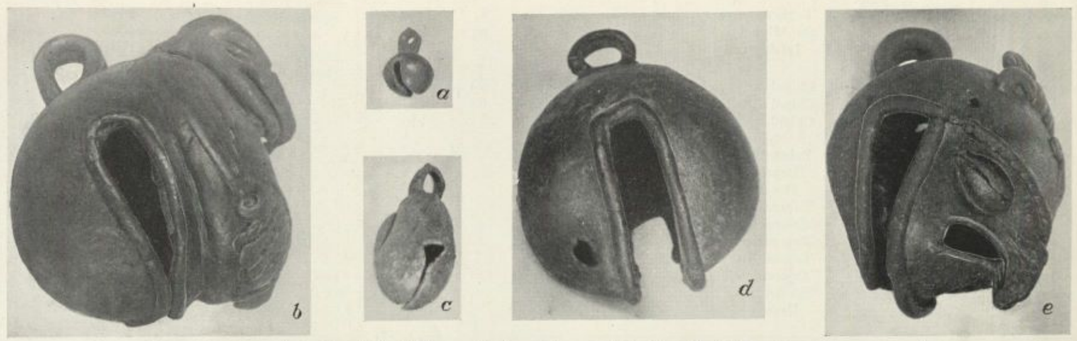


FIG. 7. Cast copper bells. Quemistlan bell cave, Honduras. Ca. actual size. See table XVI, analyses 376, 377, 535, 536.

The contents of these tombs, presumably mixed, were inspected by the writer and photographed in the *municipalidad* some months later. They included two large ear plugs of very thin gilded copper (p. 79) and a Plumbate effigy jar representing a frog. It is not possible to say whether they all came from the same grave.

The largest number of published metal objects found at one Guatemalan site come from the ruins of Tajumulco in the Department of San Marcos.[97] This city for the first time revealed Plumbate ware in quantity, and presumably it is located close to the center of manufacture. The metal specimens consisted of twenty-odd copper bells, a copper ring and strip, and a small gold disks. The analyses appear in table XV.

Another find of metal on a Plumbate level was made by Mr. A. Ledyard Smith at Nebaj.[98] He discovered half a dozen copper bells and a thin piece of gilded copper. The pottery association is definite. The bells are globular, with or without a thickened rim (figs. 75 and 76), or pear-shaped. They have a small platform under the ring for suspension.

The method of gilding employed on specimens found in Guatemala has not yet been satisfactorily explained. Bergsøe,[99] as the result of laboratory experiments, has shown that it is not possible to produce a lasting gold surface on a copper-gold alloy by the *mise en couleur* technique unless the alloy contains over 20 per cent gold. Yet half of the available analyses of gilded Guatemalan objects reveal gold in amounts ranging from only 5.4 to 16.5 per cent. This suggests the use of some process other than *mise en*

encountered a great canoe laden with merchandise.[100] This cargo included copper celts, bells, medals and "crucibles to melt the copper." Copper ore was observed on the island of Bonacca but it is stated that the tribes to the east towards Cape Gracias á Dios did not use copper. Here then is eye-witness evidence that the natives of the central part of the north coast of Honduras understood smelting.

The largest amount of copper artifacts discovered to date in northern Central America consists of several hundred bells and other objects found in the Quemistlan "bell cave" near the Chamelecón River in northwestern Honduras.[101] This cave is located above a small tributary of the Chamelecón River about 8 kilometers (5 miles) above the Aztec settlement at Naco. It is 12 meters (40 feet) wide, 17 meters (56 feet) deep and the roof ranges from 6 meters (20 feet) in height in the entrance to 1.2 meters (4 feet) at the back. It never was inhabited because the floor slopes at a 45-degree angle and there are no traces of smoke.

Sporadic excavations have brought to light several hundred bells, effigy forms and undecorated, ranging in size from the most minute to about 7 centimeters (3 inches) in diameter (fig. 7). Effigy types are distinctly local in character. A few wire-like specimens are of central Mexican style. Strips of beaten copper without definite form suggest ingots for local manufacture. A wooden mask, once encrusted with turquoise, represents the Aztec deity Eecatl [102] and gives an approximate date to the specimens found in the cave.

[96] Smith *and* Kidder, 1943, p. 170.
[97] Dutton *and* Hobbs, 1943. Root, 1943.
[98] Smith, 1947, p. 186.
[99] Bergsøe, 1938, p. 37.
[100] Lothrop (1927c, pp. 354–55) argued that, contrary to general belief, historical evidence indicated that this vessel probably was not Yucatecan. At that time the significance of crucibles in the cargo was not understood. Evidence in this volume indicates that the Maya did not smelt metals. Hence a boat carrying crucibles must have been Honduranean rather than Yucatecan.
[101] Blackiston, 1910.
[102] Saville, 1922, pl. XVII.

TABLE XVI: IMPURITIES IN COPPER OBJECTS FROM HONDURAS *

Analysis Number	Catalogue Number	Lead	Tin	Silver	Gold	Iron	Arsenic	Antimony	Bismuth	Remarks
380	C/11011	.01	0.4	0.1	...	...	.001	.001	.001	Bell, Style C
534	20/6689	.01	0.1	0.1	...	...	0.1	...	.01	Head of staff
377	C/11007	.01	.001	0.1	...	...	0.1	...	...	Large effigy bell (fig. 7, *e*)
382	C/11012	.001	.001	0.1	...	...	...	...	...	Bell
378	C/11008	...	0.4	0.1	...	...	.001	...	...	Large bell
381	C/11011	...	0.1	0.1	...	...	.001	...	...	Bell, Style C
119	4–317 MAI	...	...	0.1	...	...	0.1	...	...	Bell, Style A1
374	C/11003	.001	...	0.1	...	...	...	...	...	Bell, Roatan, Is.
383	C/11012	...	1.0	0.1	...	...	...	...	...	Bell
120	4–3918 MAI	.001	...	...	...	...	0.1	...	...	Bell, Style A1
118	4–311 MAI	...	0.4	...	...	...	0.1	...	...	Bell, Style C
532	20/6691	.01	0.1	...	...	...	...	...	...	Bell
533	20/6691	.001	0.1	...	...	...	...	...	...	Bell, Style B
537	20/6690	...	0.1	...	...	...	...	...	...	Bell (trace of zinc)
376	C/11005	...	...	0.1	...	...	...	...	...	Large effigy bell (fig. 7, *b*)
793	30.0.1687 AMNH	...	0.1	..	...	...	...	...	...	Large effigy bell (La Champa)
535	20/6693	.01	...	...	...	...	...	...	...	Bell (fig. 7, *a*)
536	20/6692a	...	...	...	...	...	...	...	...	Bell (fig. 7, *c*)
375	C/11004	0.5	>2.0	0.1	...	...	0.1	.001	...	Celt, San Pedro Sula (bronze)
...	...	...	5.0	...	...	...	...	...	...	Cuyamel R. (bronze)

* Specimens are from bell cave near the Chamelecón River unless otherwise indicated.

A few scattered copper objects from other sites in northwestern Honduras are known. The Peabody Museum has a celt 13 centimeters (5 inches) in length which is one of the only two bronze specimens from Honduras yet analyzed (table XVI, no. 375). A second bronze celt was discovered on the Rio Frio Farm near the headwaters of the Cuyamel River. It contained 92.5 per cent copper, 5 per cent tin and 2.5 per cent zinc and other metals.[103] Copper bells have been found at Taulevé [104] at the south end of Lake Yojóa. Copper fishhooks are reported from Los Naranjos at the north end of the lake and at Las Flores Balsa below Travesía.[105]

Copper bells have been discovered on the Bay Islands of Roatán, Barburata and Bonacca. At the Dixon site on Roatán [106] a polychrome vase was found which contained thirty bells, two small hoops and a piece of hammered copper which probably is an ingot. There are a few effigy bells of types found in the Cenote. About half the bells have the loop set in a flat top with a decorated band below and thus correspond to our Style D 4 (fig. 83).

Four other bells and a small disk were found at Coxan Hole on Bonacca.[107] This is the island where Columbus reported copper ore. One of the bells had exploded during manufacture,[108] probably because steam formed owing to dampness in the mold. This is an almost certain indication of local manufacture because an imperfect bell would not become an article of commerce. A copper disk is reported from Indian Hill, Site I, on Barburata Island.[109]

Three of the Roatán bells have been analyzed but by a system so different from Professor Root's that direct comparisons are not possible. No exact figures are given but it is clear that the Roatán copper was unlike any now known from the mainland. All specimens had a "moderate" amount of iron and one a "trace" of gold, neither of which is recorded on the mainland. All had a "moderate" amount of silver and one had a "strong" concentration of arsenic.

The age of copper in the Bay Islands cannot be definitely established at present. The objects from the Dixon site were discovered in a jar of Polychrome I style, which does not seem to be of great antiquity. A Plumbate sherd is recorded from Barburata but not in association with metal.

A definite piece of evidence makes it possible to state that copper bells were manufactured in the lower Motagua Valley in Guatemala. At the time of the Conquest, this region was inhabited by the Toquegua Indians, whose speech and cultural affiliations are unknown. The evidence consists of six copper bells (fig. 8) which were found on the east bank of the Motagua River opposite the ancient Maya city of Quirigua.[110] One bell exploded when it was

FIG. 8. Copper bell found near Quirigua, Guatemala. Height, 5 centimeters (2 inches).

cast, probably because the mold was not completely dry and generated steam. This was an industrial accident of which no record would normally be preserved for the metal would be recast. The specimen illustrated, however, somehow survived. Obviously it is not a trade piece, for who would want a broken bell? Therefore it must have been made in the vicinity.

Another copper bell was found near the Rio San Francisco del Mar, a small stream which parallels the Motagua to the west. In 1864, a canal was dug to connect this little river with the Bahía de la Graciosa and the Bahía de Amatique by way of the Rio Graciosa.[111] This canal cut through a small mound where the engineer in charge of the work picked up several objects of

[103] Steinmayer, 1932, p. 19.
[104] Personal communication from Doris Stone.
[105] Strong, Kidder *and* Paul, 1938, p. 41.
[106] Strong, 1935, pls. 9 and 10.
[107] Strong, 1935, pl. 17, *oo*.
[108] Strong, 1935, pl. 17, *g*.
[109] Strong, 1935, pl. 29, *i*.
[110] Information from the Dr. A. V. Kidder who kindly allowed me to have the specimen photographed.
[111] Morley, 1938, fig. 1.

jade, including the famous Leyden plate, and — incongruous though it may seem — a copper bell.[112] The Leyden plate is a slab of very beautiful jade with a human figure engraved on one side and the early Maya date 8.14.3.1.12 (320 A.D.) on the other. One can only speculate through what hands and vicissitudes this valuable object had passed during the thousand or more years between the time of its manufacture and the time it was interred in a remote and swampy plain near the coast of Guatemala.

Copper objects have been found in considerable quantity on the cays off the southern coast of British Honduras. Owing to the geological formation, there is no possibility of local ores, and the presence of these specimens may be the result of trade with the adjacent Motagua region. A bell of Style D1, two ear plugs and three celts were analyzed. All contained 0.1 per cent silver, and one had a little lead, but no other impurities were found. No such metal from Honduras is on record. Analyses appear in table XVII.

TABLE XVII: COPPER OBJECTS FROM BRITISH HONDURAS

Analysis Number	Catalogue Number	Lead	Tin	Silver	Gold	Iron	Arsenic	Antimony	Bismuth	Remarks
121	9–1783 MAI	...	...	0.1	...	...	...	...	...	Bell
122	9–6466 MAI	...	...	0.1	...	...	...	...	..	Ear plug
123	9–6467 MAI	...	...	0.1	...	...	...	...	...	Ear plug
124	9–6493 MAI	...	...	0.1	...	...	...	...	...	Celt
813	... CIW	...	...	0.1	...	...	...	...	...	Celt (El Cayo)
812	... CIW	.01	...	0.1	...	...	...	...	...	Celt (El Cayo)

A few copper objects are known from Santa Rita Corozal in northern British Honduras.[113] These include copper tweezers, a small copper head and a Mixtec-style ring consisting of two bands joined by double scrolls like the specimen in our figure 72, *a*.

An important discovery of metal in post-Plumbate times took place at Chipal, Department of Alta Vera Paz, Guatemala.[114] The specimens consist of a gilded metal sheet, gold strips in the form of elongated rectangles, a small gold cup and a necklace of twenty-two hollow gold beads. There also were pear-shaped copper bells, rings and a curious cast ornament of uncertain use. Analyses are given in table XV.

Recent excavations at Zaculeu in the Department of Huehuetenango carried out by Mr. John Dimick for the United Fruit Company have brought to light a number of metal specimens of Plumbate and later date. These include several copper bells, a gold nose pendant of Mixtec style and a remarkable copper bird's head which had been painted.[115] Analyses of these objects are not yet available.

Other small finds of metal of uncertain date have been made in the Highlands of Guatemala. Among them are a copper axe, a frog pendant, a small puma and a ring from Zacualpa in the Department of the Quiché.[116] The frog is vaguely Panamanian in shape and may have come from Veraguas. The ring, as well as two others from Chichicastenango we examined, is of the type seen in figure 72, *c*, consisting of a band with a face on one side. It probably is a trade piece from Oaxaca.

The status of metalwork in El Salvador is uncertain and must remain so until Boggs' findings are published. We have seen a copper celt which was found under the present city of San Salvador. We have heard that many years ago two gold ornaments were found at Cuzcatlan and that they were illustrated in an encyclopedia published in Barcelona.

To summarize our present picture of aboriginal metalwork in northern Central America: it is established that a knowledge of copper, bronze (?) and casting existed among non-Maya peoples in northwestern Honduras and the adjacent Motagua Valley in Guatemala by 1500 A.D. It is known that a few metal artifacts began to trickle into the Maya area as early as the end of the Great period but seemingly all objects were the result of trade, at least until shortly before the Conquest. Lack of stylistic unity suggests that all gold specimens of all periods were manufactured elsewhere. This negative picture may of course be changed by future archæological discoveries.

COCLÉ AND VERAGUAS

The metalwork in Coclé and Veraguas styles from Panama, the metallurgical processes employed in those regions and a large number of analyses by Professor W. C. Root have already been published.[117] Specimens from Panama reached the Cenote in quantity. Apart from superior craftsmanship and sense of design, Mexican metallurgy excelled Isthmian not in techniques but because tin and lead were used in alloys and because silver was known. Copper was extensively employed in Mexico but very few specimens have been found between Honduras and Ecuador. On the other hand, Mexican smiths may have based their techniques on processes first developed in the Isthmus.

YUCATAN

The Maya, gifted in many of the arts and crafts, were not metallurgists. Nevertheless, they distinguished by name five different metals and they purchased metal artifacts from far-away regions. They learned to trim and emboss with their own designs the thin sheets of metal acquired by trade. Because they were great artists, they produced articles of outstanding artistic merit.

There are two readily understood reasons for stating that the Maya were not metallurgists. In the case of cast objects, the forms found in the Cenote and elsewhere in Yucatan are well known in other production centers such as Panama or Mexico. In the case of hammered disks with Maya designs, the draftsmen evidently did not make the disks because the holes for suspension often are so placed that they interrupt the design. Obviously two non-co-operating artisans were involved.

[112] Leemans, 1878, pp. 299, 301.
[113] Gann, 1918, figs. 21, *d*, *e*; 83.
[114] Butler, 1940, p. 265, pl. XI.
[115] Woodbury, 1948, p. 122.
[116] Lothrop, 1936, figs. 72, 73.
[117] Lothrop, 1937–42, part I, and 1950.

We have seen that the periphery of the Maya area was fringed with metalworking tribes. One can only wonder why such a gifted people as the Maya failed to utilize an art and processes readily available to them. Willoughby [118] has shown that even the simplest of metalworking techniques, hammering metal into sheets, is not an altogether easy process. It is not just cold hammering but it involves annealing in order to prevent cracks. This softening process was understood all over South and Central America as well as on the mainland of Mexico and in the United States. Willoughby also showed that a theoretical knowledge applied with very primitive tools produced artifacts of technical and artistic merit. In other words, the manufacture of hammered metal objects is a cultural trait easily acquired.

Maya Names of Metals. The Maya names for metals have been discussed by Roys,[119] who points out that our information comes from dictionaries compiled after the Conquest, when many native terms had acquired new significance. For instance, the aboriginal term for copper was applied to iron of all qualities and also was used to designate a jail.

The Maya metal names, as given by Roys, include the following:

Takin — gold (aboriginal)
Zac (white) *takin* — silver (post-Spanish)
Kankan (yellow) *takin* — gold (post-Spanish)
Ek (black) *tau* — lead (aboriginal)
Zac (white) *tau* — tin (aboriginal)
Mazcab — copper (aboriginal)

The etymology of these terms is of interest as it reveals the Maya concept of the nature of metals. *Takin* (gold) means the excrement of the sun. This association of gold, the most easily secured of the noble metals, with the sun is very common. The Inca regarded gold and silver as the tears and sweat of the sun and moon. As the descendants of the divine pair, they claimed all the gold and silver found in their realm.

Silver apparently was unknown to the Maya until introduced by the Spaniards. No aboriginal artifact of silver has been discovered in the Cenote or elsewhere in Yucatan. We have already pointed out the comparative rarity of this metal in Mexico. When the Spaniards brought silver to Yucatan, the term "white gold" was invented. This in turn called for the term "yellow gold."

Native tin and lead have both been found in the Cenote. These very soft metals were known as white and black *tau*, excrement of the moon. Lead, so far as we know, had no celestial significance but tin, in place of silver in other lands, represented the moon. One of the interesting discoveries in the Cenote was a disk of almost pure tin, which resembles silver, adorned with the Maya lunar glyph (fig. 62, *a*). One of the reasons for believeing the Maya had no silver is that they named tin and lead after the moon. Had they had silver, they doubtless would have associated it with the moon and developed a different nomenclature.

Copper was known as *mazcab*. *Cab* means earth in general, and is also used for the red ochre applied to pottery vessels as a slip. The primary meaning of *maz* is an insect, especially a cricket. It is linked with metal, however, in the Motul dictionary where it is also defined as the tinkling sound given out by iron, metal or stone. In the Pio Pérez dictionary *maz* is stated to be a shoot from a seed in the earth. The implication of all these definitions combined is that copper was regarded as something red which grew in the earth.

The Maya of course had no conception of a universe constructed of definite elements as we believe today. The Maya of Yucatan, living in a limestone country, had no access to primary cources of metal but they must have known something of the sources through the traders who brought the metals. We suggest that the fact that four metals had compound names involving the sun and moon implies that these metals had been found as scattered nuggets on or near the surface. The fact that the compound for copper contains an element meaning earth may imply that this metal was mined.

Had the Maya not given names to metals in their own tongue, they might have borrowed the names used in the lands where the metals originated. For instance, the fact that the Cuna tribe of Panama used the Quechua name for gold strongly suggests that knowledge of gold reached Panama from Peru. Nordenskiöld [120] has pointed out that the usual Cuna word for gold today is *ólo*, evidently derived from the Spanish *oro*. In their mythology, however, where archaic terms might be expected, the great river of the nether world is called *Oloúbigúndihuar* but is also named *Cúligúndihuar*. *Culi* is a corruption of *curi* or *cori*, the Quechua term for gold, which is still used by many non-Quechua Indian tribes of South America, such as the Aymara.

CLASSIFICATION OF CENOTE METALS

At first glance, metal objects from the Cenote of Sacrifice are bewildering in their variety, but study shows that they readily fall into four major groups. This is so because the regions which produced the Cenote material often had characteristic ores, methods of manufacture and art forms. These will be the subject of detailed discussion.

A primary division of metallic objects may be made on the basis of whether they were hammered and trimmed to shape or whether they were cast in molds. Cenote hammered specimens are either of relatively pure gold, which presumably was imported in manufactured form from the Isthmus of Panama, or of gilded copper, probably made in Mexico. The only hammered objects not falling in these categories are a small disk of tin (fig. 62, *a*), a lead bead (fig. 5) and the specimens in figure 57, *b*, *c*.

Cast specimens may be of copper, sometimes alloyed with tin or lead. These came from Mexico or northwestern Honduras. Another cast group is of gold, often alloyed with copper and gilded to look like gold by the *mise en couleur* process. These were manufactured in what is now the Republic of Panama, with one exception each from Colombia and Mexico and another perhaps from Costa Rica.

This classification in four major groups is natural and unescapable because it is geographical, stylistic and technological. When it came to naming them, however, we chose the technological aspects because regional and stylistic determinations must remain vague until more local archæological types have been recorded and until such time as a more detailed chronological scale has been calibrated.

[118] Willoughby, 1903.
[119] Roys, 1944, p. 103.
[120] Nordenskiöld, 1928–30, part 2, p. 12.

OBJECTS OF SHEET GOLD FROM THE CENOTE OF SACRIFICE

The most ancient artifacts of metal thus far identified in the New World have come from Peru and have been assigned to the Chavín and Paracas cultures. They are usually of gold which has been hammered in sheets and trimmed to shape. We find it logical that this should be so, for gold is conspicuous and untarnishable, and it occurs as nuggets which are easily found. A single nugget from California was 1.36 meters (4½ feet) in length and weighed 66.5 kilograms (2340 ounces). Most men would prize such a glittering object and would soon learn that you could not chip it but could pound it into shape.

While it is true that ductile metals such as copper, gold and silver may be altered in form by hammering on a suitable anvil, the process is not simple if carried on for any considerable time. Hammering not only shapes certain metals but it hardens them and sets up interior stresses which make them brittle. Alloys often found in nature may become much harder than pure metals when hammered. To prevent fractures, it is therefore necessary to soften the metal by annealing, *i.e.*, heating it enough to allow recrystalization. Until some unknown genius made this discoverey, the shapes of nuggets could not be radically altered. Repeated annealing, however, permits the construction of very thin sheets and complex shapes.

Once a metal sheet had been fabricated, it could be cut or ground into a disk or any other desired form. A draftsman could decorate it by placing the sheet on a yielding surface such as leather and pressing down his design with an awl. This requires no heat treatment.

The metal from the Cenote of Sacrifice identified as most ancient consists of such embossed disks of gold. They do not suggest that an exclusively golden age flourished in Mexico and Yucatan, comparable to the early periods in Peru, because among the articles of personal adornment depicted on the disks are bells which appear to be cast like the common copper bells of Mexico.

UNDECORATED GOLD DISKS

Among the common finds in the Cenote of Sacrifice were gold disks such as are shown in figure 9. These usually had been crumpled into a ball but, when straightened out, prove to have a flat rim, a slight bulge in the center and a pair of holes for suspension. Gold disks have a wide distribution in the New World and it would cause no surprise if examples turned up anywhere between central Mexico and northwestern Argentina.

TABLE XVIII: ANALYSES OF GOLD DISKS WITH BATTLE SCENES

Analysis Number	Catalogue Number	Gold	Silver	Copper	Illustration
1290	C/10066	98.0	2.0	...	Figure 31
1291	C/10069	98.0	2.0	...	Figure 33
1288	C/10064	97.5	2.5	...	Figure 32
1289	C/10065	97.0	3.0	...	Figure 30

The Cenote specimens are all very much alike in composition (table XVIII) and shape (fig. 9), so much so that it seems probable that they all were manufactured in the same region. We believe it highly improbable that they came from any part of Mexico because they contain only 2 or 3 per cent silver and no copper and this is not a typical Mexican ore (table III). We should add that gold disks, especially of the size of the Cenote specimens, are extremely rare in Mexico and that more have been found at Chichen Itza than in all the rest of the country.

On the other hand, gold disks have been found in considerable numbers in western South America, the Isthmus and in Costa Rica. These often carry typical local designs of such styles as Chavín or Coclé. The bulging center of the Cenote specimens is a frequent but by no means universal feature in the south. The flat rim combined with the raised center, however, occurs on some Costa Rican disks, examples of which may be seen in the Keith collection. We have no analyses of Costa Rican disks but ores comparable to the Cenote pieces occur in southern Veraguas and in Coclé.[1] It thus seems probable that the Cenote disks came from Costa Rica or Panama. We believe that they were manufactured on the archæologically unknown north coast of the Province of Veraguas in Panama, both because Columbus relates that the natives there wore many gold disks and because dozens of cast gold objects from the Cenote also testify to trade between Veraguas and Yucatan.

DECORATED GOLD DISKS

In addition to the undecorated disks, seventeen others and various fragments were adorned with elaborate pictorial decoration pressed in relief. Gods and chieftains in full regalia are portrayed and ten disks record incidents of war between Tula-Toltec conquerors and the Yucatecan Maya.

The undecorated gold disks, when thrown in the Cenote, were crumpled like sheets of paper, but the decorated examples were torn in small fragments, crumpled and jettisoned. Only one was complete (fig. 34). This treatment evidently was intended to "kill" the people or gods shown on the disks. For the archæologist this is very unfortunate. It was not possible to recover all the fragments and, owing to crumpling, the designs can be seen only with the greatest of difficulty. Although experiments have been made by jewelers, it has proved impossible to remove the innumerable creases without destroying the quality of line of the intricate patterns. As a result they cannot be illustrated adequately

[1] Lothrop, 1937–42, part I, table X; 1950, table II.

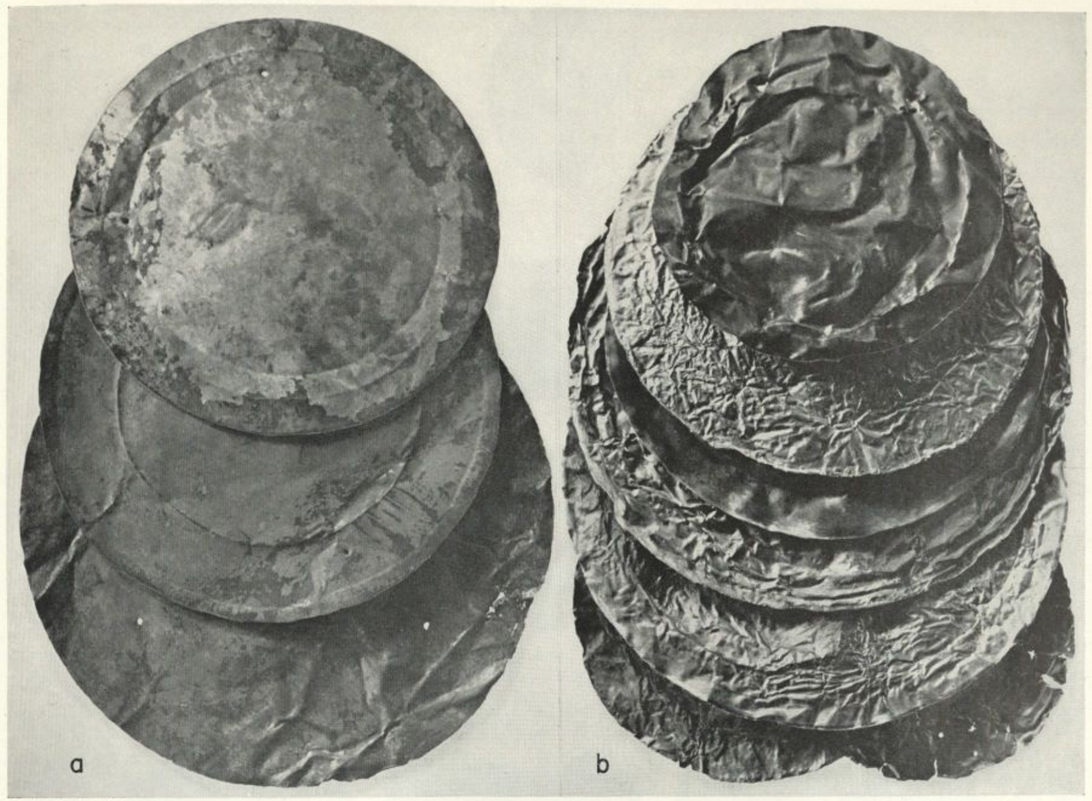


FIG. 9. Metal disks. *a*, gilded copper; *b*, gold. Scale, ca. 2/3.

by photographs (fig. 10) and it is only possible to reproduce the designs at all as a result of the extreme patience and skill of the artists who have laboriously drawn them. Nor are they suitable for exhibition, as the designs can be discerned only when they are tilted in the hands and viewed at various angles.

To bring out the difficulty of interpreting these mutilated specimens in figure 29 we have grouped three drawings of the same fragment by different artists. It will be observed that, although the essential nature of the scene is unchanged, there is great variety in depicting expressions and in the rendering of details.

The gold disks contain 2 to 3 per cent silver but no copper (table XVIII). As can be seen from the analyses in tables III and VII, this definitely does not correspond to any recorded Mexican ore. We have no figures for sheet metal in southern Veraguas or Costa Rica because authenticated specimens are rare. In the Province of Coclé, however, there is a lot of sheet gold,[2] most of it containing a little silver and also a small amount of copper. Some specimens, like those from the Cenote, contain no copper but they are not disks of Cenote shapes. The most probable conclusion at present is that all Cenote gold disks came from the archæologically unknown north coast of Veraguas, where Columbus saw many disks of gold on his last voyage.

[2] Lothrop, 1937–42, part I, tables XIII, XIV, XXII.

It has been suggested that Cenote gold disks were hammered to shape locally from imported castings or ingots. To the writer this is extremely improbable because the cast gold specimens (tables XXXI–XXXIV) show very varied metallic content which is not apparent to the eye owing to *mise en couleur* gilding. How could a Maya Indian select pieces without copper and little silver, suitable for hammering?

In the case of the decorated gold disks, whoever manufactured them also made the holes for suspension but not the designs. In many disks, such as appear in figures 29–44, the holes are so placed that they interrupt the flow of the decoration, thus indicating two independent stages in manufacture.

We do not know how the gold disks were worn. They are the right size for the Toltec "back shields" which are discussed on page 40, but back shields as depicted in bas-reliefs normally have four holes and the gold disks only have two. It therefore seems probable that they were suspended from a cord worn around the neck. As they are thin and fragile, they may have been backed with some stronger material which was discarded when the gold was crumpled and cast in the Cenote. A tin disk (fig. 62, *a*) was backed with wood.

FIG. 10. Gold disks, showing present condition. *a*, disk O; *b*, disk B; *c*, disk D; *d*, disk A; *e*, disk F; *f*, disk N; *g*, disk G; *h*, disk I; *i*, disk J; *j*, disk E; *k*, disk L; *l*, disk H; *m*, disk C. Scale, ca. ⅓.

TABLE XIX: LOCATION AND NUMBER OF BAS-RELIEF HUMAN FIGURES IN TULA-TOLTEC STYLE AT CHICHEN ITZA
(Caryatid figures are not included)

EDIFICE	DOOR JAMBS	BALUSTRADES	COLUMNS	WALLS	ALTARS	TOTAL ILLUSTRATED	REFERENCE
Caracol	...	...	...	...	12	12	Ruppert, 1935, figs. 168, 169
Tigers — top rooms	10	...	...	...	...	10	Maudslay, III, pls. 27, 35–38; Seler, 1908, taf. XVIII, XIX
— bottom room	...	...	8	83	...	64	Maudslay, III, pls. 43–51; Seler, 1908, abb. 100–106
Castillo	12	...	8	...	...	6	Seler, 1908, abb. 45–49, taf. XX; Totten, pl. XXXVI; Charnay, 1887, pp. 345–47
Chacmool	6	...	24	...	...	30	M.C.M., pls. 6, 7, 28, 30–35, 38
N. Colonnade	...	...	52(?)	...	...	(?)	*Carnegie Inst., Year Book* 26, p. 268; Proskouriakoff, 1946, 25
Warriors	6	...	80	(?)	...	80	M.C.M., pls. 41–52, 55–80; Totten, pls. LVIII, L, LIX
N.W. Colonnade	1	...	216	...	32	248	M.C.M., pls. 68–129
N.E. Colonnade	...	...	16	...	(?)	16	E. B. Ricketson
Maudslay — Structure 25	8(?)	...	16	...	...	4	Seler, 1908, taf. XXIII–IV
Tables	6	...	16	...	...	(?)	Maudslay, III, pls. 61, 62; Totten, pl. XXXVIII, XL; Holmes, 1895–97, pl. XVI
Ball Court — platform	...	...	...	85	...	18	Erosa Peniche, 1946, p. 24; Palacios, 1937, fig. 411
— N. Temple	2	6	4(?)	45+	...	45	Erosa Peniche, 1946, p. 24
— S. Temple	2	4	24	...	...	...	...
Mercado	6	2	...	...	20	28	Ruppert, 1943, pls. 8, 12, 19, 20, 22, 32; Proskouriakoff, 1946, 26
Tzompantli Annex	...	...	...	16	...	2	Seler, 1908, taf. XXVIII; Proskouriakoff, 1946, 24
Xtoloc Cenote	12(?)	...	8	2	...	...	*Carnegie Inst., Year Book* 34, pp. 249, 263–65
Temple of Wall Panels	...	...	...	28	...	26	Ruppert, 1931, pls. 10, c; 11; p. 123
Monjas Ball Court	...	...	...	(?)	...	...	*Carnegie Inst., Year Book* 32, p. 86
TOTALS	71	12	472	259	64	589	

MAYA-TOLTEC WAR SCENES ON GOLD DISKS

Many of the buildings at Chichen Itza are adorned with frescoes or painted bas-reliefs. The former often illustrate wars between the Maya and the invading Tula-Toltec. Ten of the gold disks pressed in relief also represent incidents of battles between these two groups. The bas-reliefs show warriors of both nations in full regalia, sometimes as individuals on door jambs or the sides of square columns, sometimes in large groups on flat wall surfaces.

Dr. A. M. Tozzer[3] has pointed out that in these painted and sculptured scenes there is remarkable unity in symbolism and in the details of dress which distinguish Maya and Toltec. In most cases, the weapons, accouterments and ornaments of the two nationalities are clearly differentiated and some of the individuals are even denoted by name. This is also true of the disks except that Toltec warriors sometimes are represented as wearing the finery of their defeated foes.

The wall paintings are often executed with great vigor, and individual warriors are seen in violent action, but the reliefs show personages who are stationary or walking in stately ceremonial. The gold disks exhibit actual incidents of battle or stationary but dramatic moments such as the questioning of prisoners. In the expression of emotion the disks are fully equal to the frescoes.

Altogether about nine hundred human figures in Tula-Toltec style are carved on the walls of Chichen Itza, of which over two hundred have not been published. Many of the illustrations are inadequate because either drawings or thoroughly retouched photographs are necessary to show the low relief. We list in table XIX the distribution of 880 carved figures we have seen, either in illustrations, in casts or in the original. This count is doubtless far from complete.

[3] Tozzer, 1930. See also Thompson, 1945; Wray, 1945; Morley, 1946, fig. 57.

These sculptured and painted scenes must have been the work of many artists over a considerable period of time. As one would expect, there are obvious variations in style which no doubt can and should be interpreted in terms of individual artists and historical sequence. In the case of frescoes, it is known that the Maya often replastered their walls and repainted them. Frescoes therefore may or may not be contemporaneous with the buildings that house them.

Bas-reliefs, on the contrary, are an integral part of the architecture and, unless re-used in later buildings, must be contemporaneous with the edifices that contain them. In dating them, therefore, we can depend on both stylistic and architectural criteria. The architectural sequence at Chichen Itza doubtless can be determined with great exactness owing to the practice of enlarging and adding to already standing buildings. At the moment, however, no such study is available and only the grosser aspects of architectural development have been determined.

The gold disks with battle scenes are closest in subject to some of the frescoes but they differ considerably in style. Only one stone carving at Chichen Itza parallels the disks in subject matter. This is the circular stone altar illustrated in figure 38, which depicts Maya warriors in the act of surrendering to a Toltec chief. We shall discuss it later but may point out here that it was found in the Caracol, generally regarded as the oldest edifice of the Tula-Toltec period. Apart from this carving, the closest parallels to the gold disks are the reliefs found in the lower chamber of the Temple of the Tigers and in the great Temple of Kukulcan.

Before discussing the individual disks and what they picture, we shall examine the group as a whole and point out its general characteristics.

Division of the Field of Decoration. The circular field to be decorated is never treated as a unit. Typically it is split up into four divisions, as shown in figure 11. Around the outer edge there is a border design which serves as a frame for a smaller round field. This is divided horizontally by subject matter into three panels, sometimes separated by a horizontal line. The central panel, about 10 centimeters (4 inches) high, carries the action scene which gives major character to the disk. Above this, usually there is a sky deity, who supervises but does not take active part in what is going on below. In the bottom panel there are what we may call Earth monsters – two-headed dragons, plumed serpents or a conventionalized crocodile.

Division of a circular field of decoration into parallel bands is a southern trait. It occurs in Costa Rican pottery and is common in the Province of Coclé, Panama. It is found throughout the Inca Empire and is recorded in the Amazon basin.[4]

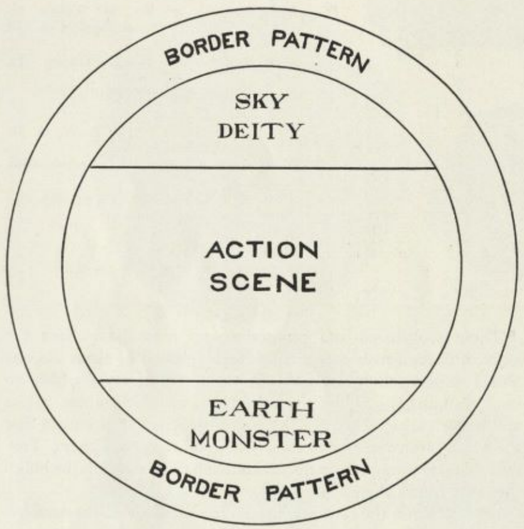


Fig. 11. Division of the field of decoration on battle-scene gold disks.

Border Patterns. Border patterns on Cenote disks are about 2.4 centimeters (1 inch) wide. They may completely encircle the disk or they may be broken up into four distinct elements. In either case, they serve as a frame for the major motives in the center of the disk. Four types may be noted, all purely Maya in concept except that scrolls in figure 13, *b, c,* terminate in small hatched lines which probably represent fur. This, we shall see, is a Toltec characteristic. The four types include dragons, scrolls, star symbols and glyphs.[5]

Figure 12, *b,* illustrates a dragon shown full face. The elements consist of nose and nose crest, fangs, teeth, eyes and eye crests. This group is flanked by highly conventionalized heads in profile. The central concept and sometimes the entire design occur throughout Yucatan in the so-called mask panels set in the walls of innumerable buildings dating from the Great period and later. The closest stylistic parallels to the Cenote specimen, however, occur in the distant city of Palenque. We call attention to examples in the Temple of the Inscriptions, the Temple of the Foliated Cross and the Temple of the Sun. In addition, a doorway in House E of the Palace is adorned by a dragon with greatly extended heads in profile.[6]

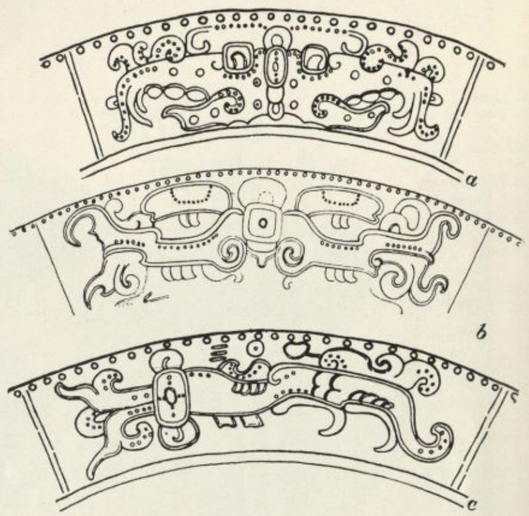


Fig. 12. Border patterns from gold disks. Actual size.

Figure 12, *c,* shows a strongly conventionalized dragon in profile. Altar O at Copan perhaps is the prototype.[7] A closer parallel, however, existed on the broken slabs from the front of the Temple of the Sun at Palenque[8] and in the main panel in the Temple of the Cross.

Figure 13 illustrates three serpentine scrolls, all from the same plaque. In each case the scrolls frame a head with a long downturned nose. This type of head occurs in the glyph for *tun* (360 days), as well as the compounds *katun* (20 x 360 – 7200 days) and *baktun* (400 x 360 – 144,000 days), the three glyphs which follow the introducing glyph of the Initial Series or Long-count Maya calendar. The nose is characteristic, also the semicircle on the head of *b*. The tongue is not characteristic of the glyphs but it does occur – for instance on the early stelæ E and P at Copan.[9] This type of head evidently represents a bird, perhaps a parrot, as may be seen in the rare full-figure glyphs such as those on stela D at Copan.[10] The use of *tun* glyphs as ornaments without numerical significance occurs on the outer corners of the sanctuary in the Temple of the Sun at Palenque.[11]

The scrolls have the typical serpentine curves of Maya art. The profile head on the left side of figure 13, *a,* has a parallel in the Temple of the Foliated Cross at Palenque, where the right-hand figure of the main tablet stands on a similar face and scroll.[12] The left-hand scroll of *b* and the right-hand scroll of *c* terminate in a series of hatched lines. The right-hand scroll in *b* ends in a waterlily or lotus, as does the fragmentary scroll on the left margin in figure 1.

[4] and [5] Lothrop, 1937–42, part II, p. 15, fig. 14.
[6] Maudslay, 1889–1902, vol. IV, pls. 81, 88, 93.
[7] Maudslay, 1889–1902, vol. I, pls. 85, 92.
[8] Waldeck, 1838, pl XVI. Also reproduced in Maudslay, 1889–1902, vol. IV, pl. 86. The right-hand slab carries one of the few Great period Tlaloc heads known to the writer.
[9] Maudslay, 1889–1902, vol. I, pls. 49, 89.
[10] Maudslay, 1889–1902, vol. I, pl. 48.
[11] Maudslay, 1889–1902, vol. IV, pl. 85. Also Lothrop, 1929, pl. IV, *c, e.*
[12] Maudslay, 1889–1902, vol. IV, pl. 81.

Star symbols are frequently represented in Maya art of the Great period and they also occur in the codices. They are found at such representative ancient cities as Copan and Quirigua, Narajo, Yaxchilan, Piedras Negras, Palenque and Chichen Itza. In spite of the fact that these symbols are well known, the meaning of most of them has not been ascertained beyond question.

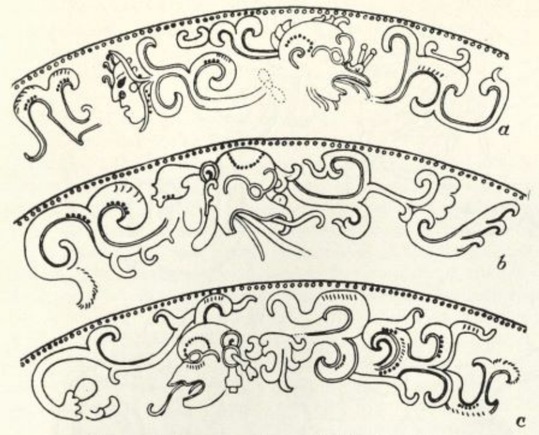


Fig. 13. Border patterns from gold disks. Actual size.

Star symbols from Cenote disks are shown in figure 14. The device with hooded eyes seen in *a* and on the right side of *b*, it is generally agreed, represents the planet Venus. This and the *kin* sign representing the sun are the two commonest symbols and are the only two identified with certainty. The latter is not found on the gold disks in this series. In figure 14, *c,* there are two alternating symbols shown with slight variations. The one with the diagonal bar may be a much conventionalized serpent and perhaps represents the planet Saturn.[13] The device with the diagonal cross is very common. It occurs as a glyph; it is placed across the eyes of the great monoliths at Quirigua; it appears in mouths and it is worn on headdresses or as a gorget.[14] It is supposed to represent the sky or heavens as a whole.[15]

Glyphs, By Tatiana Proskouriakoff

It is doubtful that any of the hieroglyphs which are depicted on the gold disks from the Cenote have calendrical meaning. They are of little value, therefore, in dating the disks. Their chief interest lies in the association of two glyphic styles with the representation of Maya and Toltec warriors in conflict. Both style variants are apparently Maya. On the Toltec period sculptures at Chichen Itza, the signs bear no resemblance to Maya glyphs and are presumably Mexican, although no serious effort has been made to identify them with a specific system. The glyphs on the gold disks, on the other hand, are clearly derived from Maya forms. One can even recognize specific elements, such as Ahau, though their meaning in the context is not certain.

One of the style variants presents the characters without any cartouche and is clearly related to that of Classic Maya inscriptions. The other encloses them in a rectangular form outlined by a raised border. Bars and dots are used with both types of glyph, sometimes perhaps as numerals, in other cases purely as ornament. The series of signs is never repetitive. Their arrangement, however, suggests that their decorative function was at least as important as their symbolic meaning. They are placed along the border in groups centering on the perpendicular axes of the design, except on disk K,[16] where the groups are shifted to the diagonals to make room for a headdress ornaments which projects into the border (fig. 40).

On disk G (fig. 35) there were apparently sixteen glyphs arranged in groups of four. These groups are flanked by four dots and a ridge, which in some cases looks like a bar, but which I believe is the edge of a slightly raised panel. In any case, the numerical elements seem to be purely ornamental. The signs themselves are all heads, human or animal, without cartouches and without affixes. They all face to the right, which is contrary to the usual Maya practice, but this may be due to the fact that the artist worked from the underside of the metal. If this is so, perhaps the signs should be read also from right to left. The fact that there are no affixes, however, indicates that they do not form phrases or statements. If they are not merely decorative, they may represent a series of deities or mythological concepts. There are no exact repetitions. Possibly the second glyph from the right in both the left and lower panel are intended to be the same. There are, however, minor differences. The first glyph of the left panel is the head of a fish, which Thompson believes to have the general connotation of counting in Maya inscriptions.[17] It may equally well in this case refer directly to the subject of the central scene, which is a battle on water. The last glyph of this group, a death's head, also seems pertinent to the subject. While none of the signs can be given specific meaning, their variety and the minute execution of detail indicates that the artist meant them to be recognized as individual symbols and that he was thoroughly familiar with the conventions of Classic Maya epigraphy.

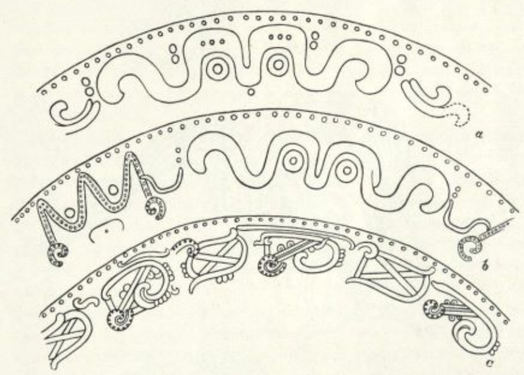


Fig. 14. Border patterns from gold disks. Scale, ca. 2/3.

On disk I (fig. 36) again only heads are represented, without affixes, and all facing to the right. Each head is enclosed in a rectangular cartouche. This is very rare in Maya inscriptions, but seems to be an intrusive rather than an aberrant form. It is used on two glyphs on stela 4 at Ucanal, which marks the end of the first katun in cycle 10. Both glyphs have coefficients, though their meaning is unknown. The two glyphs at the top of stela 3 at Seibal also have rectangular cartouches. Their coefficients, seven and

[13] Bowditch, 1910, p. 225, figs. 8, 9.
[14] Maudslay, 1889–1902, vol. II, pls. 10, 20, 58, *c.*
[15] Spinden, 1913, p. 93. Seler, 1901–02, figs. 185, *a*; 186, *b.*
[16] *See* p. 60.
[17] Thompson, 1944.

FIG. 15. Sky deities from battle disks. Actual size.

five, have suggested that they represent sequent katuns, but the signs are not Ahaus and resemble the sign for the Mexican day Cipactli more than they do Maya forms. The style of the monument itself has features foreign to the Classic Maya style, and it is therefore likely that the rectangular cartouche is also a foreign trait. Unfortunately, there is no data on its distribution outside the Maya area. It is certainly not Zapotec or Aztec and it is not known to occur at Tula. There is a rectangular glyph with a coefficient of 4 on stela 4 at Cerro de Las Mesas, but very little is known about the style which this monument represents. The stylistic implications of the use of the rectangular cartouche remain vague. Nevertheless, it seems likely that its introduction into Yucatan was approximately simultaneous with its appearance at Ucanal early in cycle 10.

On disk J (fig. 37) this type of glyph is used in combination with others of the normal Maya type. There are coefficients, but their arrangement is somewhat ambiguous. The four dots and bar on each side of the glyph panel are obviously mere decoration. In addition there are two groups of four dots placed behind the glyphs, although the glyphs themselves face normally to the left. Such peculiarities of arrangement, together with the fact that there are always four dots in each group, raise the suspicion that they are not true numbers. The rest of the inscription, unlike those of disks G and I, is composed in a way that does suggest a meaningful structure. Affixes are used and the groups are unequal. The signs, however, are of unknown meaning with the exception of the element Ahau which occurs twice: once with a superfix and a prefix or coefficient composed of four crescents, and once with a clear coefficient of 9. The constant repetition of four dots and a bar, however, makes even this number doubtful. Moreover, there is no clear indication that the element Ahau represents a day and, in view of the common use of day names as personal names in Yucatan, it is even possible that an individual rather than a date is referred to.

The glyphs on disk K (fig. 40) are poorly preserved. They also have affixes and seem to be of the same type as those on disk J. In addition there are three fragments of beautifully executed glyphs of the rectangular type, but with rounded corners. They represent heads facing to the right as do the glyphs of disk I.

Some of the disks which do not have glyphic borders include in their central design elements which may have glyphic significance. A highly conventional serpent head occurs on disks B and C (figs. 30, 31). This, however, does not have the usual structure of a Maya glyph and may be a mere space filler. A more glyph-like element is near the right shoulder of the left figure on disk B. This element may refer to the name of the individual portrayed. The double column of signs on disk A (fig. 29) recalls the arrangement of Classic Maya inscriptions and perhaps is meant to represent one in the abstract. The elements are of different sizes and shapes, however, and show no details that can be made out.

An examination of the glyphic signs used on the Cenote disks leads to the conclusion that the artists who designed them were familiar with Maya calligraphy and knew at least two glyphic styles, one of which was influenced by some exotic, possibly non-Maya style. If the artists were Toltec, they did not bring with them a knowledge of their native writing but learned the symbolism of the Maya. In any case, it is almost certain that the designs were made in Yucatan and were not imported from another area. Whether the glyphs were intended to be read is doubtful, but it seems likely that the artists understood at least their general connotation and structure. The source and the date of the foreign factor represented by the use of the rectangular cartouche is not known. It does not seem to be directly related to the Toltec immigration and may be part of a general influx of foreign ideas reflected at Ucanal and Seibal early in cycle 10, when the Classic tradition was already undergoing the process of disintegration.

Sky Deities. Sky deities appear in figure 15. There always is a serpentine element and sometimes nothing else (*b,e*). Usually, however, there is a human figure, either enmeshed in serpent coils (*a, c, d, f*) or issuing from a snake's mouth (*g*). The function of these figures apparently is to preside over or perhaps to direct the action depicted below.

In figure 15, *a*, the serpent element is a confusion of coils which apparently represent two heads as there are teeth on both sides. The man is definitely Toltec as he wears an eagle mask and carries a Toltec spear thrower. The long nose rod, belt, cuffs and anklets, however, are definitely of Mayan style.

In figure 15, *d*, a realistically rendered snake's body sprouts from the human body, but human head, arms and legs are shown. Below are two stylized serpent heads. The breast plate, representing a conventionalized bird, is a typical Toltec ornament. It is found, however, on only three of thirty-one Toltec figures represented on gold disks. Figure 15, *c*, is a fragment probably similar in type to *d*, except that the serpent is a feathered rattlesnake.

Figure 15, *g*, shows a Toltec warrior with typical hat, breast ornament and throwing stick issuing from the mouth of a snake. The snake is rendered with unusual realism, the belly scales, back markings and rattles being clearly indicated.

The only apparently Mayan deity among the Sky gods is shown in figure 15, *f*. His identity is revealed by the flattened forehead, elaborate headdress, bracelet, necklace and pendant. The spear thrower he carries, however, is of Toltec type. The god is shown leaning across a serpent body as if it were a window sill, and he steadies himself by grasping a protuberance of the conventionalized serpent head. On the complete disk (fig. 31) the reason we believe him to be Maya is explained, for he looks down solicitously on two unhappy Maya captives who are under interrogation by a Toltec warrior.

A Sky deity as seen on the Cenote disks, consisting of a human figure enlaced in serpent coils, is found in many parts of the Maya area over a considerable period of time. Often but not always the human figure portrays the Maize god. In all cases, the Sky god is subordinate to the principal design. To cite some examples, such gods are seen at Copan on stelæ B, D, H and N, and there are beautiful instances over a doorway in Temple 22.[18] These range in date from 9.15.0.0.0 to 9.17.12.0.0 (731–783 A.D.)[19] and may be much older than the Cenote disks. In the Palace at Palenque there is a splendid specimen over a doorway.[20] The most recent examples are perhaps those on the outer corridor of the Temple of the Frescoes Temple 16) at Tulum[21] which dates from the last period of construction at that city.[22] One of the architectural features of this period at Tulum is the use of serpent columns, also found at Chichen Itza during the Toltec period.

It has been suggested that what we call Sky deities on the Cenote disks should be classified as "Diving gods." We feel, however, that there are two separate ideas. The Diving god is definitely earthward bound with his feet over his head. Often, notably at Tulum, he has wings and therefore may be compared to our concept of an angel. The Sky deities here discussed, how-

[18] Maudslay, 1889–1902, vol. I, pls. 34, 37; 45, 46; 59; 77–82; 12.
[19] Morley, 1920.
[20] Maudslay, 1889–1902, vol. IV, pl. 47.
[21] Fernández, 1941, fig. 56.
[22] Lothrop, 1924, p. 172.

ever, are strictly celestial. They obviously are interested in mundane affairs but show no tendency to descend to earth — with the possible exception of figure 15, *a*. This god has wing and tail feathers, his position suggests downward movement, and a count of spears indicates he may have cast three and thus has joined the battle.

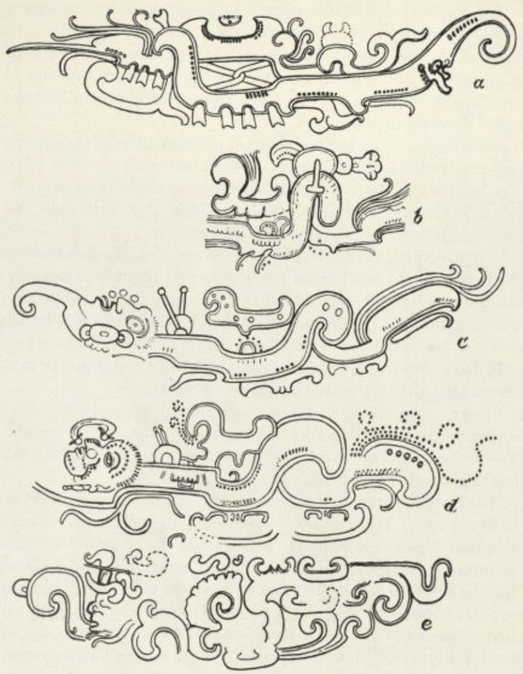


FIG. 16. Earth monsters from battle disks representing two-headed dragons. Actual size.

Earth Monsters. What we call Earth monsters serve to frame the bottom of the action panels (fig. 11). In all cases they consist of static and symbolic designs, usually in the tradition of Maya art at the end of the Great period. Sky deities, we have noted, are interested in the action that takes place below them, even if they do not participate in it. The Earth figures have no apparent connection with what goes on above them although there may be a link through some symbolism now lost to us. With one exception, all the disks in this series where the bottom is even partially preserved, depict Earth monsters. The subject usually is a two-headed dragon but a crocodile and twin-plumed serpents also appear.

Figure 16 illustrates a series of two-headed dragons from Cenote disks. In all cases the lower jaws of these highly conventionalized figures have been omitted. The example in *a* has at the left an upper jaw with teeth, below which is a bifurcated tongue. In the center there is a large eye covered by a diagonal cross which we have suggested may symbolize the heavens. Above is an eye crest and below are more teeth. At the right there is a large spiral which represents another upper jaw, attached to which is the head of a deity, perhaps God K. It seems probable that the right side of *a* is a simplification of an art motive in which a long-nosed god issues from a serpent's jaw, portrayed more realistically, for instance, at Copan.[23]

Figure 16, *c* and *d*, shows two very similar designs. In each case at the left there are human heads with bristling hair. They are incorporated in an upper jaw, and face upwards. One of them is elaborately tattooed. These heads are attached to bodies with arched tails, from which another upper jaw projects to the right. Figure 16, *e*, is a modified version, the details of which are not clear. The head at the left, however, is vertical rather than horizontal.

A unifying feature of the designs in figure 16 is an element suggesting an animal with a tail, placed on the top of all except *e*. Just what this represents we cannot say. In the case of *c*, *d* and *e*, the human heads are alike in that all have Roman noses.

FIG. 17. Two-headed dragon from stela 10, Seibal, Guatemala. Length, 1.4 meters (55 inches). After, Maler, 1908.

While the Cenote two-headed dragons have many parallels in the stone carving of the Great period, the closest link is with a minor design on stela 10 at Seibal, illustrated in figure 17. This exhibits the same general layout seen in figure 16, *b–e*. It has a Roman-nose face at the left and the same central motive on top. The resemblance is more striking when we recall that the motives in figure 16 were pressed in gold and are reproduced at approximately natural size, while the original of figure 17 was carved in relief in stone and measures about 1.4 meters (55 inches) in length. The date on stela 10 at Seibal is 10.1.0.0.0 (849 A.D.).

Of the other Earth monsters, figure 18, *a*, shows a crocodile which lies on its back in disk C (fig. 31). We can give no exact parallel to this creature in Mayan art but details, such as the eyes, the feet, the anklets and the dorsal decoration, all link it to the Great period. The twin-plumed serpents in figure 18, *h*, characterized by an attempt at naturalism in the treatment of the head and body markings, must be regarded as of Toltec inspiration.

On a number of Maya stelae the principal personage stands over a panel containing a dragon head, corresponding to the Earth monsters on the Cenote disks. The idea is quite an old one. It occurs on stela 2 at Yaxchilan which is dated 9.9.0.0.0 (613 A.D.) and also is found on stelæ 1 and 4 which both are dated 9.16.0.0.0 (761 A.D.).[24] At Piedras Negras similar bands occur across the top of stelæ 11, 14 and 25 which bear the dates 9.15.0.0.0 (731 A.D.), 9.18.10.0.0 (800 A.D.) and 9.8.15.0.0 (608 A.D.).[25] Examples

[23] Maudslay, 1889–1902, vol. I, pl. 24, *a*.
[24] Maler, 1903, pls. LXIX, LXX and LXXII, *i*. The dates are from Morley, 1938.
[25] Maler, 1901, pls. XX, XXII.

occur at Palenque on the main panels of the Temple of the Cross, Temple of the Foliated Cross and Temple of the Inscriptions.[26] Base panels with dragon heads are found at Naranjo on stelæ 2 and 31 which are dated 9.14.1.3.9 (713 A.D.) and 9.14.10.0.0 (721 A.D.).[27] In addition, there are dragon panels at Quirigua on the bases of stelæ H, J, F, D, E and A, which commemorate all the *hotun* endings (periods of 1800 days) from 9.16.0.0.0 (751 A.D.) to 9.17.5.0.0 (775 A.D.).[28]

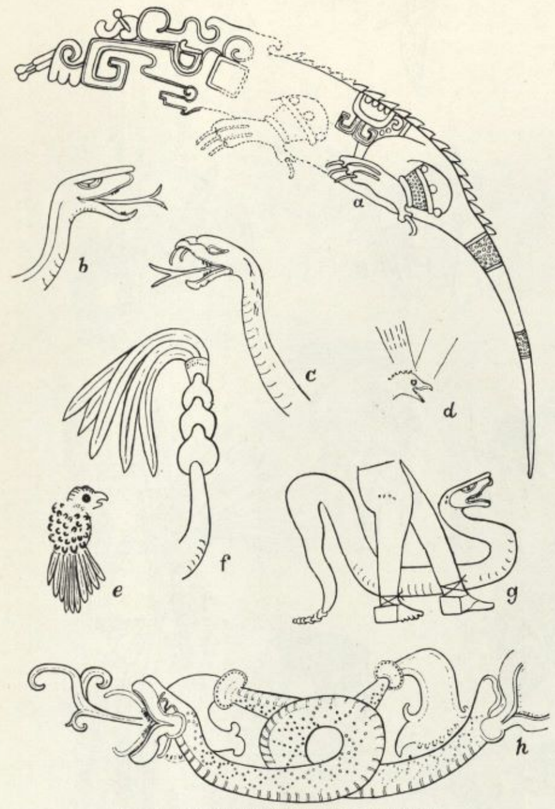


FIG. 18. Animals from battle disks. Actual size.

Enough has been said to show that the idea of an Earth monster in the form of a dragon permeates Maya stone carving of the Great period, although it is a constant feature only for a short time at Quirigua. It does not occur in stone at the end of the period.

At Chichen Itza there are literally hundreds of figures carved in low relief in Toltec style on door jambs and on the sides of square columns. Each individual often has a Sky deity above and an Earth monster below him. These owe nothing to Maya art but, in many cases, are closely linked with the carvings found at Tula on the central Mexican plateau.[29]

[26] Maudslay, 1889–1902, vol. IV, pls. 76, 81, 55–56.
[27] Maler, 1908, pls. 20.
[28] Morley, 1935a.

The designs we have so far discussed have been of religious or symbolic significance. Except for deities wearing Toltec insignia, however, the art is Mayan both in subject matter and in execution. Many parallels may be noted with stone carvings of the southern Maya cities. We come now to scenes which are purely secular, with the exception of a picture of human sacrifice. Even so, great plumed serpents may tower in the background, serpent symbols fill blank spaces in the design and Sky deities look down on the acts of man.

Accouterments. A total of forty-eight individuals are represented on the ten gold disks portraying war scenes. Of these, sixteen are Maya, twenty-seven are Toltec and five are Sky deities. With two possible exceptions in figure 20, *c* and *i*, no women are shown, but men and boys appear.

Headdress. Toltec headdresses are illustrated in figure 19. From figure 19, *i* and *m*, it appears that the Toltec cut their hair in a short bang across the forehead and allowed it to grow long behind. The simplest style of head ornament consists of attaching feathers directly to the hair as in *i*. In *m* we have a complex headdress also attached directly to the hair. It consists of a base shaped like an inverted and truncated cone from which sprouts a ring of short stiff feathers and a spray of long tail plumes of the quetzal bird. All other Toltec head ornaments are hats, which surround the head, or masks, which envelop it.

The characteristic Toltec hat is shaped like a short cylinder (fig. 19, *k*). This basic form is modified by increasing the height (fig. 19, *j*), by adding ear flaps (fig. 19, *d*, *e*), by expanding the ear flaps to cover the back of the head (fig. 19, *a*, *c*), by the attachment of feathers in various manners and by attaching what appears to be a stuffed bird to the front of the hat (fig. 19, *a–g*). The bird, when shown in color, is painted blue.

Feathers are of several distinct types. Quetzal feathers, often exaggerated in length, appear in great quantity and are easily recognized. Sometimes small disks are attached to quetzal feathers (fig. 19, *n*). Feathers of medium size which terminate in a sharp point (fig. 19, *g*, *i*) presumably are eagle feathers. In the frescoes, feathers of this shape are painted in white and terminate in a black tip.[30] There are also feathers of medium size which terminate in a rounded tip (fig. 19, *b*,*d*), and small sharply pointed feathers (fig. 19, *a*, *j*). In one case (fig. 37) the tips of the feathers have been trimmed square.

In the frescoes and bas-reliefs at Chichen Itza the hat part of these Toltec headdresses is often painted blue. The surface may be plain or divided into small squares which have been presumed to represent turquoise mosaic. On the gold disks, however, the hats are adorned with rows of dots, or small circles, or both. This must represent some kind of incrustation.

Another type of headdress, worn only by subordinates, appears in figure 19, *l* and *o*. Unlike the commoner kind, this seems to be made of some soft material, perhaps fur. In one instance (*o*) it can be seen that there is a stiff inner frame running from ear to ear across the forehead.

Masks, which are fairly common in the frescoes and bas-reliefs, are rare in the gold disks. Of the three examples, one is worn by a Sky deity (fig. 15, *a*), one by a warrior (fig. 37) and the third by

[29] Thompson, 1946, pl. IV. Acosta, 1941.
[30] Morris, Charlot *and* Morris, 1931, pl. 34, *E*.

FIG. 19. Tula-Toltec headdresses from battle scenes. Actual size.

the executioner at a human sacrifice (fig. 1). In each case the mask represents an eagle.

It is obvious that these Toltec headdresses are the insignia of a military organization but probably the forms were not as rigidly standardized as our own are today and there was individual variation. It is clear, however, that the wearers of birds on the front of their hats were chiefs. Not more than one of them appears on any one disk. They hold the center of the stage and they have one or more attendants who usually are slightly smaller in stature. They are shown giving orders and performing feats of war.

We shall now consider the possibility that definite individuals are represented on the disks. Tozzer [31] plausibly argues that the people pictured in the lower chamber of the Tiger Temple are individuals, pointing out that the men without name glyphs wear the insignia of high command and doubtless were too well known to need name glyphs. On the gold disks, the leaders with birds on their hats, with two or three exceptions, have long beards (fig. 19, *a–g*). Apart from that, however, they differ in their dress and ornaments. In the case of figure 19, *f* and *n*, we believe it possible that the same man is represented because in each case he has a

[31] Tozzer, 1930, p. 159.

moustache and is shown as left-handed, as can be seen in figures 1 and 34. His costume naturally would vary, as in one instance he is pictured in battle and in the other as ceremonially cutting out a heart. All the heads in figure 19 conform to the same physical type, marked by high foreheads and hooked noses.

Maya heads, illustrated in figure 20, are characterized by flattened foreheads and long pointed noses. The hair at times was

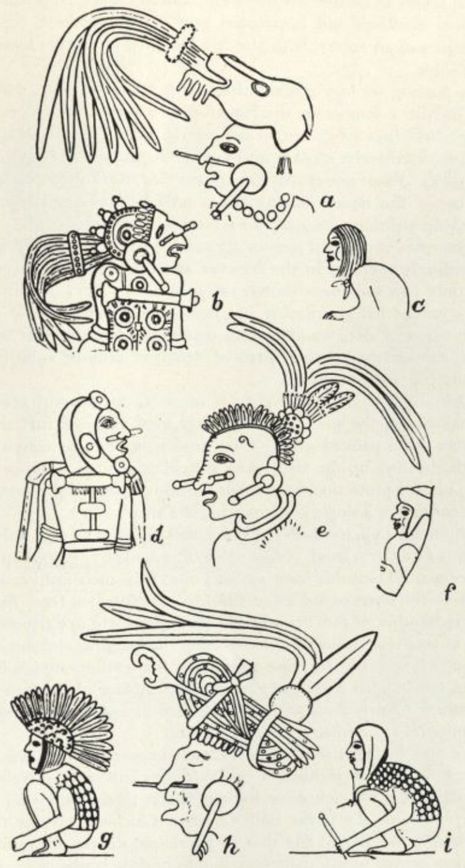


FIG. 20. Maya headdresses from battle disks. Actual size.

allowed to grow to the shoulders (*c*, *g*). The normal headdress consisted of a simple skull cap which often was secured by a strap under the chin (*f*). This form was embellished by the addition of feathers (*b*) or by adding small ornaments, presumably of jade (*d*).

Figure 20, *h*, shows an elaborate turban to which the leg of a bird and quetzal plumes are attached. Large turbans are represented on Great period stelæ and altars, notably at Copan, and are still worn in certain Quiché and Zutugil villages in the highlands of Guatemala. Figure 20, *a*, illustrates an elaborate animal headdress, the nature of which is not clear. Finally in *j* we have a head simply covered with a cloth.

FIG. 21. Jade bar-pendant assembled from elements found in the Cenote of Sacrifice. Length of bar, 36.2 centimeters (14¼ inches).

Additional Maya headdresses appear in figure 23. Of these, *e* is rendered with unusual detail, showing clearly the woven design of the cap. The details of *b*, *c* and *h* are not clear but all are elaborate affairs.

Nose Ornaments. The usual Tula-Toltec nose ornament consisted of buttons inserted in the wings of the nose. At times two or even three of these were worn on each side (fig. 19, *f*, *g*). The Maya adorned their noses by long rods inserted through the septum (fig. 20). In four instances (fig. 19, *a*, *i*) Toltec warriors are shown wearing this ornament. There is no standard color for representing nose rods in frescoes at Chichen Itza, which probably indicates that they were made of various materials. Figure 19, *m*, pictures a terraced nose pendant, a form seen in Mexican codices.

Ear Ornaments. The standard ear decoration is a disk with a stem which was inserted in the ear (fig. 19, *a*). In many cases a tubular bead was attached so that it projected from the center of the disk (fig. 20, *a*, *b*, *e*, *h*). In one instance (fig. 19, *l*) a second disk hangs below the one in the ear.

Breast Ornaments. We have already spoken of the Toltec bird-shaped gorget which was an insignia of rank. Only three examples of this occur on the gold disks (figs. 15, *d*, *g*; 19, *e*). Figure 19, *d*, illustrates a semi-circular gorget with a face on it and a fringe of danglers below. Figure 19, *b*, shows a similar piece with a rectangular outline.

A number of Toltec warriors of high rank wear a sort of yoke on their shoulders. This may be round (figs. 15, *a*; 19, *f*) or rectangular (fig. 19, *a*, *g*) in outline. Yokes sometimes are seen on Chacmool statues.

Toltecs rarely wear bead necklaces. When they do, the beads may hang down the back (fig. 19, *n*). Great period Maya frescoes at Bonampak and Uaxactun also show beads hanging down the back but these appear to be choker collars with "pigtails" of beads attached to them.

The Maya represented on the disks wear necklaces of large beads, presumably of jade like those found in the Cenote of Sacrifice. These may sustain a carved pendant as in figure 15, *f*. More often, however, there is an elaborate compound bar-pendant as in figures 20, *b* and *d*. An example assembled from jade elements found in the Cenote of Sacrifice appears in figure 21.

The only direct suggestion that gold disks such as we describe were worn as gorgets comes from figure 19, *d*, which shows a decorated disk on the chest.

Clothing. The major Toltec warriors shown on the disks are pictured in action. Hence they wear a breech clout and belt but nothing else. Examples of this are shown in figures 15, *a*, and 22, *a–c*. Details are none too clear but it is possible to see that the belt encircled the body two or three times and was tied in front.

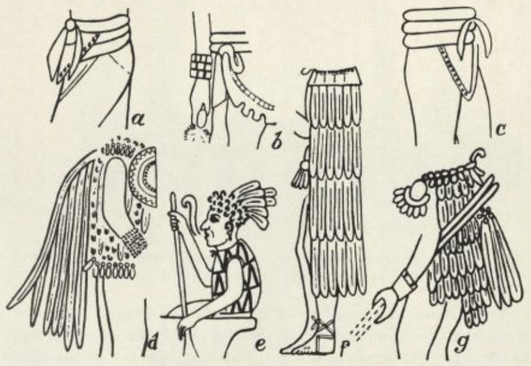


FIG. 22. Tula-Toltec clothing on the battle disks. Actual size.

The less active spear bearers and attendants of the principal Toltec warriors usually wore a sleeveless shirt or poncho which covered the hips. Examples occur in figure 22, *d*, *e*. In a few cases (fig. 22, *f*, *g*) feather cloaks were worn. These were short like the shirts or came down to mid-calf. The Maya wore short shirts and breech clouts (figs. 20, *b*, *d*, *g*, *i* and 23 *f*). The shirts usually were adorned with disks, possibly of jade or gold.

Back Shields. In the frescoes and bas-reliefs of Chichen Itza and the statues from Tula, almost all Toltec warriors are shown wearing a "back shield" or "dorsal mirror" on their rumps. These are disks about the size of those we are discussing, which were attached to the body by one or two cords, placed high enough so that the wearer could sit down. The only Toltec back shields represented in gold appear on the four boys shown in figure 1. This follows the usual convention of showing only half the shield, a crude attempt at perspective.

Maya back ornaments, illustrated in figure 23, are elaborate affairs which run from the neck to the hips and are adorned with feathers. There are several types, none of which is shown in enough detail to permit a good description. One type, seen in figure 23, *a*, *d*, *g*, *h*, looks like a curved board in which a series of holes had been cut. The feathers apparently were inserted in the holes and secured with wedges or gum. A second type is illustrated in figure 23, *b*, *c*, *e*. The main part of these shields appears to be of basketry or wickerwork. An example very much like our *c* is represented in the frescoes of the Temple of the Warriors.[32] The frame is the color of straw; the design is black and the feathers are green. Figure 23, *f*, apparently shows a double back shield which hangs from the shoulders.

Arm Ornaments. Arm ornaments, illustrated in fig. 24, consist of cuffs and sleeves or flexible shields. The cuff in *b* appears to be of mosaic, possibly turquoise or jade set on wood. In the wall paintings at Chichen Itza similar cuffs are rendered in blue or green. The example in *d* is perhaps intended to represent hammered metal, a type well known in South America. Some of the cuffs in frescoes are red, perhaps indicating copper.

The commonest type of cuff is seen in figure 24, *a*. This is worn in units of one, two, three or four, sometimes bunched on the forearm (fig. 34) and sometimes spaced out (fig. 19, *n*). The material seems to be fur. In the wall paintings this type of cuff has similar markings and is painted gray. We reproduce (fig. 25) examples of an animal with the fur indicated by similar hatching and color.

In passing we may remark that fur is a material better suited for use in a temperate than a tropical climate. Fur does not appear in Maya art except in connection with Tula-Toltecs, who used it extensively: on arm and leg bands, on hats and on throwing sticks. From this it may be argued that the Toltec developed the use of this typical adornment in a cool climate and at a considerable altitude presumably in the highlands of Mexico.

Examples of so-called sleeves appear in figure 24, *c*, *e*. They are exceedingly common in the frescoes and bas-reliefs but these are the only two specimens shown on gold disks. They usually are worn on the left arm and it has been widely assumed that they were made of cloth wadded with cotton and hardened in brine, in short that they were a form of defensive armour substituted for the conventional shield.

This interpretation probably is incorrect for several reasons. A majority of the specimens evidently were made of fur and in frescoes were painted gray. They consist of four to eleven fur bands running up the arm. Any stiffening of such a device, far from being a protection, would put the arm out of action. Another type consists of a single pelt covering the arm.

Another group, to which the specimens in figure 24, *c*, *e*, belong, consists of an arm band, either of cloth or basketry, placed on the upper arm. From this hang various objects in such fashion as to reach to the knees or ankles and to leave the forearm free. In the lower chamber of the Temple of the Tigers there are five examples of this type of sleeve. In two cases the hanging element consists of a single large fur; one apparently is a textile; one is a bundle of ten braided ropes and one is an assemblage of thirteen rattlesnakes. Clearly these and the specimen in figure 24 served an ornamental rather than a useful function.

We may further state that it is clearly impossible for a warrior to wear a stiffened protection on both arms and take active part in battle. Yet the eighty-five human figures in six panels on the inner walls of the Great Ball Court at Chichen Itza are thus adorned.[33] We should add that in bas-reliefs, sleeves are seen on warriors carved individually on columns or door jambs or in ceremonial processions on walls. They are not shown in battle scenes in any media. Our examples in figure 24 come from disks representing the interrogation of prisoners – an occasion when an officer might be expected to wear his full regalia.

Belts. Belts as a rule appear to be undecorated (fig. 22, *a–c*). Figure 24, *c*, however, shows a Toltec example with three elements each made of different material. Figure 15, *a*, illustrates a Sky deity wearing an elaborate belt and cuffs. These perhaps are comparable to the somewhat narrower bands of bird bones or gold tubes found on the wrists of skeletons in Coclé. Although the deity in figure 15, *a*, must be regarded as Toltec, his belt and cuffs are of Maya style, frequently seen on stelæ.[34] Maya belts on the gold disks also

[32] Morris, Charlot *and* Morris, 1931, pl. 154, *b*.

[33] Erosa Peniche, 1946, p. 24. Palacios, 1937, fig. 41. It is hoped that the Carnegie Institution of Washington or the Mexican Government will publish adequate illustrations of these and other figures which differ radically from those in the Temple of the Tigers.

[34] Lothrop, 1937–42, part I, figs. 139–42.

FIG. 23. Maya back ornaments from Tula-Toltec battle disks. Actual size.

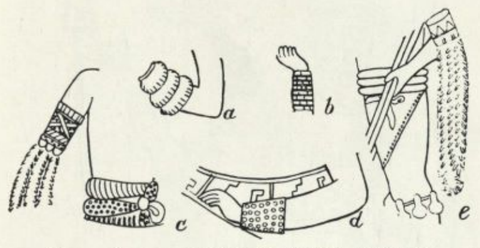


FIG. 24. Arm ornaments from battle disks. Actual size.

FIG. 25. Animal head showing Tula-Toltec method of depicting fur. Temple of the Warriors, Chichen Itza. After MCM, pl. 165.

are simple. An exception to this, adorned with a band of feathers, appears in figure 23, *g*.

Leg Bands. Among the Toltec the higher officials often wore bands around the calf (fig. 26, *b*, *c*, *e*, *f*, *g*, *i*, *j*) and occasionally around the ankle (fig. 26, *b*, *e*). In a few cases these were of fur (fig. 25) but in general it is not possible to determine the material. It is clear, however, that copper bells such as we illustrate in this volume often were attached to the bands (fig. 26, *c*, *j*).

Some of the Maya warriors have a different type of object tied to each leg by a cord. In figure 23, *g*, there is a bell on the right leg and rectangular bundle with danglers on the other. In figure 26, *g*, a rectangle and a circle are seen. The only Toltec example occurs in figure 26, *c*. We have found no suggestion of this asymmetrical decoration in the local frescoes and bas-reliefs but it sometimes is seen on Peten stelæ.

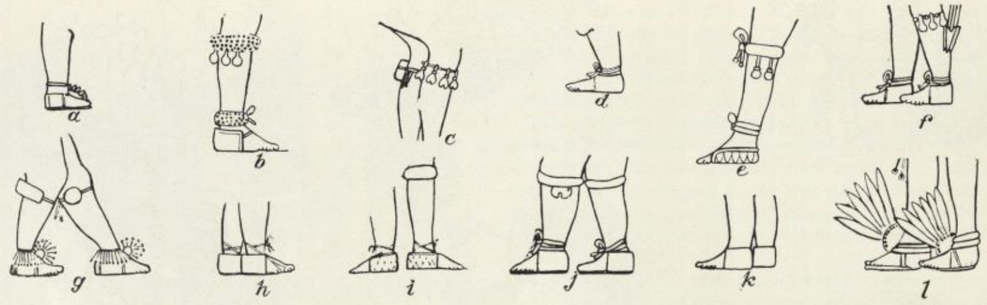


FIG. 26. Leg bands and sandals. *g*, *l*, Maya; *others*, Tula-Toltec. Actual size.

Sandals. Toltec sandals are essentially simple (fig. 26). They consist of a sole and a heel piece which covered about half the foot. They were held in place by straps which encircled the ankle and were tied in front. Occasionally there is decoration on the heel (fig. 26, *e*, *i*).

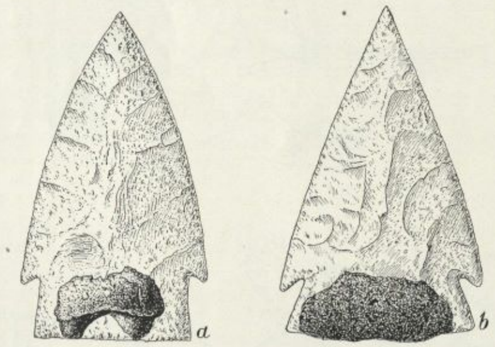


FIG. 27. Spear points from the Cenote of Sacrifice. Actual size.

Maya sandals (fig. 26, *g*, *l*) are relatively more complicated than Toltec and carry ornaments on the ankles. Yet they are simple in comparison with the ornate footgear seen in the Great period sculptures farther south.

Weapons. Just as they differed in their dress and ornaments, the Maya and Toltec had different ideas about their fighting equipment. The Toltec offensive weapon was a spear about 1.7 meters long (4½ feet) which was propelled by a throwing stick. Several examples of the latter were recovered from the Cenote of Sacrifice. These darts must have been fairly light in weight. They have small triangular heads (fig. 27). Often there was a single feather which was not split and attached to opposite sides of the shaft but was tied complete against one side. This may be seen in figures 23, *a*, and 32. The feather did not extend to the end of the shaft, evidently in order not to interfere with the throwing stick. In one instance, figure 23, *a*, a Maya, is shown with Toltec spears.

Inspection of the disks reveals that the number of javelins normally carried was five. In the battle scenes, some of these may have been discharged. For instance in figure 34 two spears have been thrown, one is being thrown and two are in reserve. In figures 30 and 31 the chief holds two spears and the attendant carries three. In Maudslay's drawings of Toltec warriors in the lower chamber of the Tiger Temple, twenty-three warriors carry five darts, six had four darts. The remaining five are shown with five butts and four points each.

Maya spears or pikes were intended for thrusting. Their blades are large and leaf-shaped, approximating the length of the hand and about twice the size of Toltec blades. In one case on the gold disks (fig. 28, *g*), a spear with lattice-work on the shaft is seen. Other examples are known from the lower chamber of the Temple of the Tigers at Chichen Itza,[35] Itzimté Sacluk, Naranjo and

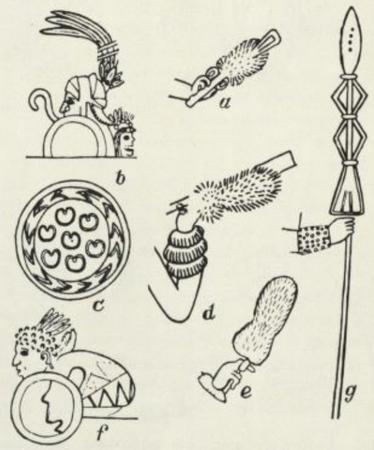


FIG. 28. Shields, spear and spear throwers from battle disks. Actual size.

[35] Follett, 1932, p. 383. Also Bonampak (Proskouriakoff, 1950, fig. 68).

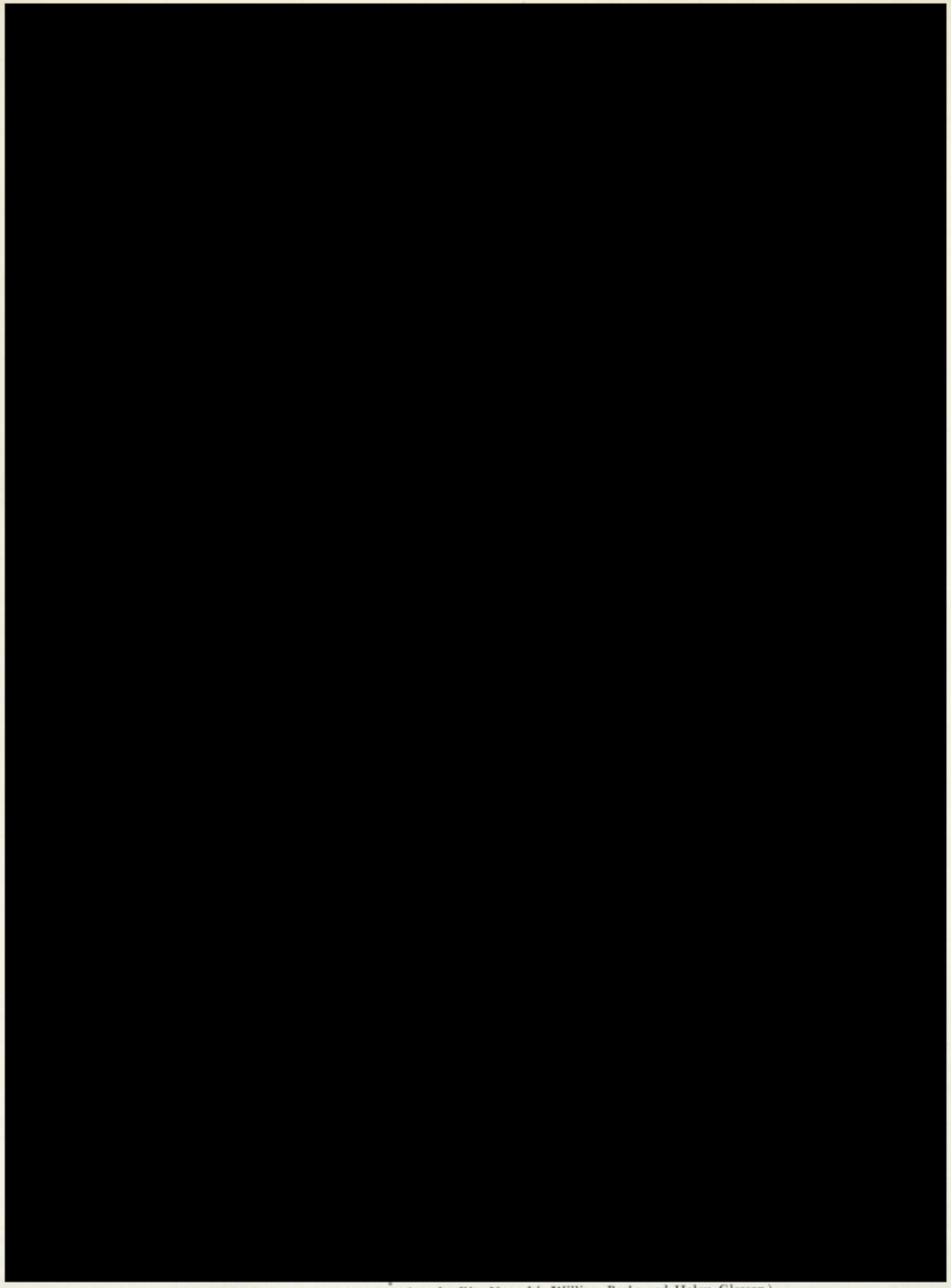


FIG. 29. Disk A. Actual size. (Drawings by Kisa Noguchi, William Baake and Helen Gleason.)

FIG. 30. Disk B, showing a Tula-Toltec warrior interrogating Maya captives. Actual size. See table XVIII, analysis 1289.

Palenque. These cumbersome spears seem fitted to serve only as symbols of authority. Figure 32, however, shows the right-hand warrior on a gold disk carrying such a spear in actual is unsuccessful combat. Perhaps he is the *Batab* who served as hereditary war chief but had little military importance.

The only three shields appearing on the disks are illustrated in figure 28, *b*, *c*, *f*. In each case they are round. One (*b*) is undecorated. Another (*f*), badly battered in the original specimen, carries what may be a crude face. The third bears a widely distributed motive, found at Chichen Itza on the frieze of the Jaguar Temple, which persisted until Aztec times in Mexico. Several examples are reproduced in Peñafiel's *Indumentaria*. No Maya shields appear on the disks although examples are to be found at Chichen Itza and the southern cities.

We have not attempted to make a study of Maya and Toltec weapons as a whole, only of what appears on the disks. It is evident from historical sources that much has been omitted. Not represented are bows and arrows, slings, axes, clubs, broadswords (macuahuitl) and fighting knives. Also body armor usually is lacking, helmets are doubtful, and the Maya warriors carry no shields. No weapons are shown for hand to hand combat. These all are elements of war which might have been depicted, at least according to sixteenth-century Spanish accounts of how and with what the Maya fought.

DESCRIPTION OF DISKS

Disk A. This consists of about one-third of the original and represents only two individuals (fig. 29). On the left is an official of high rank in full regalia. He is bearded. His head is adorned with a typical Toltec feathered headdress with a bird on the front, but the nose rod is of Maya rather than Toltec style. This warrior wears an arm shield on his right arm and carries a decorated staff in the left hand, suggesting that he is left-handed. He cannot, however, be identified with the left-handed individuals in disks F and H as they have moustaches but no beards. The arm shield consists of a decorated textile or basketry band worn on the upper arm to which three fur streamers are attached. The belt is unusually elaborate and is made of three different materials.

To the left of this personage is a C-shape ornament adorned with feathers. This perhaps is a Moan bird. An ornament almost identical except that the lower end of the C terminates in a bird-like head appears on a painted pottery jar from Yalloch, Guatemala.[36] It dates from the end of the Great period. Stela F at Quiriqua, the earliest stela with a beard, is adorned at the base with elements more comparable to the Yalloch specimen than to the Cenote example.[37] The date on this monument is 9.16.10.0.0 (761 A.D.).[38]

The individual on the right can be identified as a Maya by the pointed nose, retreating forehead and the headdress. He wears an anxious expression and presumably is a captive. Above his head are six small glyphs which do not appear to be Maya in character. They perhaps indicate the occasion rather than a name.

Disk B. This disk represents the questioning of two bound prisoners (fig. 30). The chief personage is a bearded Toltec warrior whose rank is indicated by a mosaic headdress with a bird on the

[36] Gann, 1918, pl. 28. In Gordon *and* Mason, 1925, pl. XVIII, the vessel is assigned to British Honduras. It is also illustrated in Cahill, 1933, cover.

[37] Maudslay, 1889–1902, vol. II, pl. 36.
[38] Morley, 1935a, p. 68.

FIG. 31. Disk C, showing a Tula-Toltec warrior interrogating Maya captives. Actual size. See table XVIII, analysis 1290.

front. There is an arm shield consisting of a band on the upper arm from which hang two furs. The right wrist is adorned with two bracelets of fur and there are bells on the left leg. Two nose buttons are inserted in the wings of the nose. Two spears and a spear thrower are carried in the hands.

Behind the chief stands an attendant who holds a spear thrower and three spears, bringing the total number to the customary five. He wears bells on the left leg, a mosaic bracelet on the right wrist, a necklace and a nose rod of Maya rather than Toltec type. The nature of the headdress and the facial decoration is not clear.

The two prisoners both have their arms bound behind their backs by ropes above the elbows. This was the usual Maya method for securing captives and doubtless caused great pain owing to more or less complete stoppage of circulation of the blood.

Morley [39] has pointed out that captives are shown on stelæ at seventeen Maya cities of the Great period and he lists nearly a hundred examples. These he divides into four groups on the basis of the position of the captive in relationship to the principal figure. The prisoner may be (1) behind, (2) a support of, (3) beside or (4) in a panel below the principal figure. These positions seem to be the result of local styles rather than chronological changes, as a single position is dominant at all sites except Cobá where two types are found. In disk B the captives are shown at the same level as the Toltec chief who dominates the scene. This is the most common arrangement in stone. It obviously is not of chronological significance as the dates run from 9.3.0.0.0 to 10.3.0.0.0 (495–889 A.D.).

Both prisoners, to judge by their expressions, are far from happy. They wear typical Maya ornaments, including tubular jade bars on their breasts and nose rods. The standing figure carries a small human statue (?). Behind the knee of the seated captive there is an elaborate plumed back shield which presumably has been ripped off him.

Under the back shield there is a dish containing a human head, perhaps a grim testimonial of what is in store for the prisoners. Tozzer [40] comments on the archæological occurrence of skulls in bowls. A comparable head and plate, carved in stone, was found in Temple 11 at Copan.[41]

The Sky deity on disk B is a curious assemblage of human head, arms and legs combined with a realistic serpent body. Headdress and gorget are typically Toltec. One arm holds an object which may be interpreted as a rattle with sound scrolls issuing from it. The other arm grasps a spear thrower. Below the face is a speech scroll directed downwards towards the prisoners, which suggests that the deity may be taking part in the interrogation.

The bottom of the disk is lacking, but scrolls at the right indicate that it contained an Earth monster.

As background motives or space fillers four greatly conventionalized serpents' heads are shown. These vary in size and complexity. Similar heads occur in stone carvings at Chichen Itza on buildings of the Toltec period but they are also found on stelæ of the Great period at such sites as Copan, Quirigua, Naranjo and Seibal.[42] In addition to the serpent heads there is a glyph, perhaps a name glyph, behind the head of the standing captive.

Looking at the composition as a whole, we may remark that, although no action is suggested except perhaps in the upraised arm of the Sky deity, the scene is tense and emotional. The standing figures lean forward towards each other to stress their earnestness. The seated figure recoils at what is being said. The threatening attitude of the Sky deity dominates the entire picture.

Disk C. Another disk portraying the interrogation of captive Mayas appears in figure 31. A Toltec warrior dominates the scene. His body, leaning towards the prisoners to emphasize his words, is shown full face but the bearded head is in profile. A bird is perched on his extended arm, which brandishes two spears. Rank is indicated by the helmet with a bird on the front and by the relatively great stature.

The spear bearer at the left evidently is a Toltec, as indicated by his high forehead, shoulder yoke, nose button and the weapons he carries, but his garments and ornaments are Maya. These include sandals, shirt, plumed back shield, bracelets and breast ornaments. Presumably these are the spoils of war.

Unfortunately the disk is so broken that just what the captives are doing is not clear. Both are definitely Maya, identified in one case by the head type and in the other by the tall headdress. Plumed back shields are shown on the ground beside each of them. The seated figure is wriggling his toes in apparent embarrassment. The standing captive holds a small figurine in the left hand.

The Sky deity is unusual in that all details except the spear thrower are distinctly Maya, and because his function apparently is to protect the captives rather than to encourage the Toltecs. The deity is shown leaning across the body of a conventionalized snake as if it were a window sill. With one hand he grasps a portion of the snake's anatomy (tongue?) in order to steady himself. It has already been pointed out (p. 35) that deities of this type are found in Maya art of the Great period.

The Earth monster consists of an elaborate crocodile, placed upside down so that the back follows the curve of the disk. The head is represented in angled detail as is common in painted pottery of southern Central America. The back is covered by triangular crests. Just why this feature, not particularly prominent in nature, is greatly emphasized in aboriginal American art is not clear. It does occur, however, on painted pottery or in metal, from the State of Vera Cruz, Mexico, to the central coast of Peru. The single leg seen in figure 31 wears an anklet. This form is found at Yaxchilan on a lintel in Structure 20.[43]

The border decoration of disk C consists of four dragon heads minus the lower jaws. These are shown full face and are similar to the so-called mask panels commonly found on the façades of Maya buildings. It is also possible to interpret each panel as two profile heads set back to back.

Disks B and C both portray identical subjects: a Toltec chief with his attendant questioning two Maya captives. This raises the question of whether two different artists had been commissioned or ordered to commemorate the same incident in the life of a single chief. There are obvious differences in style and details but there also are parallels which indicate an affirmative answer. These may be listed as follows.

1) The principal insignia of the Toltec chief is his headdress, which is identical on both disks. It consists of a cylindrical band with a bird in front and a domed top to which three feathers are attached.

2) The ear ornaments are the same.

3) The twin bracelets of fur are the same. The bird on the arm in disk C may be a decorative element corresponding to the band and furs in disk B, a so-called arm shield.

4) In each case bells are worn on the calf.

5) In each case one Maya is standing and the other is seated.

6) In each case the standing Maya holds a doll or figurine by the hair.

[39] Morley, 1938, table 2.
[40] Tozzer, 1941, p. 143, note 684.
[41] Maudslay, 1889–1902, vol. I, pl. 7, *c*.
[42] Maudslay, 1889–1902, vol. I, pl. 24, *f–j*. Spinden, 1913, figs. 35–38, 42.
[43] Maudslay, 1889–1902, vol. II, pl. 82.

FIG. 32. Disk D, showing a Tula-Toltec chief casting a spear at two Maya warriors who endeavor to escape. Actual size. See table XVIII, analysis 1288.

7) In each case the Maya have been deprived of back shields.

8) The seated Maya has similar leg ornaments in both disks.

9) The Toltec attendant in disk C apparently wears the barpendant and back shield belonging to the seated Maya in disk B.

10) The small conventionalized serpent heads used as space fillers on both disks are very similar. They occur on no other disks.

11) The decoration on the back of the Earth monster in disk C corresponds to part of the glyph on the left side of disk B.

In spite of these parallels, however, it should be noted that the Sky deities, Earth monsters and border ornaments are totally unlike.

Disk D. This disk, illustrated in figure 32, depicts a Toltec chief casting a spear at two retreating Maya warriors. The Toltec wears a beard which falls to his waist. His rank is indicated by a mosaic helmet with a bird on the front. In his left hand he carries two additional spears. Accompanying him is a realistically rendered rattlesnake.

The chief's attendant is clad in a feather tunic with long plumes hanging down the back. He carries a spear thrower but no spears.

Both the Maya wear elaborate plumed headdresses. The left-hand example represents some kind of an animal. The other consists of plumes attached to a basketry base, such as is shown in greater detail in figure 23, *e*. One warrior carries a spear with a latticed shaft. This feature appears on Toltec bas-reliefs at Chichen Itza and also on Maya stelæ of the Great period. The second warrior is unarmed but wears a back shield. He looks backward in an apprehensive manner and raises his hand to ward off the coming attack.

FIG. 33. Disk E, showing a battle scene. Actual size. (The right side of the border is restored.) See table XVIII, analysis 1291.

The usual Sky deity has been replaced by a greatly conventionalized serpent which we shall not attempt to analyze. The Earth monster is of the usual type. Border decoration consists of symbols of the planet Venus.

Although disk D is unusually well preserved, it does not rank high in artistic merit. It will be noted that the sky and earth elements are not symmetrically placed, with the result that the central panel is awkwardly shaped. We may also point out that the feet of the Maya and Toltec are not in the same plane, which perhaps denotes that they are not moving in the same direction. The great fault, however, lies in the stiffness of pose which denies vigor to a scene of action.

Disk E. Only about half of this disk was recovered as shown in figure 33. The principal personality is a bearded Toltec warrior of high rank, pictured in the act of casting a spear from his throwing stick. He wears sandals, anklets, calf bands with bells, an elaborate breech clout, a huge gorget depicting a face with danglers on the sides and a quadruple bracelet of fur. On his head is a

FIG. 34. Disk F, showing a wounded Maya warrior and a second who surrenders as a Tula-Toltec chief is about to cast a spear at him. Scale, 9/10.

mosaic helmet with plumes behind and a bird in front. There are two buttons in the wings of the nose. In the background are bodies of huge snakes.

The spear bearer is clad in a tunic with plumes on the back. His headdress is surmounted by an inverted cone of feathers with long plumes issuing from the center. He wears ear disks and a terraced nose ornament. There is a speech scroll in front of the face.

The Maya opponents probably were two in number, one of them being on the ground and one of them standing as in figure 31. This is suggested by the feathers in front of the feet of the Toltec chief, whose spear seems to be aimed at a second and higher target. These feathers may be part of a back shield.

The Sky deity evidently involved a human being and a plumed rattlesnake, similar in concept to the example in figure 30.

The usual Earth monster is replaced by a pair of serpents, realistically rendered except for tongues and tails. These are not rattlesnakes and the markings suggest that they may be fer-de-lances.

The border pattern consists of Venus signs repeated four times. These are the only Maya elements on the surviving portion of the disk.

Disk F. This is the only disk in this series which had not been torn in pieces. It had, however, been crumpled into a ball and there are innumerable creases in the original which make it difficult to see the design.

FIG. 35. Disk G, which represents a naval battle. Diameter, 26.3 centimeters (10⅜ inches).

The principal personage is, as usual, a Toltec chieftain, but he exhibits some novel features. He wears the conventional garments and ornaments, including a helmet with a bird on the front to denote his rank. He has a mustache but lacks the full beard normally seen on chiefs. He is ready to cast a spear and it will be noted that he is left-handed. The artist, however, in order give a full view of the face, has placed the spear over the right shoulder and over the circular shield carried on the right arm.

The spear bearer is clad in a feather cape. He wears a fur cap decorated with disks and plumes. He carries an extra spear thrower and two spears.

The Toltec chief is shown in the act of attacking two Maya, both adorned with elaborate back shields and headdresses. One of the Maya is seated on the ground and is endeavoring with one hand to extract a spear which has been driven into his shoulder. In the other hand he holds his own weapons. The face expresses complete misery. The second Maya is standing and holds under his right arm a spear reversed with the butt forward. This evidently is an offer of surrender. We suspect that the spear in question has already been thrown at him by the Toltec because it has tabs on the base of the blade similar to those on the poised spear and because it thus accounts for the five spears customarily carried.

The position usually occupied by the Sky deity is filled on this disk by a rattlesnake with a huge head and mouth. The Earth monster is of conventional type. Of the border patterns, the top and bottom pair consists of elaborate profile heads set back to back. The lateral panels contain single heads of the same type, elongated and more stylized. All are of Maya Great period style.

Disk G. This is an unusual disk both in subject and in workmanship. We feel certain that it could not have been manufactured by the same individual who produced any of the other specimens we illustrate. The subject, an attack by water, is unique in metal although found in frescoes. The composition, with perspective indicated by placing more distant features at higher levels, is characteristic of gold plaques and also is found on frescoes at Chichen Itza. The whole scene is rendered in a smaller technique and in finer detail then occurs on other examples. Furthermore, the greater delicacy with which the Sky deity is depicted, as contrasted with the rest of the disk, raises a suspicion that two different artists may have collaborated.

We may also note that arms, adornments and details of dress are different from those seen on other specimens. There are only a few Toltec characteristics: the spear throwers of the Sky deity and the chief figure in the canoe, the eagle mask of the former and the nose button of the latter. Perhaps then we should interpret the scene as a conflict between two Maya groups, one of which made use of Toltec paraphernalia to a slight extent and presumably fought as Toltec allies. On the other hand, the peculiar perspective, as well as the method of showing water and the fish, are characteristic of frescoes in the Temple of the Warriors which are regarded as typically Tula-Toltec.

Disk G is also unusual although not unique in that it has no Earth monster at the bottom. Instead, the central field is enlarged by extending it to the border pattern. As a result, it contains more subject matter than any other disk. In a circle only 20 centimeters (ca. 8 inches) in diameter there are twelve more or less elaborately dressed individuals, a Sky deity, a two-headed dragon, three rafts, a dug-out canoe, two swimmers and six fish, as well as spears, shields, paddles and the ripples of water.

The glyphs on the border of this disk are unusual in Maya epigraphy as they face not to the left but to the right.[44] It might be argued that this indicates that they were fashioned by some ignorant craftsman who did not understand writing – were they not obviously the work of a master. We think it more probable that the artist, sculptor, featherworker or painter by trade, was unused to working in gold, that he pressed out his inscription from the reverse side of the disk in the manner he normally depicted glyphs, and then was surprised when they appeared backward on the front.

Perspective, in this case, is of a type seen in Chichen Itza frescoes, which do not employ either the linear or aerial perspective we normally use. Each object is pictured in the same scale and as if viewed at eye level. Distance, however, is indicated in two ways: by placing remote objects successively higher in the decorated field and by partly obscuring the more distant by the nearer. The former is a local development but the latter is common to all art portraying more than a single plane.

As for composition, most disks, including disk G, have the decorated area almost completely covered, in many cases by the use of small elements especially introduced for that purpose. The design is cut, however, by a horizontal line along which the major action takes place. This is true of disk G, but the rafts and swimmers below are shown not parallel to the medial base line but diagonal to it. This is the only case in relief at Chichen Itza, apparently, where an attempt has been made to show not only planes of varying distances but also motion in two distinct directions.

The Sky deity, the most elaborately adorned in the series, is pictured against a background of immense scrolls which represent a two-headed dragon with wide-open jaws and protruding tongues. These can be identified by the teeth, seen to the left of the deity's head and to the right of the back plumes. A similar background is shown on a carved slab found in the western court of the acropolis at Copan.[45] The deity is represented as running with outstretched arms and right thigh raised. The pose is one of the most violent represented and perhaps indicates that the god, if not descending to earth, at least is in a hurry to get nearer the action depicted.

The deity wears an eagle mask with open jaws. In the nose there is a nose rod. On the wrists are typical Maya cuffs. Beneath each outstretched arm there is a semi-circular ornament fringed with long plumes which frame an unusually long and slender body. The shoulder and chest are covered by a yoke fringed with beads. The god holds in his left hand two spears. In the right hand is a Toltec spear thrower, held as if it has been just used. Ten spears are shown on the disk, five of which can be attributed by customary count to the standing warrior in the canoe. Did the god hurl the remaining three spears and thus join in the battle?

This sky deity obviously is a Toltec protagonist but, apart from his spears and spear thrower, shoulder yoke, mask and speech scroll, he is shown in Classical Maya style. The semi-circular panels fringed with plumes under the arms contain conventionalized serpent heads which lack the lower jaw. This motive is found on the wings of the Maya deity known as the Moan bird, which will be discussed later. Similar symbolism appears on other Tula-Toltec sculpture and in metal at Chichen Itza (figs. 44, 54, 55). A circle surrounding the eye is typical of Tula-Toltec portraits of this divinity.

The principal characters, portrayed across the center of the disk, are five men in a canoe attacking a Maya who is attempting to escape on a raft. Pairs of Mayas are fleeing on two other small rafts and also two individuals are swimming.

The canoe is just large enough to hold five people. There is a distinct gunwale projecting outside the hull. At bow and stern there are platforms with relatively little overhang. The shape of the hull is obscured by water. Similar canoes with greater overhang appear in the Dresden Codex.[46] Three frescoes in the Temple of the Warriors at Chichen Itza[47] show seven canoes which all have bow and stern raised to about double the height of the freeboard amidships. There is an example of this type in the Dresden Codex.[48] Two of the frescoes, however, can definitely be identified as ocean scenes owing to the presence of sting rays. The canoe on disk G then by inference is a type designed for inland waters. We should point out that, although the canoe carries at least two Toltecs, the crew may be Maya and the vessel itself presumably is of Maya workmanship, because a dugout is something one cannot maufacture at a moment's notice in the heat of battle.

The rafts are about half the length of the canoe and are large enough to carry only one or two people. They appear to be made of logs, to which greater buoyancy is given by gourds placed underneath. Rafts supported by gourds were used in Peru.

The paddles used by the occupants of the canoe are shaped like a modern oar. The end of the blade is square and the blade itself tapers to the width of the shaft. The man in the most distant raft holds a paddle of this type in one hand and a circular paddle with a short handle in the other. The circular form also appears on the other two rafts. These paddle types do not occur in the frescoes at Chichen Itza or in the Dresden Codex. In the former, ovate paddles are shown with a split handle attached to the rounded end.[49] In the Codex, the blades are diamond shaped or have rounded ends with either square or rounded shoulders.[50]

[44] For glyphs facing to the right at Copan, see Morley, 1947.
[45] Maudslay, 1889–1902, vol. I, pl. 9, *a*.
[46] Codex Dresden, xxix, xxxvi, lxv.
[47] Morris, Charlot *and* Morris, 1931, pls. 139, 146, 159.
[48] Codex Dresden, xliii.
[49] Morris, Charlot *and* Morris, 1931, pl. 159.
[50] Codex Dresden, xxix, xxxv, xliii.

The canoe is propelled by a crew of three paddlers, two in the stern and one in the bow. They are dressed alike in ponchos adorned with zigzag patterns and wear berets surmounted by short, rounded feathers. The man in the bow carries a circular shield.

Amidships are two figures, one seated and one standing. The former is largely concealed by a circular shield. He wears an elaborate headdress with long plumes and has an ornament in the shape of a head, perhaps a trophy, on his back. The standing figure also wears a headdress with plumes and a head suspended on his shoulders. He has a nose button, a necklace and some sort of fringed gorget. He has cast two spears at a warrior fleeing on a raft and is in the act of throwing a third. Additional spears have already struck a man on a raft and a swimmer. There is a spear floating on the water and two others are held in the hand. None of the spears have points or feathers such as customarily appear on Toltec weapons but the spear thrower is of Toltec type.

The occupants of the canoe and the Sky deity are given dramatic unity by the presence of speech scrolls. These are shaped like a question mark, tipped forward horizontally. In the case of the man in the bow this is embellished by a second scroll. Evidently both the god and the men are saying the same thing to the fleeing warrior, doubtless a demand to surrender.

This fleeting warrior is in a perilous position. The two spears already cast at him were very near misses and another spear is about to come. The pose, showing the body full-face, the left side of the legs and right side of the head, is one not easily rendered in low relief but it is adequately portrayed according to our conventions of perspective. The anatomy is in proportion and there is a good impression of flesh and muscle. Both arms are outstretched to hold the paddles out of the water, perhaps as a sign of surrender. At any rate, something is being said to the attackers in the canoe as indicated by a speech scroll.

Maya artists seldom attempted to show the human figure in this strained position but occasional examples occur over a wide area and in various media. Comparable figures, rendering with various degrees of success, may be noted in frescoes at Chichen Itza,[51] Tzulá and Chacmultun,[52] in the Maya Codices,[53] in pottery from Yucatan [54] and the Guatemalan highlands,[55] in Great period stone carving [56] and in the frescoes at Bonampak.[57]

Below the warrior and the raft we have described a portion of the disk is missing, but part of two figures are preserved who presumably occupied another raft, as they are shown with round paddles in their hands. The left-hand figure has been struck in the middle of the back by a spear and appears to be bending over in pain. The other is holding up his paddle, perhaps to indicate surrender.

A third raft with two occupants is shown at the bottom of the disk. Both wear ponchos of what appears to be quilted cotton, perhaps a form of body armour. The left-hand figure has a cap, adorned by plumes, which seems to be of the same material. A similar hat is worn by the single warrior on a raft and comparable forms appear on the three paddlers in the canoe.

Behind each of the rafts with two passengers there is a swimmer, perhaps in the water because there was not room on board for three. The upper figure, like one of the occupants of the adjacent raft, has been pierced by a spear. The other, together with the crew of the raft, appears to be making a successful get-away. As for the method of swimming, each individual seems to be using his arms in a different fashion. The right-hand figure may be doing a breast stroke. The other clearly is using his arms alternately in a crawl or "dog paddle." The relaxed fingers of the left hand suggest that it is out of water. The legs evidently are doing a scissors kick.

Little can be said regarding the six fish except that they are of several varieties, presumably fresh water species. With a few exceptions with outstanding characteristics, such as sharks and rays, Maya fish are too conventionalized for identification.

Disk H. This disk, perhaps the most satisfactory of all in this series if judged by European art standards, is also one of the most dramatic and savage. It portrays the culmination of victory, the extraction of the still-beating heart of an unfortunate prisoner of war in order to offer it to the gods (fig. 1).

Human sacrifice, as we have shown elsewhere,[58] was a widespread if usually not a very frequent practice in the New World. The two most common types were the heart-extraction rite here depicted and the arrow sacrifice. Both existed in Peru and among the Chibcha of Colombia but apparently not in the Isthmus and southern Costa Rica. The Guetar of northern Costa Rica killed people every moon but by what method is not known. The heart-extraction ceremony is recorded among the Nicarao and Chorotega of Nicaragua and thence extended northward to central Mexico. The arrow sacrifice was practised from central Mexico as far north as the great plains in the United States.

Let us speculate for a moment on the origin and distribution of human sacrifice. It is well known that human sacrifice reached its peak among the Aztec a few decades before the Conquest, and amazing numbers of victims were slaughtered on special occasions such as the dedication of the great temple in Tenochtitlan. It has been generally assumed that human sacrifice originated among Nahua tribes on the Mexican plateau and was spread to Yucatan and elsewhere by the Toltec. With the latter part of this asumption we agree. The early Maya apparently rarely sacrificed human beings, and there are only two fairly certain but not definite representations of sacrifice in the Great period cities south of Yucatan.[59] There is no suggestion of sacrifice in other early art styles such as Archaic, Monte Alban I or Olmec. The Toltec invasion of Yucatan is recorded in legend and confirmed by archæology, and it is an obvious mechanism for introducing this custom into Yucatan.

The question of origins has not been answered, however. According to tradition, the first human sacrifice among the Toltec took place in 1018 A.D., a slightly later date that we would like to assign to disk H. Perhaps this statement refers only to the offering of children to the God Tlaloc and not to human sacrifices as a whole.

Without claiming a definite point of origin, it can be demonstrated that human sacrifice existed over a large part of the coast of Peru centuries before there is any suggestion of it in Mexico or Central America. This was ascertained by the late Dr. Julio C. Tello who pointed out that, although no direct representations of sacrificial rites occur, the products of sacrifice appear in Nasca pottery of the early period A and in Mochica (Early Chimu) pottery. These manifestations consist of rows of severed human heads, often with blood streaming from them, or of other severed parts of the human body depicted on Nasca vessels.[60] In the Chimu area

[51] Keleman, 1944, pl. 263, *c*.
[52] Thompson, 1904, pls. II, VIII.
[53] Codex Dresden, xxvi, xliv, xlviii, lxvi. Tro-Cortesianus, xciv.
[54] Spinden, 1913, fig. 185.
[55] Lothrop, 1936, pl. I, *a*; fig. 78, *c*.
[56] Spinden, 1913, fig. 62.
[57] Villagra Caleti, 1947.
[58] Lothrop, 1926, vol. I, pp. 64, 71–73, 80, 82.
[59] At Naranjo, Guatemala. See Maler, 1901–03, pl. 20; Morley, 1946, pl. 28.
[60] Putnam, 1914, pls. III, *7, 12*; IV, *10*; V, *1, 2*; VI, *6*; VII, *9*; X, 2. Schmidt, 1929, p. 339, *4*. In the Museum there is a Nasca jar which apparently represents a bloody human heart.

farther north it is not uncommon to find vessels of early date modeled to represent severed hands, arms and legs, again suggesting a sacrificial victim who has been butchered.[61] Severed heads, limbs and torsos are carved in stone at Cerro Sechín in the Casma Valley [62] where a skull rack like the Aztec *tzompantli* also is depicted. They date from the Chavín period.

We repeat that no point of origin has yet been established, only the fact that human sacrifice took place in Peru many centuries before it was recorded in Mexico.[63] The probability of Peru as the original center is increased, however, by a curious but definite link on an early horizon between the two countries which may be related to sacrifice. This consists of altering a human face by plastic surgery to make it resemble a god. That this custom was invented twice seems improbable. That the operation was confined to the left half of the head in each region makes an independent invention seem only remotely possible. Examples of this cruel mutilation are known from Cupisnique in Peru (coastal Chavín culture)[64] and from Los Tuxtlas, Vera Cruz, and Tlatilco in the Valley of Mexico.[65] The last example was associated with Archaic and Olmec remains.

Regarding human sacrifice in Yucatan, very complete data have been collected by Tozzer.[66] Although the early Maya may not have practised it frequently, the sixteenth-century Maya often performed the rite in many varied manners, and the Catholic Church put an end to it only with great difficulty. The purpose, according to Diego de Landa, usually was for the general good of the community: to secure rain, crops, etc.

The types of sacrifice reported in Yucatan included the classical Mexican heart extraction pictured in disk H. Variants of this comprise decapitation before heart extraction, heart extraction with the victim lashed on a frame and, after the Conquest, heart extraction while or after the victim had been crucified. The arrow sacrifice together with flaying also was practised. In addition, victims were killed by hurling them from heights – into a cenote or on a pile of rocks. In one case, a girl was lashed to a post and beaten over the breasts with a thorny rod until she died. After the victim was dead, the flesh might be eaten, the body might be buried or it might be cast into a cenote. There is then a definite link between the cenote and the sacrificial cults.

Regarding the sacrificial ceremony as practised in Yucatan, we quote the account of Diego de Landa,[67] who in fact might have described the scene on disk H.

"If the heart of the victim was to be taken out, they led him with a great show and company of people into the court of the temple, and having smeared him with blue and put on a *coroza*, they brought him up to the round altar, which was the place of sacrifice, and after the priest and his officials had anointed the stone with a blue color, and by purifying the temple drove out the evil spirit, the *Chacs* seized the poor victim, and placed him very quickly on his back on that stone, and all four held him by the legs and arms, so that they divided him in the middle. At this came the executioner, the *Nacom*, with a knife of stone, and struck him with great skill and cruelty a blow between the ribs of his left side under the nipple, and he at once plunged his hand in there and seized the heart like a raging tiger and snatched it out alive and, having placed it on a plate, he give it to the priest, who went very quickly and anointed the faces of the idols with that fresh blood."

Landa also writes: [68] "The *Nacoms* were two officers; the first was perpetual and did not bring much honor with it, since it was he that opened the breasts of the human victims whom they sacrificed. The second was a choice made of a captain for war and for other feasts." Tozzer [69] adds, "According to the varied testimony on the subject of idolatry, taken in 1562, we learn that the priest, *ah kin*, who was always regarded with favor, sometimes performed the actual sacrifice." [70]

The sumptuously adorned and resplendant figure who takes out the heart on disk H does not tally with Landa's picture of the lowly *Nacom*. It seems more probable that he is the high priest and that the ill-clad individual standing second from the right actually is the *Nacom*, deprived of his office on the occasion commemorated by the disk. The possibility of this interpretation is enhanced by the fact that a priest who rarely acted as executioner would be far more likely to have the event recorded in gold than a *Nacom* engaged in his normal trade.

The executioner is stripped for action and wears only a belt and apron but he is richly adorned. On his calves are bells such as we illustrate in figures 75–86. On the right arm are four widely spaced bands of fur. Around his neck is a necklace. This hangs over both chest and shoulders in typical Tula-Toltec fashion, also seen on the figure at the extreme left. The head is encased in an eagle mask, comparable to that worn by the Sky deity in Disk G (fig. 35) but far more gorgeous. To the eagle head are attached a row of beads, a set of small feathers and a row of immense quetzal feathers which arch downward to the level of the hips. In the center of this array is a cylinder topped with beads, from which sprouts a second group of quetzal feathers. These are adorned by disks, presumably of jade, the weight of which causes them to curve more sharply than the other plumes.

The executioner holds in his left hand a large knife. Perhaps he is left-handed; perhaps he opened the victim's breast with his right hand, transferred the knife and, at the moment shown, is tearing out the heart with his right hand.

The knife probably is of flint with a wooden handle. A knife of this type, found in the Cenote, has been illustrated in several publications.[71] The handle is carved to represent two intertwined serpents. Several blades without handles were also recovered. Tozzer,[72] quoting early documents, states that the sacrificial knife was called *u kab ku*, "the arm of the god" and that, when used, the handle was wrapped in white cloth.

The victim is held by four *Chacs*. These were individuals selected to help the priests in various ceremonies.[73] Landa repeatedly states that old men were chosen for this service. On disk H, however, they are definitely young warriors, and, from their expressions, they find their task nauseating. They all wear back shields of Toltec type, the only examples seen on disks. Their hats indicate minor military rank. One of them apparently has a broken feather in his headdress, perhaps caused by the struggles of the victim.

At the left stands the principal attendant of the executioner, carrying his paraphernalia. They consist of five spears, spear thrower and possibly his outer clothing, removed for his act of violence.

At the extreme right is a figure in a long feather cloak reaching to mid-calf. He wears a military headdress with long quetzal

[61] Tello, 1938, pls. 254–59.
[62] Tello, 1943, pls. XVI–XVII, fig. 18.
[63] For comparative dates, see "The Maya and Their Neighbors," table IX, pp. 488–89. Also Kroeber, 1944, p. 114.
[64] Larco Hoyle, 1941, figs. 212–14, also cover.
[65] Covarrubias, 1943, p. 42.
[66] Tozzer, 1941, see especially footnotes 533, 535, 536, 541–44, 947.
[67] Tozzer, 1941, pp. 118–19.
[68] Tozzer, 1941, pp. 112–13.
[69] Tozzer, 1941, p. 113, footnote 515.
[70] Tozzer, 1941, p. 113.
[71] Willard, 1926, p. 140; Morley, 1946, fig. 14.
[72] Tozzer, 1941, footnotes 541, 543.
[73] *See* Tozzer, 1941, p. 312.

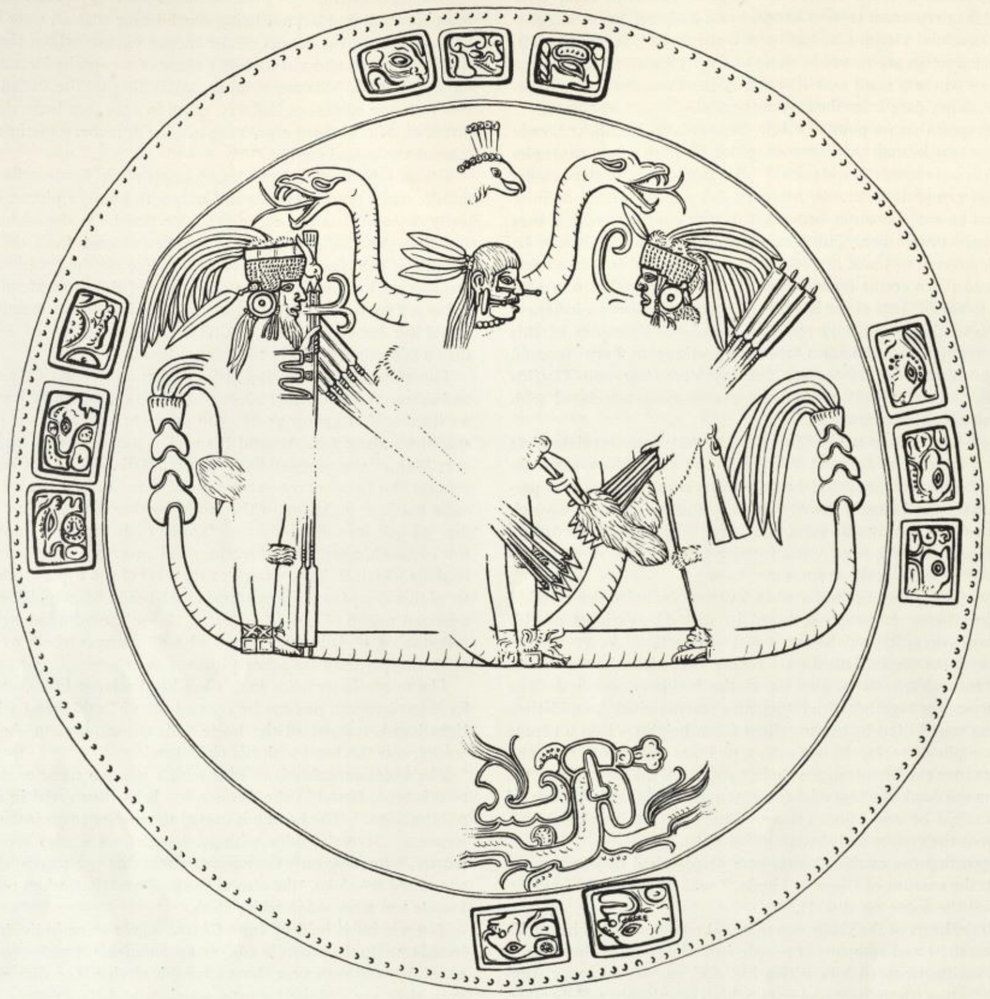


FIG. 36. Disk I, which represents a discussion between three Tula-Toltec warriors of various ranks. Actual size.

plumes. In his hand is some object, possibly a cup to receive the blood of the victim, for which purpose it seems small.

In front of this individual and behind two of the *Chacs* is the figure which we suggested may be a *Nacom* whose job has been taken over by a warrior-priest. Like the executioner he is stripped for action and wears only a breech clout. His face is tattooed and he wears his hair cut short except for one long lock. No other head at Chichen Itza is like this, which implies that this man had some special social or ceremonial function.

Lastly we come to the victim. He is naked except for a loin cloth. He is held by the four *Chacs* over a hemispherical object placed on what looks like a mat.[74] The arched chest has been cut open and the body appears to have relaxed in death.

Over the scene and the individuals described is a great rattlesnake, in the open jaw of which appears a Sky deity. Rattles, belly scales and body markings are realistic but the head is conventionalized. Scrolls outlining the body are decidedly Mexican in character, found, for example, at Xochicalco, and they are reminiscent of Totonac sculptures. The Sky deity is dressed in Toltec regalia including hat, spear thrower, spears, fur bracelets and breast ornament. The nature of the feather-like ornament beside the right arm is not clear. Perhaps it was attached to the hat but the disk is so broken that it is impossible to tell. From the way in which this is shown the deity appears to be behind rather than actually in the jaws of the snake.

Beneath the action panel is a delicately wrought double-headed dragon, conventionalized to the point where only two upper jaws are shown. At the left is a small upper jaw with three teeth. Below these is a scroll, often found at the jaw angle of Maya serpents. The rest of the design is a serpent head and upper jaw facing to

[74] For a discussion of sacrificial stones, see Beyer, 1918.

the right. It is possible to distinguish four teeth, an eye covered by the X-shaped symbol of the heavens, above which is an "eye plate." On the under side of the curling snout there is a small head of a long-nosed god.

This design is in the style of the Maya Great period to the last detail. It represents the Maya conception of a conventionalized serpent deity. In contrast the serpent in the sky is completely Nahua in style. The pair, occurring together on the same disk, are definite evidence that the two styles were in part contemporaneous.

Of the border patterns, three — top, bottom and right — are very much alike. The long-nosed heads are *Tun* glyphs. The scrolls, except for a touch of fur at the right, are completely in the tradition of the Maya Great period. The incomplete ornament at the left evidently was different as it terminates in a large flower, perhaps a lily or lotus.

There are several comments to make on disk H. In the first place, it emphasizes, as we have said, the mating of Maya religious symbolism and art with foreign costumes, ornaments and ritual.

The technique of Miss Proskouriakoff's drawing is not one often used to reproduce Maya art although common in portraying the art of Europe. Like anyone else drawing gold, she has found it necessary to intensify the shadows to bring out the high lights. She used her shadows to frame the central scene and emphasize the act of sacrifice and, in so doing, has created an aerial illusion of distance. This, however, was the intention of the original artist, who carefully placed his figures for this purpose.

Although the Maya rarely portrayed individual characters, disk H shows the reaction of individuals to drama by lines of stress in the poses of the figures comprising the scene. Thus emotion is shown on the faces of the *Chacs* holding down the victim. The flanking attendants lean forward to watch. This contrasts with the balanced stance, the muscular pose and the business-like face of the executioner. We also find this emotional quality both in the badly battered original as well as in a line drawing in ink by another artist, which has not been published. It is something rarely found in Maya art.

Disk I. The badly broken disk seen in figure 36 is unusual in several ways. Unfortunately the missing portions are such that there must be considerable speculation as to the nature of the scene. It is also unfortunate that this specimen originally was in very low relief and is the worst preserved of the entire group. It evidently represents two Toltec warriors of high rank questioning or giving orders to a third. No Maya character appears and, were it not for the border glyphs and the fragmentary Earth monster, this disk could be classified as of unadulterated Tula-Toltec workmanship.

The principal personage stands at the left. His insignia include a headdress with the typical bird on the front. He also wears a characteristic Toltec gorget shaped like a conventionalized bird. The artist, unable to handle this in perspective, has placed it over the right shoulder. The left hand grasps a bunch of spears, the feathered butts of which appear in front of the feet. In the other hand is a furred Toltec spear thrower, not extended forward, as is usually the case, but held towards the rear. There is a speech scroll.

On the right side of the disk is another Toltec warrior, of high but lesser rank than the first. He wears a typical and elaborate headdress which lacks a bird in front. This apparently was the emblem of supreme command. The headdress is unusual in that it covers the shoulders. In front is some kind of a gorget. Clothes consist of an apron in front and a breech clout, the ends of which hang down behind. There are fur bands on calf and ankle. This individual holds a bunch of spears and a fur-covered spear thrower which apparently is held butt out, as is the case on the opposite side of the disk.

In most scenes, the principal personage occupies the center of the disk and is shown as larger than the other characters. Here, however, the central figure clearly is a subordinate who appears to be taking orders or receiving a reprimand, represented by speech scrolls. He must be classified as Toltec on account of his features, his weapons and his wristlet.

In the background, as in disk E, there are two intertwined plumed rattlesnakes, their heads reared above the ranking warriors as if they were guardian spirits, symbolical of Kukulcan. Just how the central coils were arranged is not clear. The heads, rattles and feathers, however, are depicted in characteristic Toltec style.

Over the head of the central figure there is a bird head with open beak. It is not possible to determine whether this was attached as a headdress to the individual below or whether it was an independent motive, replacing the Sky deity who typically occupies this area.

Most of the bottom of the disk is missing but part of an Earth monster survives. This is rendered in typical Maya Great period style as exemplified in figure 16.

The glyphs are in four groups of three each. They are not numerical and cannot be deciphered.

Disk J. This disk must be included among the war scenes because, although no weapons appear, both Maya and Tula-Toltec personages are present. There is no sky deity but there is an Earth monster at the bottom (fig. 37). The principal character can be identified as Tula-Toltec by his high forehead, his headdress and his feather cloak (see figs. 1, 32 and 34). His sandals, however, are definitely Maya. The partially preserved figure at the left wears a typical Maya back shield and a Maya type of headdress. The scene as a whole perhaps represents the questioning of a captive who bows in submission, although the Maya's arms are not bound.

The Tula-Toltec headdress consists of a helmet representing an eagle which frames the face, one of the three found on battle disks. Attached to this base is a huge mass of feathers. Two long rods project to the front and rear, each with a socket in which bunches of feathers are set. They are weighted with small disks, presumably of jade. The socket for feathers on a staff is an uncommon but widely distributed device. We illustrate examples from Panama (fig. 89, *h*, *i*) and Peru (fig. 90). It was also known to the Maya and Aztec.[75]

The body of the Tula-Toltec warrior is partly covered by a feather cloak which consists of a band, probably of cloth, across the shoulders. Small disks are sewn on this and below is a line of short feathers with long plumes below. Partially concealed by the cloak is some kind of spiral arrangement, perhaps a Tula-Toltec "arm shield" such as we have discussed (p. 40). It also recalls the twisted garments seen at Palenque in the Temples of the Sun, the Cross and the Foliated Cross.[76] Hanging below the cloak is a train, apparently of textile, which terminates in stiff feathers. Similar trains are seen in Mixtec codices.[77]

It seems possible that all the garments are designed to carry out the impersonation of an eagle, the cloak suggesting the wings

[75] Peñafiel, 1890, pls. 83, no. 13; 84, no. 9.
[76] Maudslay, 1889–1902, vol. IV, pls. 88, 75 and 81.
[77] Codex Nuttall, p. 22, top right center.

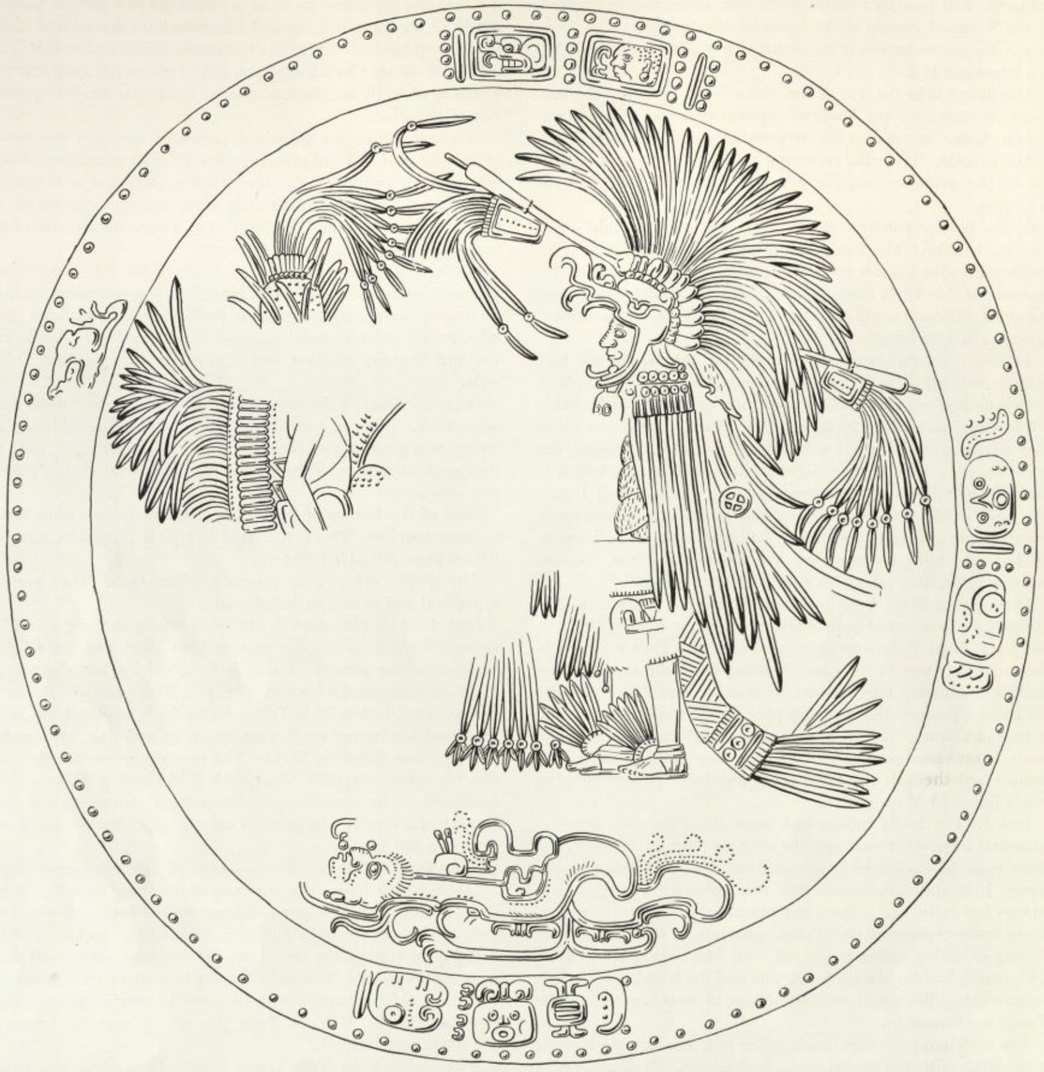


FIG. 37. Disk J, showing a Tula-Toltec and a Maya, both elaborately arrayed. Actual size.

and the train the tail. This is also true of the Sky deity on disk G (fig. 35) who has wings attached to his arms and long plumes forming a tail. Eagle impersonators appear in Mexican codices.[78]

What was shown in the middle of the disk is unknown but we believe that it contained a third figure, probably seated on the ground, because there is a set of plumes in front of the legs of the Tula-Toltec chief.

The feathers seen on disk J are more complicated than on any other in this series. There are (1) short stiff feathers on the sandals and (2) longer stiff feathers on the train. The Tula-Toltec headdress and the Maya back shield apparently were adorned with (3) flexible quetzal plumes. The feathers set in sockets on the Tula-Toltec headdress and on the crown of the Maya headdress seem to be (4) quetzal plumes with a button at the tip, to which a small feather has been added. In addition, (5) the long plumes in front of the legs of the Tula-Toltec chief clearly terminate in a button to each of which three small feathers are joined. The small feathers (6) on the collar of the feather cape seem to be of a different variety as also may be those set in the beehive-like Maya headdress (7). No doubt the ritualistic regalia of Middle America combined many kinds of brilliant plumage and colors but it is unusual to be able to distinguish such variety in sheet gold.

[78] Codex Nuttall, p. 11, top right.

Discussion. The series of disks we have described raises several questions. In the first place, who decorated them? To this the answer is Maya craftsmen working under the orders of Toltec conquerors. Toltec arms, insignia, ornaments, clothing, gods and the physical type are clearly portrayed, but all other details – border patterns, space fillers, Earth monsters, etc. – almost invariably reflect Maya art of the Great period. In other words, except when explicitly directed, the makers of the disks employed their own habitual art forms.

How did one become a gold worker in Yucatan? We do not use the word *smith* because there is no evidence that any Maya ever cast metal. Presumably preliminary training was in painting or the carving of stone or wood. Yet the style of the disks reflects neither the free vigor of the local frescoes nor the stiffness of the bas-reliefs. The answer perhaps is to be found in the statement of Sahagún (p. 17) that Aztec gold beaters had their designs drawn for them on sheet metal of their own manufacture by the featherworkers. The artistry and skill of Aztec featherworkers is fabulous. We have no way of knowing how good a tenth-century Maya was. It seems possible, however, that, when the importation of gold disks to Yucatan started, the local featherworkers were asked to decorate them. This would account for the slight divergence in style between painters, sculptors and metalworkers.

What was the technique of manufacture? Inasmuch as many undecorated disks were found in the Cenote of Sacrifice, it seems probable that all examples were imported as plain disks. There is nothing to indicate that the Maya ever learned to hammer gold into sheets. They were able, however, to press designs in sheet metal and to cut it to the desired shape. Pressing a design is a relatively easy process if the sheet is placed on some yielding substance such as leather. We have no knowledge of Maya metalworking tools.

What wars do the disks commemorate? There seem to be two possibilities. One is the conquest of Chichen Itza by Hunac Ceel with the aid of Mexican mercenaries in the katun 8 Ahau which ended in 1204 A.D. This we reject because in the correlation we follow the Initial Series date is 10.19.0.0.0, fifteen katuns after the last-known Initial Series date. We do not believe it possible that the scores of art links with the latter part of baktun 9 which we have pointed out could have survived during the intervening three hundred years. We may add that there is no evidence that the Mexican troops of Hunac Ceel settled permanently in Chichen Itza. On the contrary, we know that it was re-occupied by Itzas within forty years, clearly too short a space to account for the many Toltec buildings.

A second possibility is that the disks commemorate the re-occupation of Chichen Itza and the arrival of Kukulcan in the katun 4 Ahau ending in 987 A.D. or 10.8.0.0.0 in the long count. The difficulty here is that we have no mention of wars at this time except for the conquest of Izamal and Motul in the seventh tun of katun 4 Ahau.

This dating, however, is more satisfactory from the Toltec angle. The disks clearly show the symbolism of Quetzalcoatl-Kukulcan, and details of dress and ornaments correspond closely to the Toltec art of Tula in the Mexican highlands. According to Mexican tradition, Quetzalcoatl-Kukulcan left Tula for Yucatan in the year 947 A.D.

There is only one direct link in subject matter, composition and style between the Cenote battle disks and any of the bas-reliefs at Chichen Itza. This occurs on a circular stone "altar" associated with a stela in a niche in the steps of a building known as the Caracol. The Caracol is a circular tower on a rectangular platform mound. This type of building is associated with the Quetzalcoatl-Kukulcan cult and the edifice combines Maya structural forms with Toltec features such as serpent balustrades and roof ornaments.

The stela and "altar" were not found in situ and two suggested reconstructions have been published by Ruppert.[79] The altar is a circular stone with a tenon which we believe was set in the wall below the stela so that the carved surface faced upward. This association of stela and altar, uncomplicated by architecture, is typical of the Great period in many southern cities.

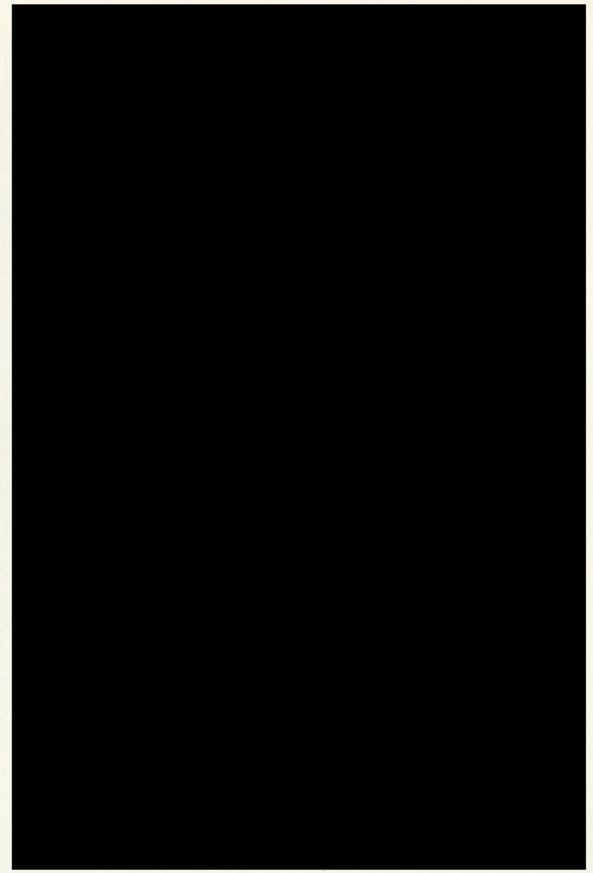


FIG. 38. Altar from the Caracol, Chichen Itza. Diameter, 73 centimeters (28¾ inches). After Ruppert, 1935.

The carved surface, badly weathered, is divided horizontally into two semi-circles. The upper panel (fig. 38) reveals on the right a Toltec chief with two attendants. Behind and above the chief is a plumed serpent with a Sky deity issuing from the open jaws. To the left are three Mayas, at least two of whom have placed a hand on the opposite shoulder in token of surrender. The lower panel contains other Maya warriors, perhaps awaiting their

[79] Ruppert, 1935, figs. 171 and 172.

FIG. 39. Sculptured columns, Northeast Colonnade, Chichen Itza. *a–c*, Spear types; *d–g*, column 1 (east, north, south, west); *h–k*, column 4 (north, west, east, south). After E. B. Ricketson. (Drawn by Dr. Oliver G. Ricketson.) Note copper bells, mouth mask like gilded disk, spears, puttees, sorcerer.

turn to submit. On the side of the circular stone there is a hieroglyphic inscription. This Morley [80] dates as 9.19.0.0.0 "which must be questioned by at least two interrogation points."

The date on the associated stela has been variously interpreted. Morley [81] believed it to be 10.0.15.0.0, 10.0.16.0.0 or 10.0.17.0.0. Thompson [82] reads is as 10.2.17.0.0. Weitzal [83] suggests 10.3.17 (or?) .0.0. Beyer,[84] however, picks 11.3.17.0.0. The concensus of opinion is then that the date falls in the first three katuns of baktun 10 or the second half of the tenth century. This is roughly in accord with our other evidence.

The Caracol, however, contained other dates, placed in decorative panels on the walls of the upper story. Morley and Thompson agree that one of these reads 10.7.0.5.1 or 968 A.D., a date which falls in the katun 4 Ahau when tradition records that the Itza and Kukulcan came to Chichen Itza.

The Toltec period at Chichen Itza lasted over two centuries according to native chronicles. The huge buildings and the filling in of older buildings to serve as bases for new construction all testify to a long occupation. Art styles change and it has been recognized, for instance, that the Temple of the Warriors is later than the second (or outer) Temple of Kukulcan. In spite of the vast amount of work the Carnegie Institution of Washington and the Mexican Government have accomplished at Chichen Itza, however, only a gross architectural sequence has been established and not even a preliminary attempt has been made to work out the chronology of bas-reliefs and frescoes. The writer is obviously

[80] Morley, 1935b, p. 282.
[81] Morley, 1935a.
[82] Thompson, 1937.
[83] Weitzal, 1945.
[84] Beyer, 1937.

not equipped with data to fill this gap in our knowledge but the following is tentatively suggested.

In the case of public buildings we would expect the carvings and frescoes to depict scenes of general interest or at least of special concern to the ruling class. The disks, however, we presume to have been private property. If so, it follows that the scenes which they portray reflect feats of arms or moments of triumph which their owners wished to perpetuate. It also seems probable that the Toltec, like ourselves, might record the exploits of a long-dead George Washington or John Paul Jones in decorating their public edifices. The disks, however, must have been manufactured soon after the episodes they record and thus were made during the lifetime of their owners. And we have shown that the closest local stylistic link is with the Caracol altar dating from the beginning of the Tula-Toltec period.

In searching for a common element of design or equipment which undergoes changes in the art of Chichen Itza, we examined the number of spears carried by warriors with the results shown

TABLE XX: NUMBER OF SPEARS CARRIED BY TULA-TOLTEC WARRIORS *

LOCATION	MEDIUM	NORMAL	OCCASIONAL
Cenote of Sacrifice	gold disks	5	3, 4, 6
Temple of the Tigers, lower chamber	reliefs	5	4
Temple of the Tigers, upper chamber	frescoes	4	3
Castillo, outer structure	reliefs	4	3
Chacmool temple	frescoes	3	...
Tzompantli, E. wing	reliefs	3	...
N. W. Colonnade columns	reliefs	2	3, 4
N. W. Colonnade dais	reliefs	2	...
Temple of the Warriors columns	reliefs	2	3
Ball Court, N. Temple	reliefs	2	...
N. E. Colonnade columns	reliefs	1	...

* For references to illustrations, see Table XIX.

in table XX. This indicates either that the number of spears habitually carried underwent a change or that the artists' concept of a properly armed soldier became progressively less accurate. At any rate, the above table produces a sequence which can be discussed.

The validity of this sequence is enhanced by other elements than spears. In general, it may be said that the details of dress and equipment which have been described as typically Tula-Toltec (pp. 37–44) tend to be replaced by Maya equivalents, and such changes become more and more marked as one goes down the list in table XX. This remark applies to headdresses, fur bracelets, gorgets, clothing, leg ornaments, back shields, sandals, shields and spears. The reliefs in the lower chamber of the Temple of the Tigers correspond closely to the Cenote battle disks in these details. On the other hand, none of the features listed appears in Tula-Toltec style in the North Temple of the Ball Court, the six huge sculptured panels in the Ball Court itself or the Northeast Colonnade. These reliefs have little in common with the Cenote disks and, were there not intermediate forms, might be classed in a different stylistic group (fig. 39).

The facts which we have ascertained lead to the conclusion that the battle disks from the Cenote of Sacrifice were made at the beginning of the Tula-Toltec period in Yucatan when the art of the Maya Great period still flourished. In the chronological scheme we follow, they date from the second half of the tenth century A.D.

[85] Lothrop, 1925, fig. 4.

OTHER DECORATED GOLD DISKS

The ten gold disks we have discussed were grouped together because they commemorate incidents in a war between Tula-Toltec and Mayas. They are a unit in subject and are all approximately of the same size. In addition seven other gold disks were recovered which are reasonably complete. One of these is of the same size as the battle disks but contains no Toltec elements. The others are smaller and, although not identical, evidently were manufactured in pairs. From the evidence of style, it is possible to assign this group to the same period as the battle disks and to the same Maya-Toltec strain of art.

Altogether some sixty other small fragments of gold disks were found which cannot be linked with anything else and tell no paritcular story in themselves. Not that each fragment represents a separate specimen, but these isolated pieces indicate that a good many gold disks were thrown in the Cenote of Sacrifice and they suggest that a good deal still remains there.

Disk K. This plaque (fig. 40) doubtless once was a splendid ornament but today it is in bad shape and the design can be discerned only with the greatest difficulty. It represents a gorgeously clad warrior with the body shown from the front and the head in profile. This is a subject seen on Great period stelæ. Often the warrior carries a square shield on one arm and an upright spear in the hand. Stelæ 4 and 34 at Piedras Negras are examples, also lintel 2.

The personage in the disk appears to hold a rectangular shield in his out-stretched right arm. There is a somewhat similar rectangular plaque in front of the thighs but it is not clear whether this was attached to the belt or was held in the left hand. It is possible that the figure is dancing with a shield in either hand, which is suggested by the widely spaced feet and an apparently swaying ornament between the two shields. Dancing figures are found in the Peten, notably at Motul de San José and Cancuen.

The headdress of quetzal or macaw feathers is a towering and intricate affair radiating from a sort of skull cap. Feathers in bunches were attached to sockets of various shapes and these units were then joined to the cap in some manner which is not clear. In spite of the many representations of Maya headdresses which are available, we know practically nothing of how they were constructed and what materials were used.

The writer once witnessed the making of a feather headdress in the town of Cacaopera in El Salvador. The feathers were mostly macaw. In spite of the fact that they were kept in oiled silk and exposed to the light only for a few days each year, they were badly faded. Evidently they had been in ceremonial use for a long time. The first step in making the headdress was to lash about a dozen feathers to each of a series of rods. The rods then were sewn, some upright, some slanting, to a specially woven hat with no brim. The rods were covered with cloth and bird skins.[85] Finally strings were attached to secure the headdress, which was about 72 centimeters (30 inches) in height.

In disk K, the body is covered with a feather cloak and two large bunches of feathers are attached to the waist. There are also bunches of feathers projecting upward from the shoes in typical Great period style.

Each calf is adorned in a different fashion, a practice seen in other gold disks and on stelæ dating from the end of the Great period. On one leg there is a broad lattice-like band with danglers at the top and bottom. On the other leg there is a narrow band from which hang bells.

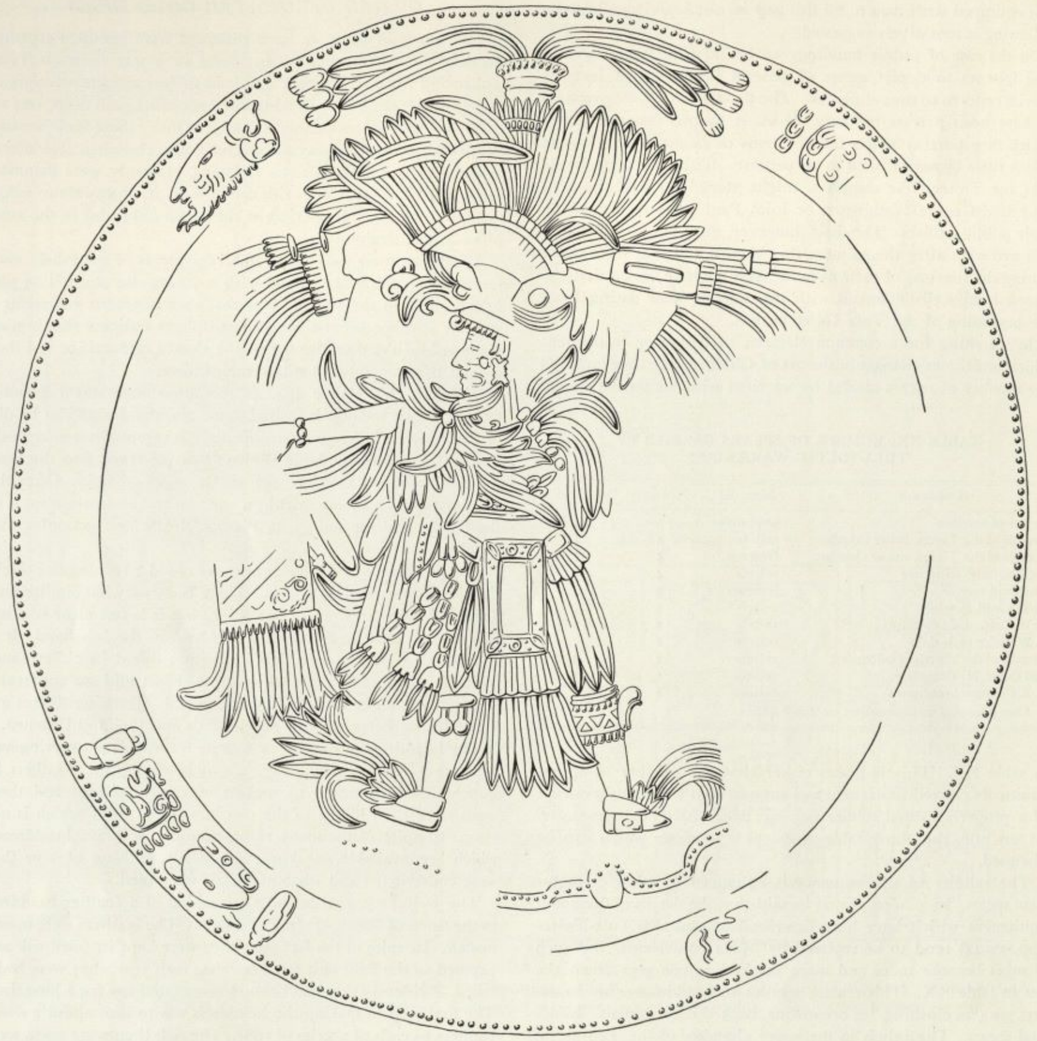


FIG. 40. Disk K, showing a sumptuously dressed official. Actual size.

The field decoration in disk K is not subdivided like the battle scenes. There is an outer band of glyphs which we cannot read and the principal personage occupies the rest of the space. A unique feature is that the top of the headdress fills part of the border panel.

Disks L and M. Figures 41 and 42 illustrate a pair of gold disks slightly smaller than the battle scenes. Although details differ, the subject in each case is the same: an eagle with a human head in the jaws attacks a prostrate Maya and reaches with a claw as if to extract the heart. Beneath is the head of a dragon shown full face with surrounding scrolls. This is represented upside down. Border patterns are the same in both disks.

Among the Aztec, various warrior orders existed of which the most important were the Knights of the Eagle and the Knights of the Tiger or Jaguar. Similar military societies evidently existed among the Toltec at a much earlier period and their symbolism is reflected in the arts, notably in sculpture at Tula and Chichen Itza. At the latter city the great Ball Court is dominated by the Temple of the Tigers, so named from the animals sculptured on its walls. East of this is the Tzompantli, a T-shaped platform with bas-reliefs on its vertical walls. On the eastern end of this edifice, which corresponds to the stem of the T, warriors accompanied by serpents and eagles consuming a human heart are shown. Adjacent again to the east is the Platform of the Eagles (Temples of the Cones) where alternate jaguars and eagles are portrayed in the act of consuming a human heart. Jaguars also appear on the inner Temple of Kukulcan and both eagles and jaguars are represented on the substructure of the Temple of the Warriors. These buildings form the ceremonial heart of Toltec Chichen Itza. Their sculptured decoration is mute testimony to the importance of the Eagle and Jaguar societies in the life of the community.

FIG. 41. Disk L, showing a Tula-Toltec eagle attacking a Maya. Actual size.

We should point out that the Platform of the Eagles is oriented not with the near-by larger structures but with the causeway leading to the Cenote of Sacrifice. Hence they form an architectural unit and the sacrificial rites are associated with the two warrior groups.

Eagles or eagle masks occur on five of the sixteen decorated gold disks dredged from the Cenote of Sacrifice. Jaguars are not represented at all. This is curious because the jaguar is more important than the eagle as a symbol in Chichen Itza bas-reliefs. Perhaps gold disks were an insignia worn by members of the Eagle society only.

On the pair of gold disks in figures 41 and 42, human faces appear in the eagle's beaks. This is not found on the bas-reliefs and raises a suspicion that the disks portray individuals garbed as eagles, but this cannot be determined as both specimens lack the feet. The subject — an eagle attacking a man — occurs in Nahua art of other regions, for instance in Guatemala,[86] where heart sacrifice is also represented.

The Maya victims in each case are shown half sitting up with the weight of the body supported on an arm. They both wear large back shields with a base adorned by interlocking frets. To these plumes were attached. The headdresses are complex and of completely different styles. The individual in disk L has an intricately tied turban. There are danglers across the forehead and a bird leg and claws extending above it. On top is a round object with long feathers and perhaps a leaf projecting from it. This identification is made on the basis of a stone carving from Los Tarros near Pantaleón, Guatemala, which has a similar headdress with the ribs of the leaf clearly indicated.[87]

The headdress on disk M (fig. 42) consists of a skull cap with diagonal bands. Evidently this is of woven material but it is impossible to say of what kind of fiber. On top of this base is a semicircular crest in which three parallel rows of feathers may be seen. On the original there would have been five rows in total. From the back of the cap a beaded fringe hangs to the shoulders.

Disks N and O. Figure 43 illustrates a pair of disks each of which features a god who emerges from a large shell. The identical border treatment clearly indicates that these specimens belong together, although the nature of the deities is in each case distinct.

The concept of a divinity who inhabits a snail shell, if not common, is widely distributed and is one of the many intellectual links between Middle America and Peru. Examples occur at

[86] Habel, 1878, pls. VI, VIII.

[87] Eisen, 1888, pl. VII. Waterman, 1924, fig. 6.

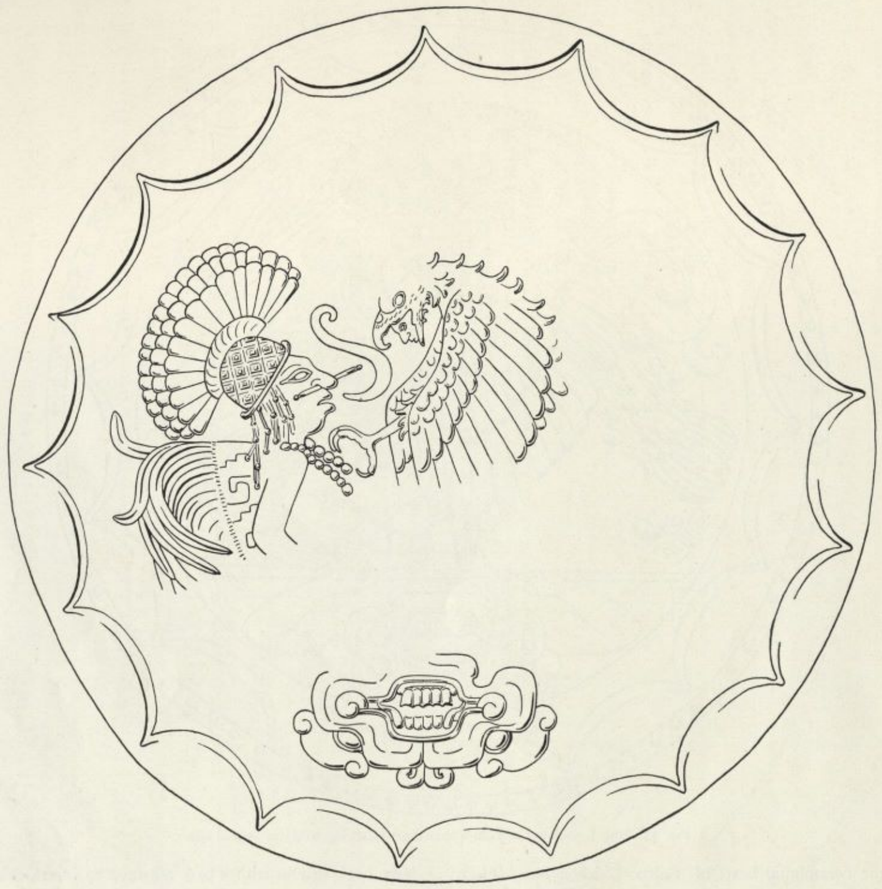


FIG. 42. Disk M, showing a Tula-Toltec eagle attacking a Maya. Actual size.

Tikal, Palenque, Chamá and Chichen Itza and in the Pérez, Dresden, Borgia and Nuttall codices.[88] A time span of many centuries thus is indicated in Middle America. In Peru, however, this idea is confined to Mochica period pottery styles, both modeled and painted.[89]

In Peru the snail-shell deity has a jaguar head with large fangs. In Maya art, a deity identified by Spinden as god N often is shown. This is the god who presided over the five unlucky intercalendary days at the end of the Maya year. He is represented as an old man and in the Pérez Codex is shown in association with god K, a benevolent deity who ruled the storms. He is also known as the god with the ornamented nose.

It is very probable that the snail-shell gods in figure 43 are N and K, although they are not pictured exactly as in the codices. God N often is shown with a *tun* sign for a headdress, here replaced by an animal head (*a*), and it might be argued that god D or G is portrayed, symbolizing the sun and sky. It is also possible that *b* represents God B, the rain deity.

[88] Spinden, 1913, pp. 83–84, figs. 108, 110. Dieseldorff, 1926–33, vol. I, taf. 18, 21. Morris, Charlot *and* Morris, 1931, pls. 14, 28, 29, 36, 37. Winning, 1949. Seler, 1908. Also a polychrome jar in the Bliss collection.

Unfortunately both the disks in figure 43 are incomplete and lack the same parts of the design. In both cases the hands and whatever they held are missing. Hence the symbolism of the disks is not fully apparent.

As pointed out, snail-shell gods were known to the Maya over a long period of time. A clue to the age of these disks is the quality of the scrolls which is similar to the battle scenes, especially disk G. We may also point out that fur is shown on the headdress of *a* and this is a Toltec trait. It therefore seems probable that this pair dates from the end of the tenth century.

Disk P. Figure 44 shows a fragment from a small gold disk. The surviving portion is adorned by a vigorously embossed ornament of quetzal plumes. At the right there is a necklace and portions of a head. Part of a clawed foot appears at the bottom. The subject seems to be a Moan bird, depicted in a style and detail typical of the Maya Great period. There is no suggestion of any Tula-Toltec influence in this specimen. This mythical animal is discussed on pages 71–72. In addition, there is another fragmentary

[89] Schmidt, 1929, figs. 177, *4*; 190. Larco Hoyle, 1938–39, vol. II, p. 47. Wasserman-San Blás, 1938, nos. 69–72.

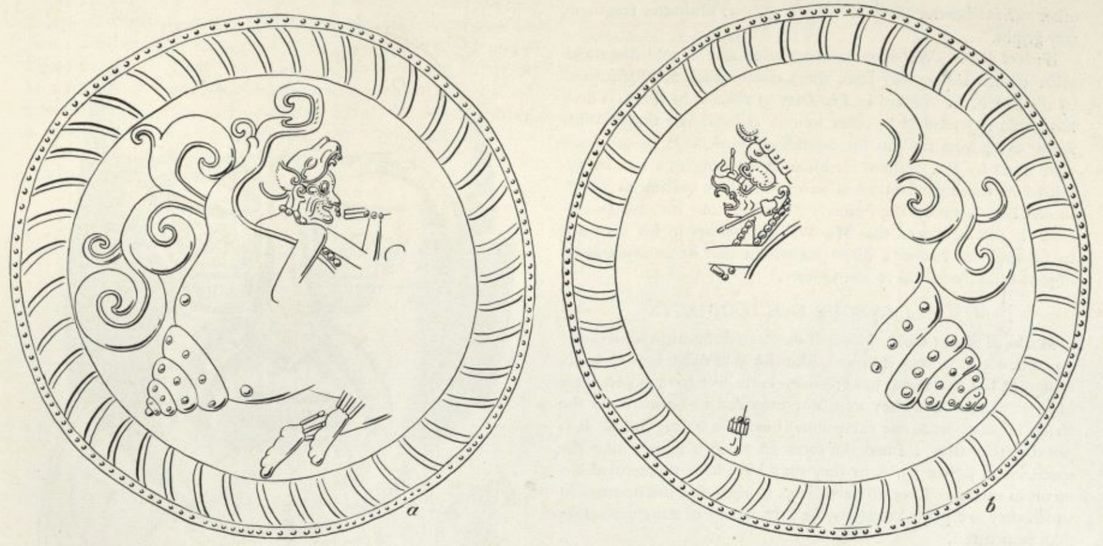


FIG. 43. Gold disks N and O, showing gods emerging from shells. Actual size.

disk of approximately the same size which may be the mate of disk P. It was too badly crumpled to be drawn.

Fragments. In addition to the disks we have illustrated and described, small fragments of many others were secured from the Cenote of Sacrifice, indicating that much material remains to be recovered. Needless to say, the staff of the Museum has worked hard over these pieces and there is no prospect of fitting more together. We are unable to estimate the total number of disks represented. It is clear, however, that styles and types of adornment exist which are not found on the disks we have illustrated. Two such fragments appear in figure 45, *d*, *e*. The top of the larger specimen is indicated by a hole for suspension. The border pattern consists of a series of eyes but not enough of the central design remains to make its nature clear. Figure 45, *e*, shows an-

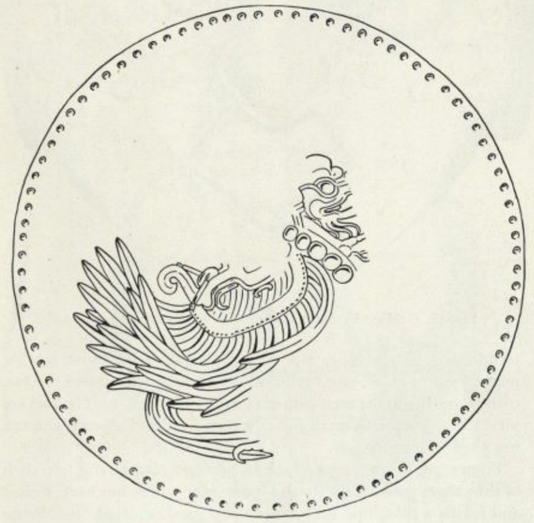


Fig. 44. Disk P, showing a Moan bird. (Border restored.) Diameter, 11.4 centimeters (4½ inches).

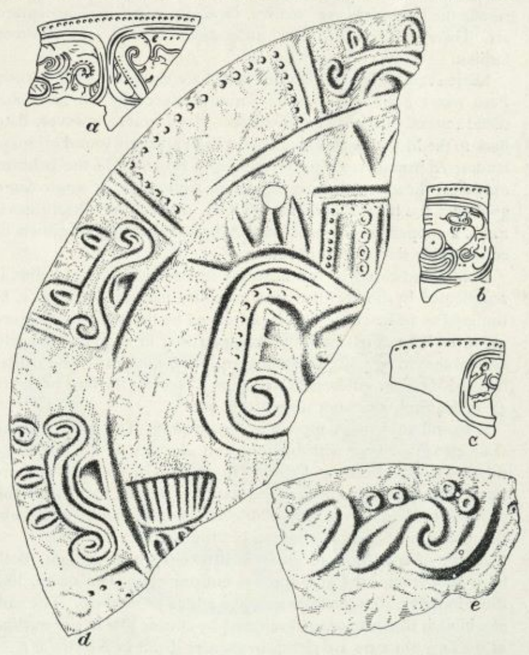


FIG. 45. Fragments of gold disks. Slightly reduced.

other variant border pattern. Figure 45, *a–c*, illustrates fragmentary glyphs.

Willard Disks. We should also mention several gold disks and other objects supposedly from the Cenote which are illustrated by the late T. A. Willard in *The City of the Sacred Well.* These have been reproduced by other writers as legitimate finds. With a few exceptions now in the Southwest Museum,[90] these pieces were made by Mr. Willard for his own amusement, a fact he admitted in writing when asked to explain how specimens which should have been in the Peabody Museum came into his possession. It will be noted that Mr. Willard neither in his text nor in his captions makes a direct statement that he is illustrating objects actually found in the Cenote.

MISCELLANEOUS GOLD OBJECTS

Masks of Sheet Gold. Masks of sheet gold appear in figures 46–49. The metal is very thin and, like the gold disks, is very badly crumpled but the metal has not been torn. We have called these objects "masks" but they were not intended to be worn by the living because, with one exception, they have no eye holes. It is possible that they formed the faces of wooden figures like the specimen in figure 53, *d*, or they may have been the central elements in shields. They all have holes in them but the manner in which they are placed suggests the attachment of danglers rather than suspension.

The specimen in figure 46, *a*, has a curiously elongated face with raised lumps on the forehead and cheeks. The nose is long and thin but terminates in a pointed bulb. The eyebrows are strongly emphasized. Beneath each eye there are interlocking elements which represent "gold" in Mexican codices. These symbols are placed in semi-circular frames. Smaller frames are attached below, containing rows of parallel vertical lines. The whole assemblage recalls the "weeping eye" motive, typically found in Tiahuanaco art. Tears are shown in Mexican codices but in a very different fashion.

Large realistic human faces in metal are extremely rare outside Peru where life-size statues were manufactured by the Inca and metal mummy masks were common . Metal heads, however, date back to the Mochica period. Faces in high relief are found on huge hammered breastplates in Colombia and Ecuador. In the Isthmus only small heads on bells or figurines are typical. A single large gold mask has been found in Costa Rica. Apart from Cenote specimens, a copper face from Monte Alban is the only specimen of considerable size known in Mexico.

Gold is indicated in two manners in the codices. Gold dust is represented by bowls filled with granular material (fig. 47, *a*, *b*) but gold as an intrinsic idea is portrayed by the symbols in figure 47, *d*, *e*. The smelting of gold is pictured in *c*. Why the gold symbol should be placed on a human face is not clear. The titular deity of Mexican goldsmiths was Xipe Totec but the face in figure 46, *a*, definitely does not suggest this god.

A second gold mask appears in figure 46, *b*. The nose is of the same elongated type with bulbous end also seen in *a*. There are raised dots on cheeks and chin. On the top of the forehead are small holes, perhaps for attaching danglers or false hair as is done on wooden Peruvian masks. The eyes are round and staring and the mouth is open as if shouting or singing.

A pair of smaller gold masks is illustrated in figure 48. Both have cut-out mouths and one has cut-out eyes. The noses, like those in figure 46, terminate in bulbs with a pointed tip. The ears of *a* in each illustration are indicated by cutting slits in the outline of the face but ears are shown in greater detail in the two *b*'s.

A fragmentary gold mask appears in 49, *a*. The ears are preserved as is part of the nose, which apparently was long and narrow but

[90] Watkins, 1944, p. 23.

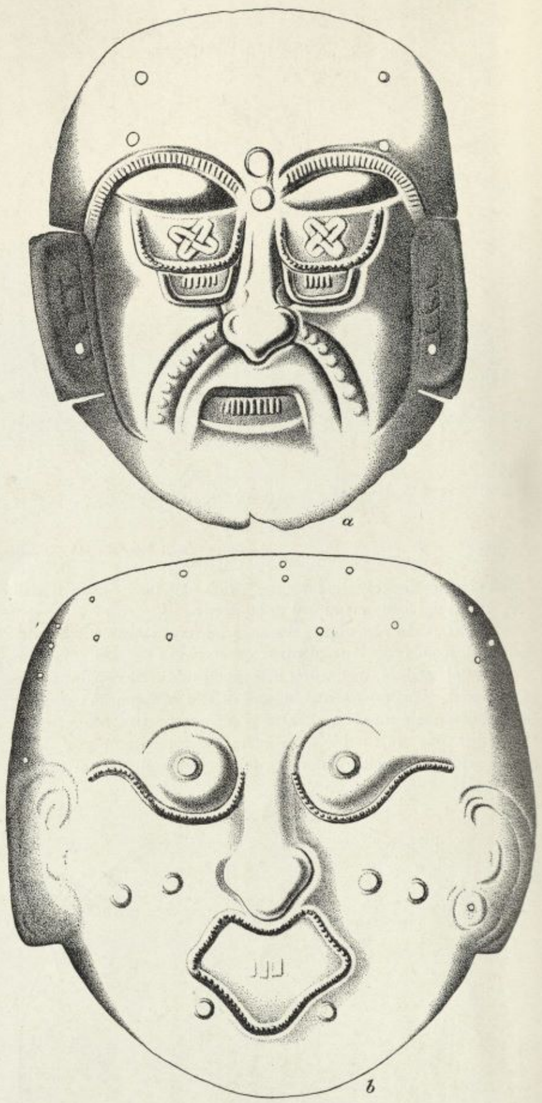


FIG. 46. Gold masks. Scale, ⅘. See table XXI, analyses 1326, 1328.

terminated in a bulbous tip. To the right of the nose is what might be an eye but more probably is an ornament under the eye, corresponding to the arrangement seen in figure 46, *a*. The ears are pierced by numerous small holes, either for danglers or for inserting a spiral wire (p. 96).

Figure 49, *b*, represents a face in profile facing to the left. It is of thin sheet gold except for the lower edge which has been melted and forms a thick lip. Presumably this specimen had been thrust into a ball of copal or rubber which burned fiercely enough to melt the gold when it was cast into the Cenote. The gold is of the same quality as the masks.

The six specimens just considered have been grouped together because of their nature and because the unusual type of nose implies a similar artistic tradition. The signs for gold on one of them indicate that they were made within the region where the Aztec or Mixtec writing was understood. We can find no art strain, however, with which they should be associated. On the other hand, at Chichen Itza, faces carved in relief with similar noses are seen in the upper chambers of the Temple of the Tigers [91] and the Ball-Court North Temple.[92]

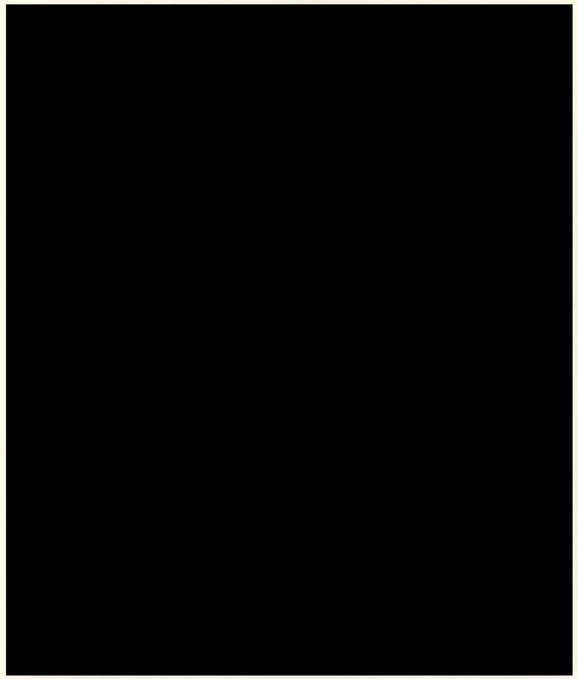


FIG. 47. Gold as shown in Mexican codices. After Aguilar, 1946.

TABLE XXI: ANALYSES OF GOLD MASKS

Analysis Number	Catalogue Number	Gold	Silver	Copper	Remarks
1326	C/7689	99.8	0.2	0.0	Figure 46, *a*
1328	C/10046	95.6	4.4	0.0	Figure 46, *b*
1329	C/10048	94.9	3.6	1.5	Figure 49, *b*
1327	C/7690	94.3	2.4	3.3	Figure 48, *a*

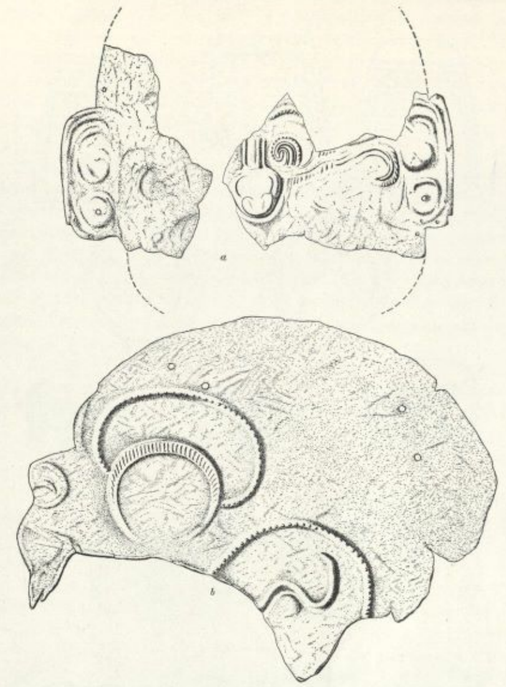


FIG.. 49. Fragmentary masks of sheet gold. Scale ½. See table XXI, analysis 1329.

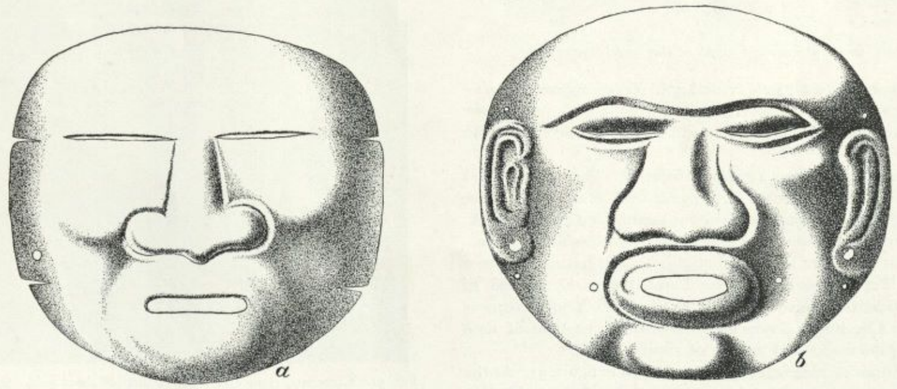


FIG. 48. Gold masks. Actual size. See table XXI, analysis 1327.

[91] Maudslay, 1889–1902, vol. III, pl. 35.

[92] Seler, 1908, abb. 98.

Analyses in table XXI show that the metal probably is not a Mexican ore for all specimens contain only a little silver, whereas Mexican gold has a large amount of silver (tables III and VII). Two specimens contain a little copper, which also is not typical of Mexico. The other two have no copper and are comparable to the gold disks with battle scenes (table XVIII). Both ores are of types known in Panama and may well be the product of overland trade which was maintained by Montezuma.[93]

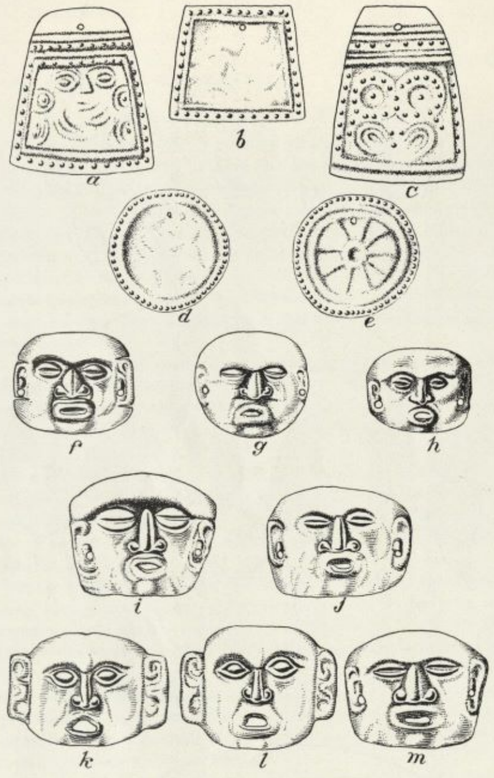


FIG. 50. Small plaques and masks of sheet gold. Actual size.

Small Sheet-Gold Objects. Small gold objects appear in figure 50. Just how they were used is not certain but the plaques on the top all have a hole for suspension and many have been sewn on clothing.

The little faces are from a group of fourteen. They show a good deal of individuality. Some have coffee-bean eyes; others have double-outline eyes. Some have cut-out mouths and others do not. The ears are variously treated and some have holes for ear ornaments. It is therefore unlikely that this set was beaten out on a mold. In Peru, especially in the Lambayeque region and in Colombia, identical faces were hammered on molds and strung as necklaces. The small Cenote faces have the same type of nose found on gold masks and may be of similar origin.

Three groups of identical objects are shown in figure 51. At the top are a series of crescents. In the center are thirty-nine gold rings

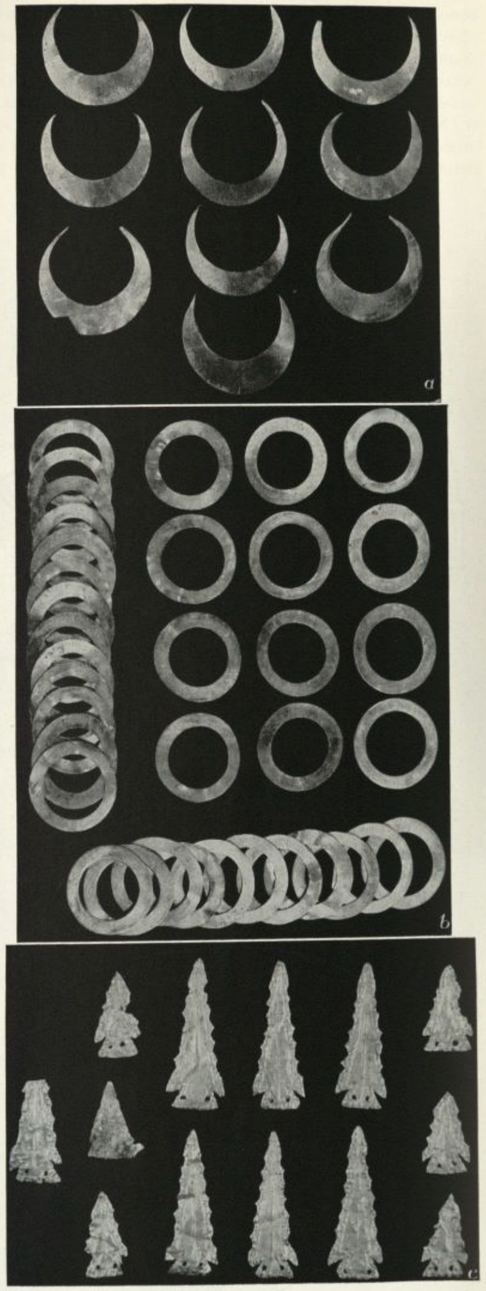


FIG. 51. Crescents, rings and arrow points of sheet gold. Scales, *a*, 2/3; *b*, 5/7; *c*, 5/6.

[93] Lothrop, 1942.

and at the bottom are thirteen gold arrow points. The crescents and rings have no holes, and how they were used is uncertain. They may have been sewn on clothing or inlaid in wood, perhaps a shield or idol. The arrow points each have a pair of holes for suspension and probably were sewn on clothing. It will be noted that the points reproduce the jagged outline of chipped blades and the effect is enhanced by stippling the surface. The metal is, of course, too soft to be of any practical use.

Regarding the gold crescents in figure 51, we may note that there are two rows of similar gold crescents sewn on a magnificent feather headdress now preserved in Vienna.[94] This specimen presumably is part of the Cortés loot and its history is known from the end of the sixteenth century.

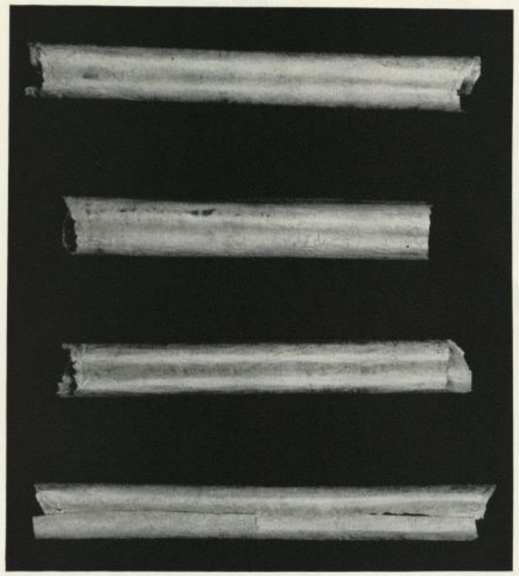


FIG. 52. Gold sheathing, probably from a spear-thrower shaft. Slightly reduced.

Gold Sheathing and Overlays. Figure 52 illustrates one of two sets of rectangular gold sheets which had been rolled into tubes. They can be distinguished from each other because one lot has a single small hole in each corner. The other has a pair of holes in the corners of one of the long sides, with single holes in the opposite corners. They were so bent when discovered that it was evident that they had once encased some perishable object, perhaps a wooden shaft. This is by no means certain, as many wooden objects were recovered from the Cenote in good condition. It is possible, however, that they covered the shafts of spear throwers.

Assuming this to be the case, each shaft was about 1.5 centimeters (5/8 inch) in diameter. The group with four holes consisted of seven large and two small sections with a total length of 68.5 centimeters (27 inches). The lot with six holes included four large and three small sheets having a combined length of 50.8 centimeters (20 inches).

In the list of booty secured by Grijalva when he skirted the coast of Yucatan, Campeche and Vera Cruz in 1518, he mentions gilded *tijeras*.[95] This probably is a misspelling of *tiraderas* or spear throwers but it is not certain where they came from. In Florence there are two gilded Mexican spear throwers,[96] and there are others both in Rome [97] and London,[98] all of which we have seen. They are not comparable to the Cenote specimens because the gold is a leaf so thin that it follows the contours of elaborate carving.

Although spear throwers were used in many parts of Central America and the Isthmus, no gilded examples are on record. The Chibcha in Colombia made cast gold spear throwers as toys [99] and the Quimbaya encased part of the shaft in gold.[100] In Ecuador spear throwers have been found with one or more bands of gold or silver wrapped around the shafts.[101] In the Museum of the American Indian, Heye Foundation, there are three gold casings for spear throwers, two presumably of Chimu workmanship and the third in Nasca style.[102]

The metal sheets here discussed, as well as a few other objects, appear to have been nailed in place. These specimens include narrow ribbons of gold and perhaps the great gold basin seen in figure 54, *a*. Metal nails were used on the coast of Peru and hard-wood nails in a few other localities.[103] What was employed in Yucatan is not known.

Two examples of sheathing on wood appear in figure 53. The first (*b*) consists of a dagger-like object surmounted by a loop handle, beneath which is a head sheathed in copper. The other (*dd'd''*) is a ceremonial staff or baton topped by an elaborately carved kneeling figure who holds a fan and rattle (?) in his hands. The face is of sheet gold and the headdress once was completely covered by mosaic, of which only a trace remains. The ears are adorned by small jade buttons. This figure, except for the face, recalls the so-called manikin scepter of Great period Maya art, even to the detail of having only one foot.[104]

On the other hand, it is probable that this specimen is not of local workmanship. Certainly the gold and jade did not come originally from Yucatan.

Figure 53, *a*, shows an example of sheet gold and turquoise forming part of a mosaic on wood. Three mirrors found at Chichen Itza have circular reflecting surfaces of hematite mosaic surrounded by wide bands of design in turquoise mosaic, all mounted on wood. The present specimen appears to be a different and coarser type of workmanship. The gold inlay recalls large wart-like excrescences on the faces of several of the surviving masks.[104a] This fragment then may be part of a mask.

Figure 54 illustrates what we believe to be the gold cap and golden features of a large wooden idol. The three pieces repre-

[94] Nuttall, 1888. There is a clearer illustration in Nuttall, 1895, pl. 1.
[95] Saville, 1920, p. 17.
[96] Bushnell, 1905.
[97] Saville, 1920, p. 214, footnote 56.
[98] Joyce, 1927, p. 151.
[99] Créqui-Montfort, Rivet *and* Arsandaux, 1919, pl. XI, *4*. Museo del Oro, 1944, pl. 38.
[100] Museo del Oro, 1944, pl. 20.
[101] Saville, 1924, pl. IV.
[102] Lothrop, 1937, fig. 6.
[103] Nordenskiöld, 1931.
[104] Spinden, 1913, pp. 50–53.
[104a] Saville, 1922.

senting the eyes and mouth were found separately but they obviously belong together. The cap, which is of more massive metal than the features, may originally have been a gold bowl which was converted to another use by punching five large holes in the top for inserting some ornaments and by making twenty-five small holes around the rim. These may have been nail holes or they may have held small danglers. A gold hat found on a skull in Coclé had a similar line of holes in the rim.[105] The Cenote specimen, however, could not have been worn by a man because it is much too large for the human head. It is the heaviest gold object found in the Cenote (*see* table XXXVI).

The eyes and mouth are indicated by broad circles and an oval, each cut from a sheet of gold with accompanying elements. At the corners of the mouth there are cartouches containing a serpent head minus the lower jaw. They are shown in profile facing outward. The style is Mayan.

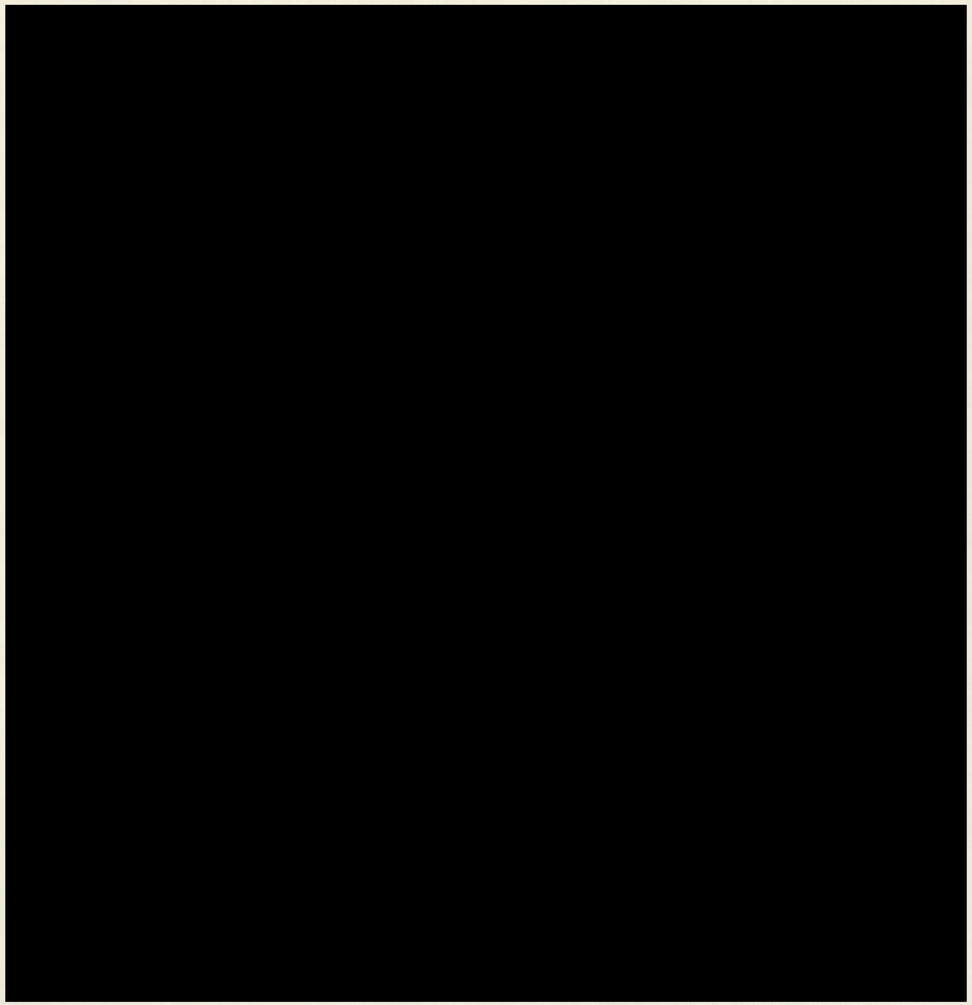


FIG. 53. Sheet metal overlays. Scales, *a*, actual size; *b*, 1/2; *c*, *d*, 2/3. (Water colors by Miss Adela Breton.) See table XXII, analysis 95.

[105] Lothrop, 1937–42, part I, fig. 107, *a*.

The eyes are surmounted by intricate plumed serpents of Tula-Toltec style which might be considered conventionalized eyebrows. They evidently were pressed into shape with a pointed tool in the same fashion as the battle disks. In fact, details of the heads correspond closely to the serpent head in disk H (fig. 1). After the relief had been achieved, the background was cut away, thus boldly emphasizing the design.

Cutting away the background of an incised or embossed sheet-metal motive gives it the clarity of outline which also results from casting. The technique is widespread and in Peru is a very old one as it occurs in all the earliest metalworking cultures. It is so simple that it probably has been invented several times.

The most ancient metalwork now known in the New World is assigned to the Chavín culture in northern Peru. About a third of the forty-odd known specimens have cut-out designs.[106] In southern Peru, the use of metals began during the Paracas Cavernas period and the Nasca period A, and again a large proportion of the designs are cut out.[107] The technique also appears in classical Tiahuanaco art in Bolivia [108] and extends southward to the Rio Lípez.[109] In later times cut-out objects of elaborate forms were manufactured in quantity on the central and northern coast of Peru.[110]

In Ecuador [111] and Colombia,[112] cut-out ornaments occur in small quantity, as these regions produced few objects of sheet metal. They also are found in Coclé [113] but we have seen no examples from Veraguas, Chiriquí, Costa Rica or any other part of Central America.

In Mexico, cut-out ornaments are on record from the State of Oaxaca, notably the vicinity of Teotitlan [114] and Coixtlahuaca.[115]

Cut-out ornaments of sheet copper occur in the Middle Mississippi area including the states of Georgia, Ohio, Oklahoma and Tennessee.[116] They are among the cultural traits of that region for which an origin has been sought in Mesoamerica.

The plumed serpents in figure 54 must be classed as one of the finest examples of the cut-out technique in the Americas. The snakes are rattlesnakes with four rattles each. There may be some significance in this number as it also occurs on the gold battle disks from the Cenote (fig. 15), on the Aztec calendar stone and elsewhere. The heads, as we have pointed out, are similar in detail to serpents on the battle disks – except for two features. One is the large fang which runs across the front of the open mouth. The other feature is the long pendant tongue which has a double tip.

The double tongue is a minor art motive both ancient and widely spread in the New World. It is found in Tula-Toltec sculpture both at Tula and Chichen Itza,[117] especially in portrayals of a serpent bird associated with the worship of Quetzalcoatl-Kukulcan. It is seen in Maya carvings of the Great period.[118] It occurs on Chorotegan pottery from Nicaragua and Costa Rica.[119] It is represented in the goldwork of Chiriquí, Veraguas and Coclé.[120] It also appears in the sculpture and weaving of the Chavín and Paracas cultures of Peru.[121] This then is one of the deeply ingrained symbols which links Mexico and Peru, for which there is no adequate explanation today.

The feathers in figure 54 evidently represent quetzal plumes. They are grouped in four bunches attached to the tail, the middle of the body, the side of the neck and the top of the snout. They are gracefuly bent as if stirred by a breeze or undulating from the motion of the serpent body.

Human and animal faces with flat rings around the eyes are known in central Mexico and the Maya area. They are of comparatively early date. The pyramid of Quetzalcoatl at Teotihuacan is studded with massive stone heads of this kind [122] and there are many Teotihuacan pottery figurines with rings around the eyes.[123] Examples in plaster reliefs are on record from Acanceh [124] and Uxmal [125] in Yucatan and there is a stone specimen from Copan [126] in Honduras. Other examples might be cited. The monkey, when shown full face or in the round, almost always has circular eyes. Gold examples of Veraguas style from the Cenote appear in figure 105. Comparable methods of representing monkeys in stone or pottery extend sporadically from central Mexico to Peru.

It is only at Chichen Itza itself, however, that close parallels to the face in figure 54 have been found. We illustrate in figure 55, *a*, the head of an Atlantean stone carving, one of fifteen which supported an altar or throne in the upper chamber of the Temple of the Tigers. The mosaic headdress is of typical Tula-Toltec style and is adorned with a symbolic bird. The eyes are encircled by rattlesnakes which lack the feathers seen in figure 54, *b*. The mouth is surrounded by a flat oval which has snake heads projecting from the sides. These heads suggest Tlaloc, the Aztec Rain god.

The curious head in figure 55, *b*, appears in painted bas-relief on the western wall in the lower chamber of the Temple of the Tigers at Chichen Itza. It has been pointed out by Seler and others that it probably represents the head of an idol which dominates the entire scene on the wall and vault. It occupies a central position and is guarded by a huge plumed serpent. All the human figures face it, those above bending down and those below looking up. These variously arrayed personages seem to be bearing gifts to the idol.

This idol's head obviously is very similar to the gold features in figure 54. Not only do the eyes and mouth with their appendages correspond closely but the gold cap we picture is pierced with holes which would permit the attachment of the additional ornaments seen on the idol. It is evident that the gold is more closely linked chronologically with the idol than with the head in figures 55, *a*, or with a somewhat similar head painted on the east wall of the inner chamber of the upper Temple of the Tigers, which we have not illustrated.

The great Ball Court at Chichen Itza obviously was not built as a unit and the sequence of its construction now becomes of interest to us. We believe that the lower Temple of the Tigers was the first structure and that it is approximately contemporaneous with the inner or early Temple of Kukulcan. Both have

[106] Lothrop, 1941a, pls. XVII, XVIII, XX. Keleman, 1944, pl. 207, *a*.
[107] Lothrop, 1937, pls. XXXI–XXXVI.
[108] Lothrop, 1937, fig. 11.
[109] Lothrop, 1937, pl. LXVII.
[110] Baessler, 1906.
[111] Kelemen, 1944, pls. 210, 211.
[112] Museo del Oro, 1944, pls. 14, 26, 27, 32, 33, 42, 43.
[113] Lothrop, 1937–42, part I, figs. 99, 118.
[114] Saville, 1920, pl. XVII.
[115] Aguilar P., 1946, pl. XVI.
[116] Phillips, 1940, fig. 31. Kelemen, 1944, pls. 193, 194.
[117] Thompson, 1945, pl. IV.
[118] Spinden, 1913, figs. 251, 262.
[119] Lothrop, 1926, pl. XLI, *b*; fig. 44.
[120] Lothrop, 1937–42, part I, figs. 84; 85; 94, *d*; 118, *e*, *f*; 161, *a*; 162, *b*.
[121] Yacovleff *and* Muelle, 1934.
[122] Toscano, 1944, p. 163.
[123] Tozzer, 1921, pl. 10, *B*.
[124] Seler, 1902–23, vol. V, p. 00.
[125] Saville, 1921, pl. V. Kelemen, 1944, pl. 86, *c*.
[126] Kelemen, 1944, pl. 85, *b*,

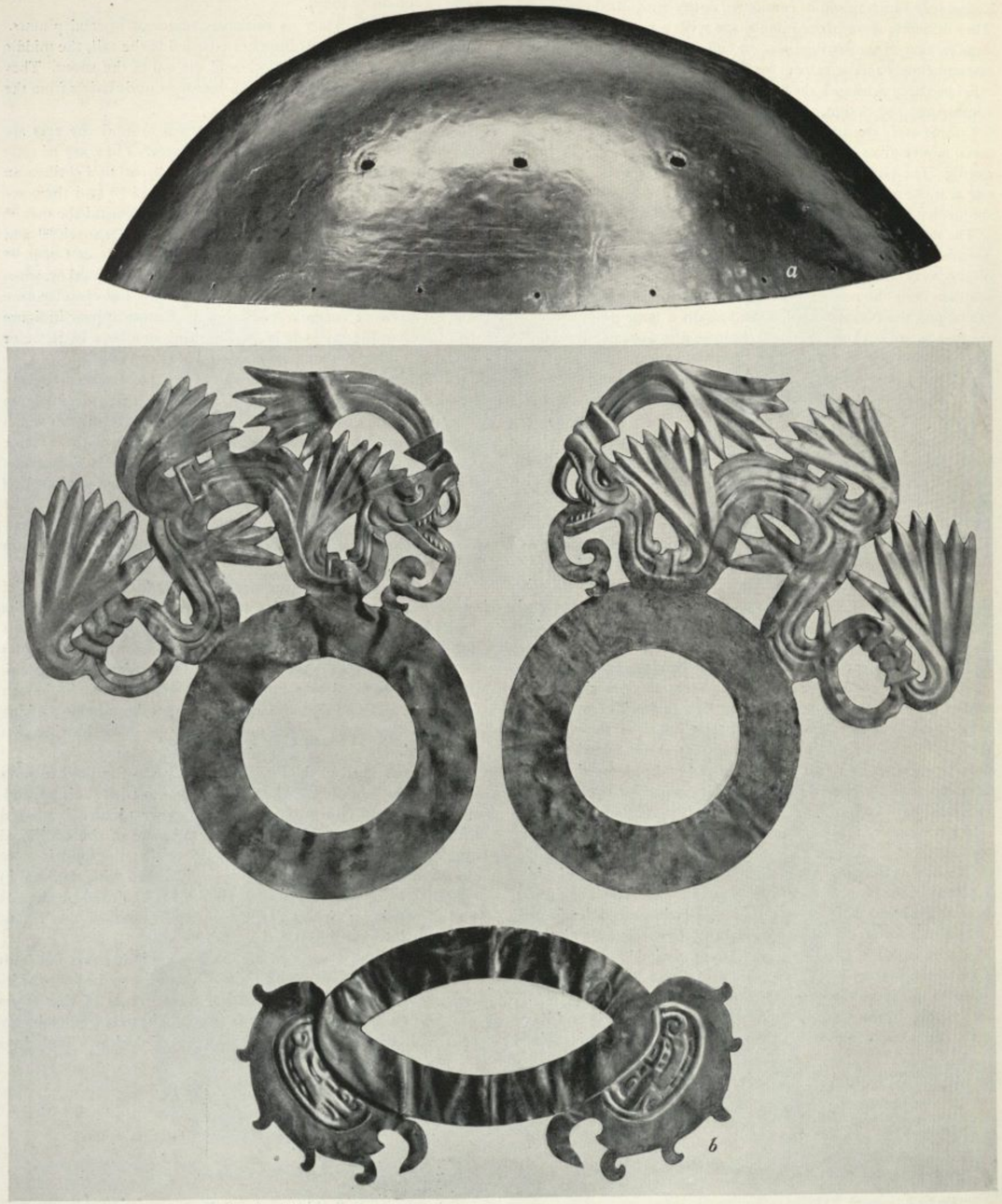


FIG. 54. Gold cap and face, probably from an idol. Scales, *a*, 2/5; *b*, 3/4. See table XXXVI.

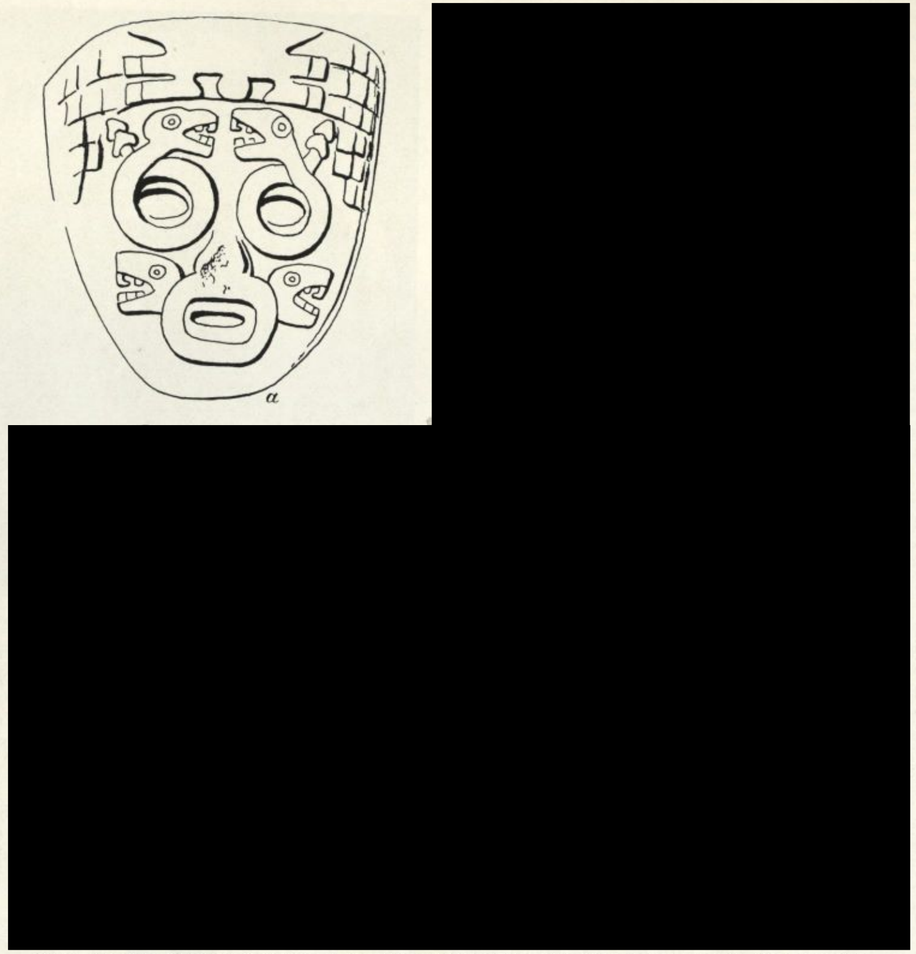


FIG. 55. *a*, Head of a caryatid. Upper Temple of the Tigers, Chichen Itza. (Drawn from a photograph.) *b*, Head of an idol. Lower Temple of the Tigers. *c*, Carved skull. Kaminaljuyú. *d–f*, Moan birds, Palenque, Copan and Tikal. (*b*, *d–f*, After Maudslay, *c*, after Kidder, Jennings and Shook.)

similar moldings and both contain jaguar thrones. The walls of the Ball Court were then erected, we believe, one of them passing a few feet west of the lower chamber of the Temple of the Tigers, which still remained an independent building.

When the playing surface of the Ball Court was finished, it was decided to embellish it with a temple on the north and south walls and three shrines on each of the long walls. All these were actually constructed except the shrine at the south end of the long east wall. Instead, the upper chamber of the Temple of the Tigers was erected in such a way that its base incorporated the western wall of the small adjacent temple which now became the lower chamber. The two have been designed to be a unit because their doors have the same axis, although they face in opposite directions on different levels. At what period the other additions took place, including the six friezes inside the Ball Court, does not concern us at the moment.

From what has been said it appears that the specimen in figure 54 portrays a deity venerated at Chichen Itza and represented only in buildings erected early in the Tula-Toltec period. This deity clearly was once of great importance and was worshipped long enough for stylistic change to take place in the manner of depicting him. The gold features we illustrate may be from the original wooden idol and the actual model from which this god was pictured in paint and stone. We cannot know why the god fell into disfavor and was cast into the Cenote.

Although this nameless deity was worshipped as an important idol by the Toltec at Chichen Itza, the prototype seems to have been a fabulous animal of the Maya Great period, today known as the Moan bird. This creature has an owl-like or sometimes a human head with circular eyes, and normally is shown with outspread wings. Various manifestations of the Moan bird all exhibit the double motives flanking the mouth seen on the Cenote speci-

men in figure 54. Similar cartouches representing profile serpent heads appear on both sides of the lower jaw of a carved human skull from Kaminaljuyú (fig. 55, *c*). On the forehead of this skull is the head of the Moan bird in profile. It came from a tomb of the Esperanza period and presumably is several centuries older than the Cenote specimen.

Other Great period representations of the Moan bird are carved in low relief and have been recorded from Palenque, Yaxchilan, Tikal, Copan and Quirigua (fig. 55, *d–f*). It is also known on polychrome vessels from Yalloch, Guatemala, and from Quintana Roo in eastern Yucatan. All of these repeat the crested serpent heads of Chichen Itza, not on the jaw but on the wings. When shown full face there are two, in profile only one (fig. 55, *d*). Evidently this motive was of great symbolic importance because it was retained when the wings of the Moan bird were eliminated and the concept became conventionalized as at Chichen Itza or Kaminaljuyú.

Figure 44 shows a fragmentary Moan bird on a gold disk from the Cenote. Enough of this specimen remains to indicate that it is in Great period style. Symbolic Moan wings appear on the left side of figure 29 and on the Sky deity in figure 35.

The significance of the Moan bird in the Maya universe is not definitely known. The owl-like head is the glyph for the month *Muan*. Schellhas believed it a symbol of death. This supposition is enhanced by the Kaminjuyú skull carved with a Moan head and insignia. Thompson thinks the Moan bird symbolized red water and he points out associations with celestial snakes and dragons who send rain.[126a]

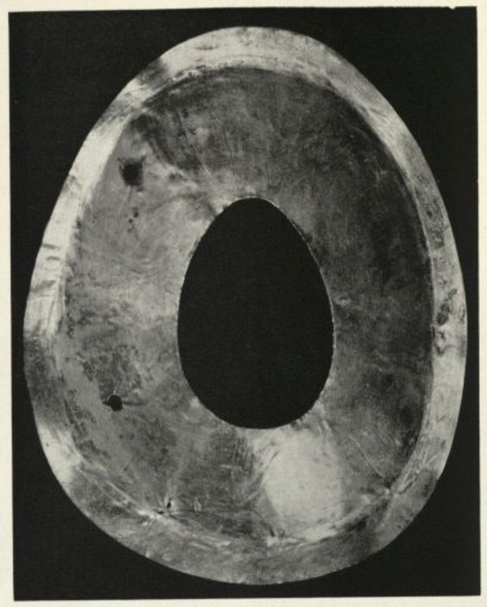


FIG. 56. Gold "horse collar." Actual size.

"Horse Collars." Objects of unknown use, shaped like the specimen in figure 56, are found in small numbers over a wide area. Except for the example here discussed, which is of gold, they are made of shell. Sometimes they have marginal nicks on the under side of the outer edge, which may be terraced. Sometimes there is a small sunken band on the upper side of the inner rim, suggesting that a central object of perishable material had once been glued in place. Invariably there are two or more holes for suspension.

Of two specimens found in tombs of the Esperanza period at Kaminaljuyú near Guatemala City, one rested on the feet of a skeleton. The other was not associated with a body but had been placed, together with an obsidian blade, on a basket.[127] Two specimens from Uaxactun in northern Guatemala presumably are of equivalent age as they date from the Tzakol period.[128] A single specimen from Holmul was found with pottery of period III, which approximates Esperanza at Kaminaljuyú.[129] Another from Teotihuacan, Mexico, may be of similar age but an example from Ojilan, Oaxaca, and one labeled "Civilización Matlatzinca" are of uncertain period.[130]

Is the gold "horse collar" from the Cenote of Sacrifice approximately contemporaneous with the shell specimens? We see no reason to believe otherwise, and, if so, it may date from the middle of the Maya Great period. It therefore may be the oldest metal object recovered from the Cenote and the oldest known metal object of the Maya area. On the other hand, "horse collars" may have been manufactured long after the examples mentioned.

It has been pointed out [131] that certain gorgets shown in relief in the later Temple of Kukulcan and the lower Temple of the Tigers may be of shell and that they correspond in shape to the "horse collars." These objects are oval or oval with pointed ends or egg-shaped. They often have more holes in them than any known "horse collar." An example in the Temple of the Warriors was painted gray. Another in the Northwest Colonnade was painted red.[132] These colors do not imply that the material is either gold or shell. The identification of "horse collars" on Tula-Toltec reliefs therefore is not certain.

Unclassified Gold Objects. There remains for discussion a number of gold specimens which fall in no definite category. Figure 57, *b*, for example, illustrates a fragment of a gold disk with a small head in relatively high relief. Bent legs appear over the head which vaguely suggest a "Diving" god. This specimen bears no resemblance to anything on record from the Isthmus, and therefore probably comes from Mexico.

FIG. 57. Miscellaneous gold objects. *a*, Pottery bead encased in gold. Actual size. *b*, Gorget. Scale, 3/4. *c*, Sheathing. Scale, 5/8.

In figure 57, *a*, we portray a pottery bead encased in gold. The inventory of Grijalva's loot mentions [133] "Five necklaces of round clay beads covered with very thin gold leaf." This description fits our specimen except that, in spite of the thinness of the gold,

[126a] Kidder, Jennings *and* Shook, 1946, fig. 165. Maudslay, vol. I, pl. 99; vol. III, pl. 78; vol. IV, pls. 6, 42, 68, 76, 81. Gann, 1918, pl. 28. Blom, 1950, figs. 1, 2. Schellhas, 1904, p. 41. Thompson, 1950, pp. 114–15.
[127] Kidder, Jennings *and* Shook, 1946, p. 149, figs. 17 (#48), 26 (#48), 62, 162, *e*, *h*.
[128] Kidder, 1947, p. 63, fig. 52.
[129] Merwin *and* Vaillant, 1932, fig. 28, *b*.
[130] Kidder, Jennings *and* Shook, 1946, p. 149.
[131] Seler, 1908, abb. 52, 55–61, 63, 66–71, 74, 75, 78–80, 82–85, 87, 88, 91, 93–97.
[132] Morris, Charlot *and* Morris, 1931, pl. 54, *top*.
[133] Saville, 1920, p. 17.

FIG. 58. Gold ear ornament (?). Actual size.

we think it may have been cast over the clay core because we can find no marks of manufacture.

Most metal beads were made by beating out two halves over a mold and then joining them together by some soldering process of which a trace usually remains. The technique is a very old one and was mastered in Peru in the Chavín period before the invention of casting.[134] In Coclé, beads were made by cutting sections of tubing and beating them round, probably over a hard wooden core which has since disappeared. They often show striations where the metal has been compressed.[135] We doubt that the pottery core of the Cenote bead is hard enough to permit the metal to be beaten into shape. It seems possible that the clay core was wrapped in gold foil which was soldered into place and polished so that the surface became uniform. No such process has yet been detected.

The Cenote gold bead is decorated by incising. Beads with a very similar design have been found at Texmelican in the State of Guerrero.[136]

Figure 58 shows one of a pair of similar objects which may have been earrings. The workmanship is unusual and we are uncertain whether they were cast or hammered and welded. The style is unknown in the Isthmus and Mexico, but linking by metal rings is very common in the Mixtec jewelry from Oaxaca.

[134] Lothrop, 1941a, pl. XX, *m*.
[135] Lothrop, 1937–42, part I, fig. 135, *a*.
[136] Vivó, 1946, lám. 52.

ARTIFACTS OF GILDED SHEET COPPER

A number of gilded sheet-copper artifacts were recovered from the Cenote of Sacrifice, including disks, various ornaments, sandals and cups. A metallographic description and photomicrographs appear in Appendix I. The copper was hammered and annealed. The gold layer, which averages only 2 microns in thickness, was applied as foil. In many cases it has peeled or been worn away. Analyses are given in table XXII. It will be noted that, except for lead and silver, impurities are present only in very small quantities. This is characteristic of most Mexican copper except in the north where there are almost no impurities except silver.

TABLE XXII: ANALYSES OF GILDED SHEET COPPER FROM THE CENOTE OF SACRIFICE

Analysis Number	Catalogue Number	Gold	Silver	Copper	Lead	Tin	Iron	Arsenic	Antimony	Bismuth	Remarks
99	C/7648	2.0	2.0	95.4 *	.01	0.4	0.1	0.1	.01	...	Disk (fig. 60)
96	(?)	2.0	0.1	97.4 *	.0001	0.4	.0001	.01	.05	...	Sandal
95	C/7649	2.0	0.1	97.4 *	.0001	0.4	...	.01	.05	...	Sandal (figs. 53, *c*; 67, *c*)
94	C/7419	2.0	.01	97.5 *	...	0.4	...	.01	...	...	Sandal (fig. 66, *a*)
19	C/7649	2.0	2.0	95.9 *	...	0.1	...	...	...	...	Sandal (fig. 67, *b*)
1306 †	C/7421	2.1	1.5	96.4	.001	0.1	...	...	...	...	Cup (fig. 68, *c*)
1307 †	C/7654	2.4	1.6	96.0	1.0	0.1	...	...	...	...	Cup (fig. 69, *c*)
1309 †	C/7657a	4.1	1.5	94.4	0.1	...	...	...	...	...	Cup (fig. 68, *e*)
1311 †	C/7740	8.3	2.5	89.2	0.1	0.1	...	...	...	...	Cup (fig. 68, *d*)

* Calculated. Spectroscopic analysis.
† Quantitative analysis.

Properties of Copper. Before proceeding with a description of artifacts, some remarks on the properties of copper may be pertinent. Copper is one of the more ductile metals and can be hammered or drawn into desired shapes. The Brinell hardness of cast copper is 35 ± 5 but in cold-worked copper, such as the gilded objects from the Cenote, the hardness may rise to 100.[1] These figures apply to pure copper, but, in archæological specimens, other metals often are present as impurities or alloys. For instance, the presence of arsenic up to 0.2 per cent facilitates cold hammering but above 0.5 per cent makes it more difficult. Most Cenote copper has a small quantity of arsenic. The presence of 5 per cent silver in copper raises the Brinell hardness to 60. Tin also is found in Cenote sheet copper but not in sufficient quantity to affect its quality.

In hammering copper to shape, as it becomes harder it becomes more brittle and tends to crack. It is therefore necessary to anneal the copper by heating it enough for recrystalization and softening to take place. Knowledge of this process is the fundamental fact on which metalworking is based. Annealing cannot be detected by eye and it is necessary to employ hardness tests or microscopic examination of sections. The softening temperature of pure copper is 185° C. The presence of 0.1 per cent silver, however, raises the annealing temperature to 325° C. and 0.5 per cent silver to 365° C. Most Cenote examples of sheet copper contain considerable silver.

Copper is much more reactive chemically than gold and tends to combine with other elements such as oxygen, sulphur, water or carbon dioxide. Cenote specimens, both cast and hammered, show remarkably little corrosion compared to similar objects buried in the earth. This may in part be due to the presence of arsenic which increases copper's resistance to corrosion by forming a protective film.

The Cenote metals have, of course, been in contact with water since they were offered in sacrifice. No complete investigation has been made of the effects of various types of waters on copper but it is evident that different waters behave differently. It has been ascertained, however, that chalky waters have very little effect on copper.[2] The limestone walls of the Cenote thus provide optimum conditions for the preservation of copper artifacts.

The effect of electrolytic action on copper is discussed in connection with *tumbaga* alloys on page 94.

Like the gold disks from the Cenote, the gilded disks probably were imported. Where they were made we cannot say, as artifacts of this type, with some exceptions from Guatemala, at present are only known from the Cenote. The probable point of origin, however, is somewhere in southern Mexico, both owing to the character of the metal and due to the fact that sheet copper objects are rare south of the Maya area.

DISKS IN SANTA RITA STYLE

The three disks in figures 59 and 60 are made of thin copper which has been gilded. The two smaller disks have holes for suspension which show no signs of wear. The larger specimen has no holes and must have been attached to some background, perhaps a wooden shield. This piece has been cracked in ancient times (upper left rim) and repaired with a metal strap. There are a pair of holes on either side of the break through which a string doubtless was passed.

[1] Gregg, 1934, p. 29.

[2] Gregg, 1934, pp. 146–47.

Fig. 59. Gilded copper disks decorated in the style of Santa Rita Corozal. Scale, 7/10.

The plaques here discussed obviously are wrought in the same manner and style. In each case, the principal field of decoration is a central circle surrounded by three concentric bands. The inner band carries a simple geometric motive. The second and widest band has motives we shall discuss. A very narrow outer circle may be stippled or remain undecorated. Stylistic unity is shown by the fact that one of the decorative motives occurs on all three disks and others are seen on two.

The style is one which has been known for many years from frescoes at Santa Rita Corozal in northern British Honduras.[3] Located near the modern village of Corozal and a mile from the sea is a group of mounds, originally about forty in number. Sixteen of these were excavated by the late Thomas Gann in 1896. One mound of earth had been erected over a limestone building with frescoes on the stucco walls running from the floor to the height of the molding. There were three layers of stucco, all of which had been painted. The frescoes had been protected by a rough stone wall a few inches from the façade which supported a slanting curtain of cement. This caught the rain from the cornice and directed it away from the paintings.

It is generally recognized that the Santa Rita frescoes incorporate many "Mexican" features such as celestial eyes and sun disks but the glyphs and numerals are Maya. Gann has suggested that the presence of a fortified Spanish town about 15 miles away may have caused the abandonment of Santa Rita, whose inhabitants sought to conceal and protect their frescoes.

Turning now to the Cenote disks, figure 59, *b*, shows a specimen with an eagle head in the central panel. It is fringed with plumes. Other examples with rudimentary bodies appear in the central panel of figure 59, *a*, and on the headdress in figure 60. Similar heads and headdresses are seen in numerous Mexican codices [4] and in the frescoes at Mitla,[5] implying a sixteenth-century date. In one case,[6] even the detail of the tongue in figure 59, *b*, is repeated in a Mexican codex.

These Cenote birds also may be compared with designs painted on pottery from the vicinity of Managua, Nicaragua,[7] often accompanied by a guilloch, such as appears on the inner ring of figure 59, *b*. This ceramic type presumably dates from about the time of the Conquest.

The inner ring around the central panel in figure 59, *b*, is split into five sections by radiating lines. Three of these have guilloche patterns and the other two contain perhaps unfinished motives of the same type. The other disks have chevrons and zigzags in the corresponding panels.

The relatively broad outer rings of all three disks contain amorphous patterns which defy analysis. There is one element seen on all three specimens. This is shaped like two hooks set back to back. It vaguely resembles the year symbol used in Mexico, which is shaped like an inverted V with curling ends, seen also in the Santa Rita frescoes. It also occurs in the gold work of the Isthmus and Colombia. We evidently then are dealing with a widespread symbolism which cannot be fully interpreted.

The curling motive shaped like a reversed question mark on the left side of the disk in figure 59, *a*, resembles a speech scroll and perhaps corresponds to the Mexican glyph for *cuicatl* or song.[8] The remaining motives doubtless have some definite significance as several apparently capricious forms are repeated but their nature is not apparent.

At the bottom of the central panel in figure 59, *a*, the day 2 Ahau is recorded. The full meaning is a katun ending on the day 2 Ahau, an event which recurred in the Maya time count at

[3] Gann, 1901, pls. XXIX–XXXI, fig. 5.
[4] Seler, 1902–03, abb. 575. Codex Borgia, 57. Codex Vaticanus B, 34. Codex Nuttall, 59, etc.
[5] León, 1901, 6.
[6] Seler, 1902–03, abb. 575.
[7] Lothrop, 1926, fig. 109.
[8] Seler, 1901–02, figs. 55, 56.

FIG. 60. Disk of gilded copper, showing head and arm in the style of Santa Rita Corozal. Actual size. See table XXII, analysis 99.

intervals of 256 years plus 160 days. This date fell in the years 1263 and 1520 A.D. The second date is definitely indicated by the stylistic links which have been discussed. This is the only piece of metal from the Cenote of Sacrifice which can be definitely dated.

The central panel in figure 60 depicts the head, right shoulder and arm of a fanged deity elaborately arrayed. As shown in profile the head exhibits no less than six different ornaments. These include a turban surmounted by a bird with head and tail plumes (fig. 61, *b*). The ears are concealed by a disk from which hangs a serpent head. The eyes are outlined by what look like spectacle frames. Projecting from the nose are a pair of pins with terraced heads. Similar objects are seen on several figures in the Santa Rita frescoes (fig. 61, *a*), where they are not placed asymmetrically but stand out on either side of the face. Finally there is a curious device which runs from the nose under the chin. This recalls the gold "mouth masks" of the Nasca culture on the south coast of Peru.[9] Only a few examples have been discovered but many are depicted on polychrome pottery. We have found only one specimen in Mexican codices.[10] This is edged with plumes as on the

[9] Lothrop, 1937, pls. XXXI, XXXII, *a*; figs. 1, 2.

[10] Codex Nuttall, 45.

disk and is painted red. Somewhat comparable mouth and eye ornaments occur on the belt of stelæ I and B at Copan.[11]

The face is marked by a large hooked nose and fang projecting from the corner of the jaw. The mouth is open and shows the upper teeth, a trait seen at Santa Rita which is characteristic of central Mexico. In the frescoes there is a very similar head, also crowned by a bird headdress. This Gann [12] identifies as a portrait of Kukulcan.

The shoulder is covered by a wide collar divided into segments. Similar collars appear in the frescoes, where it can be seen that globules attached to the edge represent bells (fig. 61, *a*). There are bands on the wrist and upper arm.

Under and in front of the chin are two day names with a numerical coefficient. These read "10 Lamat, 11 Muluc." The days are in their proper order in the Maya calendar, and the numerals place them as the eighty-eighth and eighty-ninth days in the *tonalamatl*, a divination period of 260 days (all possible combinations of the twenty day names and the thirteen associated numbers). The style of the glyphs recalls the codices rather than the inscriptions.

FIG. 61. Heads from the frescoes at Santa Rita Corozal. After Gann, 1918. Actual size.

Similar couplings of two consecutive days are found in the Dresden codex where they refer to astronomical occasions such as eclipses.[13] Presumably then this disk commemorates some celestial event of importance, a probability which is strengthened by the presence of a sky symbol in the back plumes of the principal figure.

A possible clew to interpretation of the disk comes from the day 10 Lamat. This day is associated with the planet Venus, and the number ten forms part of the name of one of the principal gods linked with the planet, *Lahun Chan*, literally "Ten Sky." Roys [14] believes that this deity is connected with the appearance of Venus as an evening star, that he is the Regent of the second Venus period in the Dresden Codex and that he was the god of the tenth Maya heaven.

Roys quotes Cogolludo's description of *Lahun Chan* as an idol with ugly teeth (*dientes muy disformes*). A passage describing the creation of the world in the Book of Chilam Balam of Chumayel states:[15] "Mighty are his teeth; his face is that of Lahun Chan, as he sits. Sin is [in] his face, in his speech, in his talk, in his understanding [and in] his walk. His eyes are blindfolded. . . . He shall walk abroad giving the appearance of one drunk. . . . There is no virtue in him, there is no goodness in his heart, and only a little on the tip of his tongue. . . ."

The face in the disk under discussion conforms to the description of *Lahun Chan* in two particulars. The teeth, including a long curved fang, can fairly be described as monstrous (*disforme*) and the peculiar object framing the eye might well be taken for a blindfold.

The Maya evidently regarded certain aspects of Venus as unfavorable. The making of this disk may have been an attempt to propitiate evil. More probably, however, the disk commemorates the successful evasion of possible malevolence, for the fact that a crack was repaired in ancient times indicates that it was cherished for more than a brief moment.

The style of these three specimens is so close to that of the Santa Rita frescoes that it seems certain they were made in northern British Honduras. This remark applies to the decorations only, for it does not seem likely that the natives of this region mined copper and gilded it. To be sure, copper objects have been found in some quantity farther south, notably on Wild Cane Key, but these are not of gilded copper and presumably came by trade from Guatemala. A cave in the Chamelcón Valley in Honduras, described on page 108, has yielded a large number of copper specimens which seem to be of local manufacture but none of gold or gilded copper have been found.

SUN AND MOON DISKS

Figure 62 illustrates two very thin disks, one of gilded copper representing the sun, the other of tin representing the moon. The latter is the only tin object discovered in the Cenote or indeed anywhere in the Maya area. It is fragile and was mounted on a wooden disk.

The glyphs identified as the moon and the sun occupy the center of each disk. These elements appear in Maya art over a period of many centuries but the styles here shown are closest to glyphs in the codices and therefore are not of great age. These disks probably form a pair for, although differing in size, the workmanship seems to be the same.

The color of gold and of silver (or tin) readily led to their identification with the sun and moon. Two famous pairs of gold and silver disks have been described by Spanish historians. One of these were the great plaques on the walls of the *Coricancha* (Court of Gold) sanctuary in Cuzco, Peru, which contained chapels dedicated to the sun and moon, their walls plated from floor to roof respectively with gold and silver.[16] Another pair was secured by Cortés in Mexico. Las Casas [17] writes: "Above all this they sent two wheels, one of gold (with) the figure of the sun carved on it, with its rays and ornaments, and certain figures of animals designed on it. I think it weighed more than one hundred marcs: [18]

[11] Maudslay, 1889–1902, vol. II, pl. 63. Proskouriakoff, 1950, fig. 19, *t*.

[12] Gann, 1901, pl. XXX, *8*.

[13] Codex Dresden, on page 58, 11 Muluk and 12 Lamat are coupled twice.

[14] Roys, 1933, p. 101, footnote 2.

[15] Roys, 1933, pp. 105–06.

[15] Seler, 1901–02, figs. 55, 56.

[16] Lothrop, 1938, pp. 34–49.

[17] Las Casas, 1876, tomo IV, cap. CXXI, 485–86. Translation in Saville, 1920, pp. 201–02.

[18] A marc is 230.0675 grams or half a Spanish pound (8.115 ounces).

the other of silver, with the figure of the moon carved in the same manner as that of the sun, (weighing fifty and some odd marcs). It has the thickness of a *tostón* of four reales, both (are) massive. Each one is a very little smaller in roundnes than a cart wheel. These wheels were certainly well worth seeing. I saw them with all the other things, in the year 1520 in Valladolid, the day that they were seen by the Emperor. . . ."

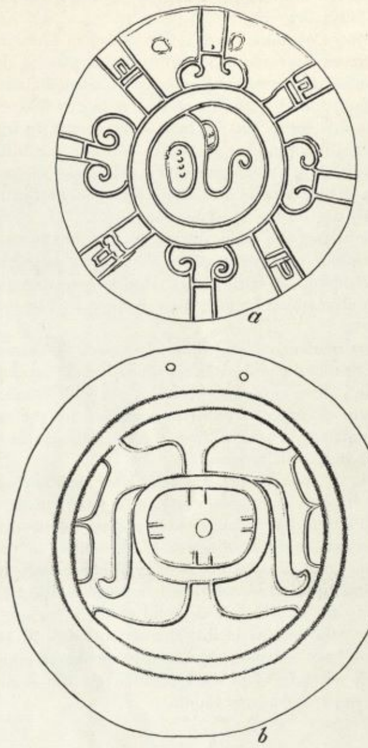


FIG. 62. Tin (*a*) and gilded copper (*b*) disks representing the moon and sun. Actual size.

These great disks and doubtless others were melted down many centuries ago and our modest pair, of little intrinsic value, are probably the only ones in existence. There are, however, both from Mexico and Peru, a few bi-metallic objects made of gold and silver. These do not portray but may symbolize the sun and moon.[19]

Figure 64 illustrates another pair of moon and sun disks, not made out of different metals, however, for both are of very thin copper which has been gilded. The copper is of good quality and has not oxidized. The surface gold layer has peeled off around the rim. Neither piece has holes for suspension and presumably both were attached to a shield.

The designs on both pieces are executed in wide but low relief within a circle and are much conventionalized.

The gilded copper used in these disks appears to be similar to the disks decorated in Santa Rita style and to various sandals and

[19] Bliss collection, no. 88.

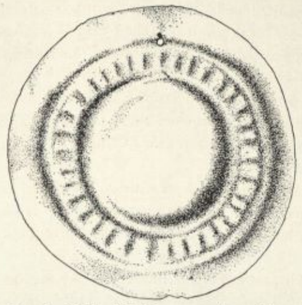


FIG. 63. Disk of gilded copper. Actual size.

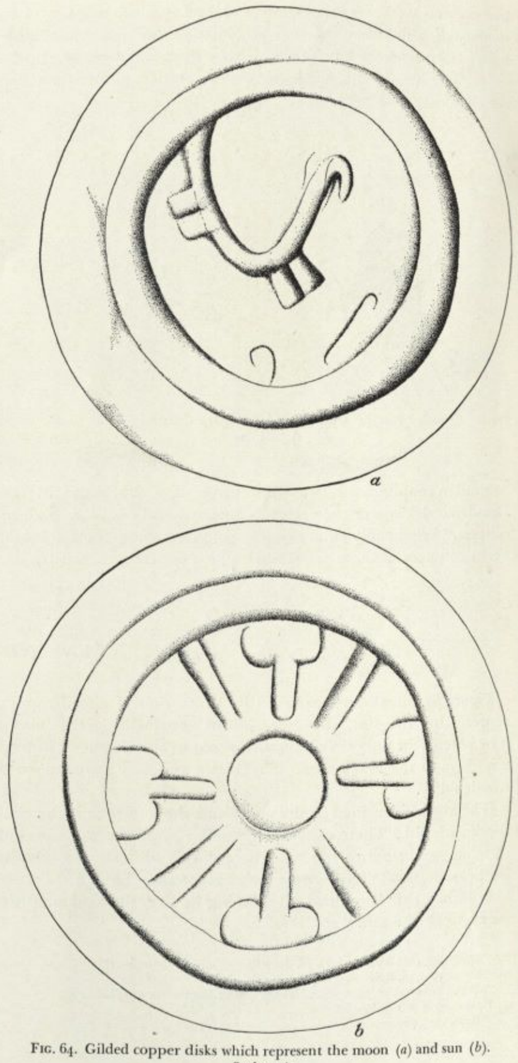


FIG. 64. Gilded copper disks which represent the moon (*a*) and sun (*b*). Scale, 4/5.

ornaments still to be described. If the gilded copper and the tin sun and moon disks can be accepted as a pair, it suggests that the copper was brought to Yucatan in a manufactured state – hammered to shape and gilded – from a region where tin was mined, and that the decorations in Maya style were added later. This points to central Mexico where bronze was manufactured, especially in the Valley of Mexico.

Figure 63 illustrates one of several small disks of gilded copper. They have simple decoration. Similar gold disks also were found in the Cenote (fig. 50, *d*, *e*).

MISCELLANEOUS ORNAMENTS

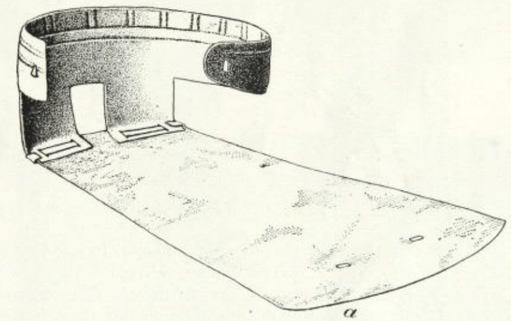
Head Ornaments. Figure 65 shows a tapering sheet of gilded copper with one end cut into strips. The outline is very similar in shape to a metal sandal (fig. 67) but it is not a sandal because there are no holes for attachment. It seems probable that this object was inserted over the forehead under a woven head band or turban. Bunches of feathers were worn in this fashion in Peru, where each feather was attached to a short string and the whole then braided together. In addition, metal plumes were worn on the head in Peru and Ecuador. A single example in gold from Monte Alban, when analyzed, may prove to be a trade piece.

FIG. 65. Head ornament of gilded copper. Length, 11.1 centimeters (4⅜ inches).

Ear Plugs. Only six ear plugs of metal were found in the Cenote of Sacrifice: two pairs (fig. 66, *b*, *c*) and two crushed single specimens. Many others of jade were recovered, however, as well as some of wood. The pairs each had a cylinder about 2.5 centimeters (1 inch) in diameter and height. This was inserted in the ear lobe and evidently held in place by a pin run through two small holes in opposite sides of the cylinder. In one case the front is a flat disk and in the other an out-sloping cone. All specimens have been hammered to shape from a single piece of copper and then gilded.

Within the regions where the higher arts of metallurgy were practised, ear plugs appear on almost every representation of the human figure, be it carved, plastic or painted. Metal ear plugs, however, are nowhere common, although they were among the first objects made of metal in the New World. In fact, apart from the Cenote specimens, I know of few others from Mexico and Central America. There is a pair in gold from Coixtlahuaca, Oaxaca,[20] which has a tube and flat front like the Cenote examples but the inner edge of the tube is bent to form a flange, thus holding the plug in the ear lobe. Three gold ear spools with a flange on each face have been found at Texmilican, Guerrero.[21] Another pair is from Zaculeu, Guatemala.[22] They are made of gilded copper and reportedly were found with a Plumbate ware vessel. They are very crude, consisting of a sheet metal rolled to form a truncated cone which was slightly modified by hammering. This resulted in slightly flattening the front. Small holes near the loose edges indicate that they were held together by string.

In spite of the great amount of metal produced in Chiriquí and Veraguas, there are no ear plugs on record.[22a] In Coclé, however, there were tubular jointed ear spools of gold.[23] One section evidently was inserted in the ear lobe and the second section then telescoped into it. The specimens we know from Colombia include a gold pair from Conto, a region influenced by Quimbaya art.[24] They measure 9 centimeters (3½ inches) in diameter and 3 centimeters (1⅛ inches) in height. They consist of narrow drums with flanges on top and bottom. This shape was used in



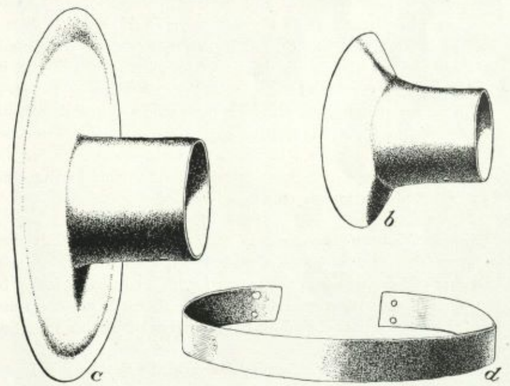


FIG. 66. Sandal, ear plugs and bracelet of gilded copper. Scales, *a*, 2/3; *others*, actual size. See table XXII, analysis 94.

[20] Aguilar P., 1946, eighth plate.
[21] Vivó, 1946, lám. 52.
[22] Villacorta *and* Villacorta, 1927, p. 160.

[22a] Since the above was written, Coclé-style ear spools of gold have been found in a Veraguas grave near Soná.
[23] Lothrop, 1937–42, part I, p. 147.
[24] Museo del Oro, 1944, pl. 30; 1948, láms. 61–63.

Mexico during the Aztec period but the material is obsidian rather than metal. Two pairs from the Colima region in the Cauca Valley are of the same shape. There is also a pair resembling the Coclé ear spools.

The invention of the metal ear plug, or at least the earliest manifestation of it, must be ascribed to the very ancient Chavín culture of northern Peru.[25] Like Cenote specimens, Chavín ear plugs consist of a tube and flat outer disk, both beaten from a single piece of metal. Apart from their elaborate decoration, Chavín examples are unique because the inner end of the tube was rolled over on itself and secured by welding or solder, thus forming a raised ring which held the plug in place. A partly finished specimen clearly shows the method of manufacture.

FIG. 67. Gilded copper sandals. Length of *b*, 15.3 centimeters (6 1/16 inches). See table XXII, analyses 19, 95.

In later times, Peruvian ear plugs took two other forms. One of these was a narrow drum with flat flanges soldered to either side,[26] an almost exact counterpart in shape of Aztec obsidian ear ornaments. The other was a drum with a flaring outer face, beaten from a single piece of metal and similar in shape to the Cenote type seen in figure 66, *c*. In Peru, however, a decorated disk was inserted in the outer mouth, usually by soldering or clinching.[27] Jade ear plugs with comparable insertions have been found in the Maya area but none of metal.[28]

Our survey of metal ear plugs has produced no close links with Cenote specimens. At the same time, owing to the unique manner of holding them in place — by inserting a pin near the inner rim — it seems probable that they were all manufactured in the same locality, which ultimately may be identified.

Bracelet. The only bracelet of metal from the Cenote, shown in figure 66, *d*, is a thin band of gilded copper with a pair of holes in either end by which it was secured with a cord. To judge by the warriors shown on gold disks, bracelets were in common use, but for the most part they must have been of perishable material.

Sandals. A number of sandals of gilded copper were found in the Cenote. It is evident that there were not intended for human use because the holes punched for the thongs have projecting edges which are still very sharp. If actually walked on, these edges would have worn smooth, and the plating is so thin — .002 centimeters — that it would show signs of wear. As things are, part of the plating has flaked off equally on both sides. If these sandals were used at all, it must have been to adorn an idol.

Sandals were made both with and without a metal heel piece. The former type, illustrated in figure 66, *a*, consists of a sole and heel piece with a strap for the ankle. It is sewn in place by a metal strip, the ends of which are clinched over the edges of the sole. Figure 69, *c*, may be the heel section of such a sandal with the end of the strap broken.

The joining of metal sheets by sewing them together with a metal ribbon is not common in the Americas, although it is a process easily adapted from textiles. After all, this is a shoddy technique in metals, which can and should be more strongly and smoothly joined by welding or soldering. This is one of the inherent qualities of metals as contrasted with other materials.

Strap joining makes its first appearance in the early coastal Chavín culture of Peru [29] where it was used not for rigid attachment but as a substitute for wire in suspending danglers. Over fifteen hundred years later, this process was revived in the Lambayeque region in Peru where it was employed both for danglers and for the solid joining of sheets.[30] The late metalwork of this region, we may point out, is notoriously flashy and poorly made. The Cenote specimens are the only examples we have seen north of Peru.

The second type of sandal (fig. 67) evidently had the heel secured by thongs which passed through one, two or four pairs of holes. In all cases the toes were held in place by thongs secured through two holes. The sandals with metal heels correspond roughly to the sandals represented on gold disks with battle scenes (fig. 26), and the other form may be of different date. This we doubt, however, for the uniform quality of the metal suggests that it came from a single and presumably contemporaneous source.

Cups. Half a dozen gilded-copper cups (fig. 68) and two cast copper celts are the only utilitarian metal artifacts found in the

[25] Lothrop, 1941a, pl. XVII. Tello, 1929, figs. 107, 110. Lothrop, 1951.
[26] Lothrop, 1941a, pl. XVII, *aa*[1].
[27] Antze, 1930, abb. 5–21.
[28] Kidder, Jennings *and* Shook, 1946, fig. 143.
[29] Lothrop, 1941a, pl. XX, *n*.
[30] Antze, 1930, taf. 3, 12; 13, 91. The technique is more common than these illustrations indicate as demonstrated by unpublished material in the Museum of the American Indian, Heye Foundation.

FIG. 68. Gilded copper cups. Scale, *top*, ca. 1/2; *bottom*, ca. 2/3. See table XXII, analyses 1306, 1309, 1311.

Cenote. Such objects traditionally were manufactured in Mexico but they are not common archæologically except in Guerrero and adjacent territory and it seems that few reached Yucatan.

The Mexican inventories reveal that Grijalva [31] only secured two saucers, two cups and an olla of gold on the coast of Yucatan and Mexico. Montezuma, however, seems to have had a complete table service. We quote Durán who received his information from Francisco de Aguilar. In a secret room with a hidden door the Spaniards found, among other treasure, "Many piles of vessels of gold, dishes and porringers made according to their (Aztec) style, from which the kings ate, especially four large dishes made like platters, all of gold, very elaborately worked, as big as a large shield, and they were so filled with dust that one understood that many days had passed in which they had not been in service. There were many gold chocolate cups. . . . " [32]

Golden dishes have not been found in Central America or the Isthmus with one exception from Coclé.[33] In Colombia, however, beautiful bottles of massive gold were manufactured in the Quimbaya region.[34] Curiously enough they were suspended from a string and worn as gorgets.[35] Hemispherical cups about the size and shape of the Cenote specimens have been found in Colombia.[36] Peru has yielded a large number of gold, silver and copper vessels. The largest archæological specimen is a silver jar now in the Museo Nacional which was found in a warehouse at Chanchan. It is 1.0 meter (39 inches) high. Much larger metal vessels were secured by the Spaniards in the sixteenth century, including one large enough to hold a cow cut in pieces.[37] There can be no question of exaggeration in these descriptions because the size

FIG. 69. Gilded copper objects of unknown use. Length of *b*, 21.6 centimeters (8 1/2 inches). See table XXII, analysis 1307.

[31] Saville, 1920, p. 15.
[32] Durán, 1867–80, vol. I, p. 37.
[33] Lothrop, 1937–42, part I, fig. 78.
[34] Lavachery, n.d., pls. XXXII-XXXIV.
[35] Lavachery, n.d., pl. XXXVII.
[36] Museo del Oro, 1944, pl. 4; 1948, láms. 8, 9.
[37] Lothrop, 1938, p. 50.

and weight of those presented to the King have been recorded.[38]

The Cenote cups (fig. 68) are all hemispherical and undecorated. The largest is 10.3 centimeters (4⅛ inches) in diameter. They vary in quality because the gilding is partly worn away but the copper has largely retained its original color.

Objects of Unknown Use. It is inevitable that in any large archæological collection there should be objects which cannot be explained. Such are the two pieces of gilded sheet copper illustrated in figure 69, *a* and *b*. They are too thin to have fulfilled any useful function and their shapes are so precise that they must have had meaning to their makers. They vaguely recall the eccentric flints found in cities of the Great period. They also may be compared with unexplained shell objects found at Holmul.[39] We suggest that *c* may be the heel of a sandal such as illustrated in figure 66, *a*.

[38] Medina, 1927. Lothrop, 1938.

[39] Merwin *and* Vaillant, 1932, pl. 35, *a*.

ARTIFACTS OF CAST COPPER

The largest group of objects from the Cenote of Sacrifice was cast from various kinds of copper ores and from copper-tin (bronze) or copper-lead alloys. It is a curious fact, which we cannot explain, that all types of gold objects were either crumpled or beaten out of shape, but cast copper objects were thrown into the Cenote intact. It might be argued that the copper artifacts represent a different kind of ceremony, perhaps at another period. It is probable, however, that bells were offered to the Cenote deities for a long time, for they are represented on the comparatively early battle disks, and some specimens are of Aztec manufacture, as proved by analysis. Inasmuch as immersion in water had little effect on copper, artifacts of this kind are today well preserved, usually in much better condition than comparable specimens buried in the earth (p. 94).

FIG. 70. Cast copper death's heads. Actual size.

Celts. Two small copper celts of Oaxacan type were found in the Cenote. One was analyzed and contained as impurities: 0.1 per cent silver, 0.1 per cent tin and .01 per cent lead. These are the only metal tools in the entire collection. Apart from copper celts, gold fishhooks are the only other tools on record from Yucatan. Grijalva brought back twenty of them in 1518. None were found in the Cenote.

Copper Masks. Figure 70 illustrates part of a series of three large and eight small copper skulls. They are rather crudely cast. The larger pieces have the teeth indicated by incised lines and there is cross-hatching on the chin.

How these specimens were used is not clear. There are no loops for suspension so that it is improbable that they formed part of a necklace. On the other hand, there are wide slits in the sides extending from the level of the mouth to the level of the brow ridges. These slits suggest that the heads were secured to a ribbon which might have been worn as a head band.

Finger Rings. Pre-Columbian metal rings for the fingers were manufactured in at least four distinct areas, each producing their own types. The most ancient examples known are three gold specimens from the vicinity of Chongoyape on the north coast of Peru which date from the Chavín period. One is a wire circle; a second is a circle of two twisted wires; the third is a circular sheet with a conventionalized bird embossed on it.[1] We have seen no finger rings dating from the subsequent Salinar and Gallanazo periods but they occurred in the Mochica period which probably overlapped them.

Perhaps a thousand years after the first metal rings, they became common in Peru. At any rate the Late Chimu and Chancay cultures produced rings in great quantity made of silver or silver alloys. For the most part these were simple bands of metal,[2] presumably worn by women because they are very small for a man.

A third region where finger rings were used is the Province of Coclé in Panama and the north coast of Colombia. At the Sitio Conte two rings were discovered which consist of gold wire bent in a circle but not soldered.[3] It might be argued that these were small nose rings had they not been found on finger bones.

A fourth type of ring comes from Oaxaca where cast filigree rings were manufactured. Some of the local finds, notably in

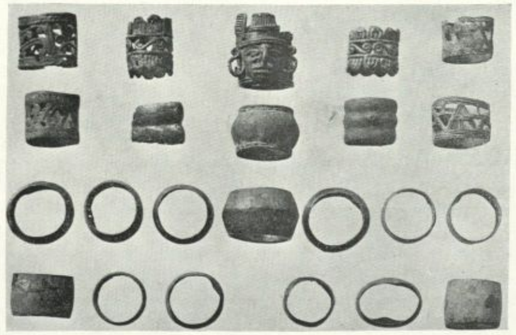


FIG. 71. Copper rings. Scale, ca. 1/2.

[1] Lothrop, 1941a, pl. XX, *i*, *j*, *k*.
[2] Baessler, 1906.
[3] Lothrop, 1937–41, part I, fig. 143, *a*.

tomb 7 at Monte Alban, are among the most elaborate and delicate castings produced in the New World.[4] These masterpieces in gold were not exported but cruder rings made of copper reached distant lands. Seven examples from the Cenote are illustrated in figures 71 and 72. A specimen like our figure 72, *a*, was found in British Honduras.[5] Three examples with a face like our figure 72, *c*, are on record from the Guatemalan highlands [6] and a similar specimen was discovered in El Salvador.[7]

FIG. 72. Cast copper rings. Actual size.

The Cenote specimens are of two types. Figure 72, *c'*, illustrates a ring with a band decorated by serpent heads shown in profile and a human head shown full face, which projects above the edge of the band. This type of ring is well known in gold examples and there is a beautifully carved specimen in bone from Guatemala in the museum in Rome. The Cenote specimen, however, as well as the rings pictured in figure 72, *b*, and 73, *d*, is a faulty casting because the inner and outer sections of the mold did not meet properly. As a result, what should stand out as wire-like filigree is backed by a thin sheet of metal.

The casting of these rings must have been difficult, as the molten metal had to flow through small and intricate channels. In Veraguas goldwork, there are occasional pieces with similar failures in the juncture of the two parts of the mold.[8] The explanation obviously is poor workmanship but one may ask why it is poor. We suggest either that it is possible that the Cenote rings represent a period when filigree casting had not been fully mastered in Oaxaca and that they therefore are older and cruder than the classical gold jewelry from Monte Alban or that they are school pieces which had no local market. Figure 73, *d*, obviously represents inexperience. It is what you would expect a beginner to do in attempting to build a design of wax threads.

The inner motive in figure 73, *c*, also suggests a workman who has been uncertain of what he wanted to do. On the other hand, the twisted and braided borders have the quality of a precise art — a style which happens to have flourished in Panama. The inference is that foreign traits were copied in early Mexican jewelry. We may add that the precise S-scrolls seen in figures 72, *a*, *b*, and 73, *a*, *b*, are typical of gold castings in Panama, Colombia and the north half of the Peruvian coast.

Another suggestion of relatively early date for some Cenote rings come from the face illustrated in figure 72, *c*. The nose and ears at present have no known parallel. The eyes, mouth and the headdress consisting of parallel vertical bands, however, have a distinct affinity with the heads on the great caryatid figures at Tula,[9] whence came the inspiration of Tula-Toltec Chichen Itza.

FIG. 73. Designs from cast copper rings. Actual size. See table XXIII, analyses 92, 93.

The Salvador ring illustrated by Kelemen and the bone ring in Rome to which we have referred both spring from the same artistic tradition.

In addition to the previously published type of rings, a fifth style was recovered in the Cenote of Sacrifice and is illustrated

FIG. 74. Copper rings. Actual size. See table XXIII, analysis 21.

TABLE XXIII: ANALYSES OF COPPER RINGS

Analysis Number	Catalogue Number	Silver	Gold	Tin	Lead	Iron	Arsenic	Antimony	Bismuth	Remarks
92	C/6031	0.1	...	0.2	0.5	0.1	0.4	.01	.005	Filigree (fig. 73, *a*)
93	C/6028	0.1	...	...	0.5	.01	0.4	...	.005	Filigree (fig. 73, *c*)
21	C/4839	0.1	0.1	...	.01	.001	.01	...	...	Plain (fig. 74, *a*)
90	C/4831	.01	...	0.1	.001	...	.01	...	...	Plain
91	C/6034	.01	...	0.1	.01	...	.01	...	...	Plain
36 *	C/6034	0.1	>8.8	...	.01	0.1	.0001	...	...	Grooved, gilded

* Copper: 84.5 per cent.

[4] Caso, 1932a, 1932b. Kelemen, 1944, pl. 228.
[5] Gann, 1918, fig. 83.
[6] Lothrop, 1936, p. 75, fig. 72.
[7] Kelemen, 1944, pl. 228, *b*.
[8] Lothrop, 1950, fig. 70.
[9] Reynolds, 1946, p. 182.

in figures 71 and 74. They consist of copper bands with a slight bulge or bevel or with encircling grooves. One of them (fig. 74, *c*) has decorated edges and one was gilded by the *mise en couleur* process. This form also occurs in Oaxaca.

Analyses of these rings are given in table XXIII. With the small amount of comparative material at present available, it is not possible to determine where they were manufactured.

COPPER BELLS

Bells of cast copper and copper alloys were dredged from the Cenote of Sacrifice in great numbers (figs. 76 and 81). In fact they comprise the largest group of metal objects recovered. In addition to the several hundred specimens in the Peabody Museum, there are about a hundred others in the museum in Mérida, Yucatan, and there are four in the Southwest Museum, Los Angeles, California.[10] From the shapes of the bells and their composition it is sometimes possible to determine the place of origin, which was Mexico or Honduras.

New World bells fall into several categories. The simplest types consist of square metal sheets, rolled to form a narrow cone or pinched at the corners to make a shallow depression. Both have suspended clappers. The first group comes from northern Mexico and the southwestern United States.[11] The second group is from the Diaguita area in northwestern Argentina, adjacent portions of Chile [12] and the coast of Peru. In this area there also are large bells, oval in section with insloping sides, a flat top and suspended clappers. They are made of cast bronze or of wood. It is probable that they were worn by llamas.[13]

A different type of bell has a resonating chamber completely enclosed except for a slit, through which a loose pellet is inserted. This corresponds to our sleigh bell and in reality is a metal rattle. The normal suspension of these bells is by a loop in the top. This type is found from the southwestern United States to Peru [14] with scattered examples occuring as far south as Chile.[15] All Cenote bells are of this type.

There are two variants of the rattle bell which might well have but actually did not reach the Cenote except in gold. One form, found in southern Mexico,[16] has no loop and hangs from two holes in the top. In another type the loop is replaced by a handle or a tang for the insertion of a handle. It occurs on the north coast of Colombia (fig. 87), in the Province of Coclé, Panama,[17] Costa Rica (fig. 108, *b*, *d*) and in the States of Sinaloa [18] and Michoacan,[19] Mexico.

Most Cenote bells probably come from the central Mexican plateau and adjacent Mixtec, Zapotec and Tarascan areas. This region, together with Yucatan, has produced most of the surviving codices, in which bells are frequently depicted. They are shown in Maya manuscripts on wrists and calves, attached to bars worn on the chest, on necklaces, on shields, on belts and on headdresses.[20] Schellhas [21] has pointed out that bells are associated with the Death god in the Maya codices. Landa [22] states that after the Conquest the Yucatecans paid fines with "small bells and hawk bells of copper which they had from the time of their unbelief."

It is not yet possible to state where or when bells were first made in the New World; the one positive statement which can be made is that nowhere can great age be claimed for them. In Peru, early metalworking cultures such as Chavín and Nasca did not produce bells. Chavín figurines of soldered sheet metal may contain a pellet which rattles, but this is not a true bell. The most ancient Peruvian bells now known date from the Gallinazo period (ca. 850 A.D.),[23] but most dated specimens are from the Inca period and are of bronze rather than copper.[24] In Ecuador, metal was worked at an early period but no bells of comparable date are known.[25] We have no chronological data for Colombia, western Panama and Costa Rica. At the Sitio Conte in Coclé bells come from the earliest graves, dating perhaps from the thirteenth century.[26]

In Mexico, the home of the Tula-Toltec, bells probably were introduced together with the knowledge of metalworking. Vaillant [27] wrote: "Metallurgy seems to have arrived late in Mexico, certainly not before the eleventh century. Mentions of copper in Toltec times refer more probably to the Dynastic (Tula-Toltec) period than to that of Teotihuacan. I know of neither copper nor gold which comes from the early or middle periods of the great Middle American civilizations, although some hollow clay bells from the late (Teotihuacan) Toltec occupation at Azcapotzalco tantalizingly suggest metal prototypes." The evidence of the Tula-Toltec disks from the Cenote, however, is that metals were known in central Mexico a little earlier than had been supposed. The published archæological record in central Mexico reveals no bells definitely older than the Aztec period. Thus bells found by Gamio [28] at Teotihuacan dated from the Aztec rather than the classical period. Specimens from Tenayuca also were Aztec.[29]

In table V we give analyses of copper bells from the Valley of Mexico, which fall into three groups, one alloyed with lead, another with tin and a third of fairly pure copper. In addition to the bells analysed and published by Arsandaux and Rivet, fifteen others contained lead in approximately the quantities indicated.

A great many Tarascan metal artifacts have recently been brought to light as a result of excavations at Tzintzuntzan and Cojumatlan in the State of Michoacan. This region yielded many gold and silver objects at the time of the Conquest but the archæological finds consist largely of copper tools, perhaps the most important development of this kind north of Peru. There are, however, a large number of copper bells of the circular and wire-like types (A and F).[30] No analyses have been published but it is probable that the Tarascans contributed to the finds in the Cenote of Sacrifice.

Gold bells have been found in great numbers in the State of Oaxaca and presumably many copper specimens were manufactured but they have not been placed on record. In table VI we give the analyses of various copper objects from Oaxaca, only one of which (108) is a bell.

Farther to the northwest, copper bells occur in considerable quantity. Ekholm,[31] who recovered one hundred and eleven specimens at Guasave, Sinaloa, notes a general resemblance to others from the State of Mexico, Jalisco and the southwestern United States. McLeod has analysed copper found by Kelly at Culiacan in Sinaloa.[32]

[10] Watkins, 1944, p. 23.
[11] For a recent bibliography, see Haury, 1947.
[12] Ambrosetti, 1904, figs. 43, 46. Latcham, 1938, fig. 146, 2, 3. Debenedetti, 1910, figs. 173, 174. Nordenskiöld, 1921, fig. 26, *a*.
[13] Ambrosetti, 1904, figs. 66, 67, 68.
[14] Baessler, 1906, taf. 34, figs. 513, 519.
[15] Latcham, 1938, fig. 146, *6*, 7.
[16] Aguilar P., 1946, lám. IV, A 1. Bergsøe, 1938, pl. III, *15*.
[17] Lothrop, 1937, figs. 74, 75.
[18] Ekholm, 1942, fig. 19, *h*.
[19] Kelly, 1947, fig. 80, *N*; pl. 20, *B*.
[20] Codex Dresden, II, III, V, XLIII. Codex Troano, XIV, XXXIV. Codex Cortesianus, XVI, XXVIII, XXX. Codex Peresianus, 22.
[21] Schellhas, 1904a, p. 11; 1904b, figs. 118, *g*; 126, *h–k*.
[22] Tozzer, 1941, p. 80, footnote 342.
[23] Bennett, 1939, p. 71; 1946, p. 80.
[24] Nordenskiöld, 1921, figs. 19, *b*; 44, 1, 3, 8.
[25] Jijón y Caamaño, 1927, pp. 144–45.
[26] Lothrop, 1937–41, part II, p. 263, table VI.
[27] Vaillant, 1941, p. 148.
[28] Gamio, 1922, vol. 1, lám. 137, *c*.
[29] Noguera, 1935, lám. LVII, 9–10.
[30] Acosta, 1939. Borbolla, 1944. Aguilar P., 1946. Lister, 1949.
[31] Ekholm, 1942, pp. 97–100.
[32] McLeod, 1945.

Copper bells have been found in the southwestern United States from the Mimbres, Tonto Basin, Tucson and Flagstaff districts and in excavations at Snaketown,[33] where they are placed in the Sacaton Phase, dating from about 900–1100 A.D. They thus are among the most ancient copper bells to which a satisfactory age can be assigned. The forms are similar to bells from Casas Grandes in northern Chihuahua [34] and to various bells from other parts of Mexico.

It has generally been assumed that the copper bells from the Southwest were imported from Mexico.[35] The analyses by Dr. W. C. Root which we published in table XIII reveal two types of ore, each with silver in varying amounts as the principal impurity. No copper-tin or copper-lead alloys are recorded. In other words, the composition of the bells from Arizona and New Mexico is unlike that of any central Mexican artifacts now on record. This does not mean that they are not importations but, if so, their source has still to be demonstrated. It is possible that some trader taught the art of casting.

Clappers, with a few exceptions of metal, consist of small stones. They may have been incorporated in the clay core which was subsequently broken to free them or they may have been inserted after manufacture by bending the slit.

Cenote bells must have come from many localities. The forms, which we shall now describe, are almost always known somewhere else but there is no other single district in which so many different shapes occur. In other words, the Cenote has yielded an epitome of Middle American copper bells.

Style A (Spherical). This series, illustrated in figure 75, *a*, and 76, *a*, consists of spherical bells with loops on top and a slit on bottom. This opening extends around approximately half the circumference and usually is wider at the ends than in the middle. The clapper, if present, is of stone. The fact that so many bells have no clapper raises the thought that they may have been purposely silenced before they were thrown into the Cenote of Sacrifice.

TABLE XXIV: IMPURITIES IN COPPER BELLS OF STYLE A *

Analysis Number	Catalogue Number	Lead	Tin	Silver	Gold	Iron	Arsenic	Antimony	Bismuth	Remarks
47	C/4872	>4.0	1.0	>2.0	.1	.2	.4	.1	.01	...
30	...	1.04	.7	2.0	.0001	.14	.42	.02	.06	Bell and ring the same
48	C/4872	.01	.2	2.0	...	.1	.0001	...	.005	...
3	C/4872	> .07	.1	2.08	...	.23	.01	...	.11	...
34	...	.1	.01	.1	.01	.1	.01	.01	.01	...
51	C/4872	.01	.1	1.0	.1	.1	.0001	...	.01	...
35	...	.5	.4	.1	...	.1	.2	.05	.005	...
87	...	.5	.1	.1	.0001	.01	.04	.05	.01	...
52	C/4872	.01	.0001	.1	...	.1	.1	.01	.01	...
49	C/4872	.01	.01	.1	...	.001	.1	...	.01	...
50	C/4872	.01	.1	.01	...	...	...	...	(?)	...
9	C/6007	...	.1	.1	...	...	.1	.05	...	...
53	C/4872	.0001	...	.1	...	...	...	...	...	...

* No platinum, chromium, calcium, germanium, zinc or cobalt.

Turning now to the Cenote bells, we obviously cannot hope to date individual specimens until there are stratigraphic and chronological data from the areas of manufacture. On the other hand, the Cenote affords evidence that bells were produced while Maya art of the Great period still flourished. This comes from the battle scenes on gold disks which combine Maya and Tula-Toltec styles. Many of the warriors wear bands of bells on the legs below the knee (fig. 26). The art of casting and the manufacture of bells in Mexico therefore extends back to the end of the tenth century. This is in accord with Stanley Bogg's finds at Tazumal in El Salvador [36] and the tree-ring dating in Arizona and New Mexico.

All the Cenote bells were cast *á cire perdue* over a clay and charcoal core, subsequently extracted through a slit in the base. Traces of the core may be seen in many broken examples. Specimens from central and western Mexico often were built up by spiral wax threads, regularly spaced, which were not smoothed down (fig. 86). Microphotographs show definitely that this is not a soldering technique, as the interior structure is homogeneous (fig. 112). Bells with smooth surfaces may have been manufactured in the same fashion to insure uniform thickness of walls. How the liquid metal was poured we do not know. It is obvious, however, that there was a vent on the top of the loop, for many specimens exhibit a small projecting knob. There also is a suggestion of a vent at the base of one specimen (fig. 84, *j*).

Bells of this shape made of copper occur in western and northern Mexico as well as in the southwestern United States. Gold examples found in the Cenote have their shape slightly modified by the insertion of a small circular platform under the suspension ring (fig. 103, *b*), a type also found at Monte Alban.[37] The gold specimens from the sacred Cenote probably were imported from Panama.

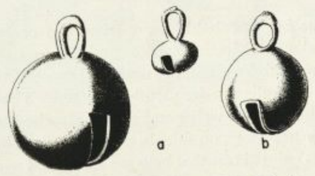
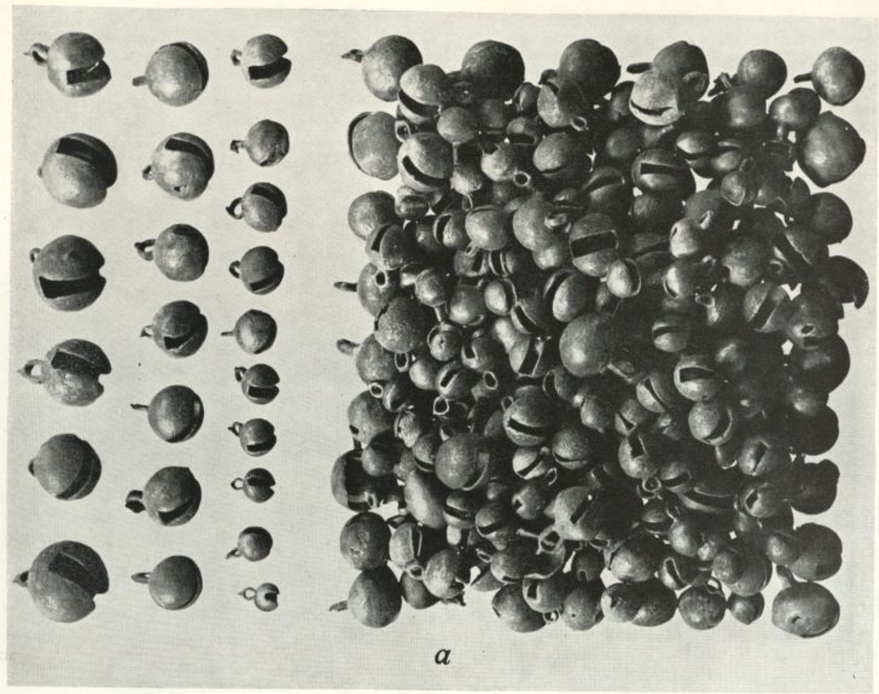


Fig. 75. *a*, Copper bells, Style A; *b*, copper bell, Style A1. Actual size.

The composition of bells of this series appears in table XXIV. It will be noted that the first four specimens contain about 2 per cent silver as an impurity. The first two specimens also have a considerable amount of lead, which may have been added as an alloy. The others, with one exception, are more than 99 per cent pure copper.

[33] Gladwin, 1937, p. 108.
[34] I am indebted to Dr. A. V. Kidder for photographs of bells in the Gila Pueblo collection.
[35] For a recent discussion, see Haury, 1947.
[36] Verbal information in Kidder, 1948.
[37] Aguilar P., 1946, lám. V, C 1.



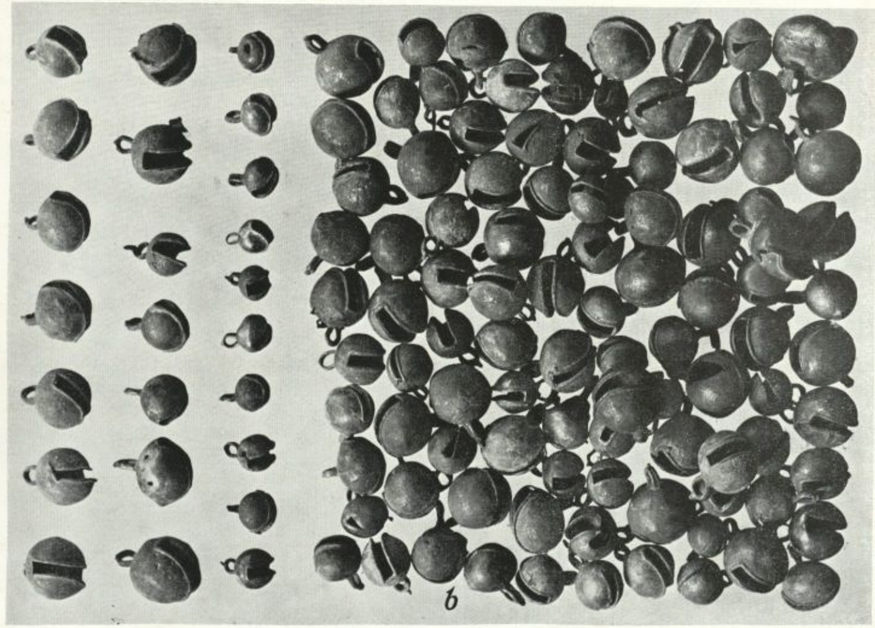


Fig. 76. Copper bells. *a*, Style A; *b*, Style A1. Scale, ca. 2/3.

Style A1. This group, shown in figures 75, *b*, and 76, *b*, is spherical like Style A, but has the opening reinforced by a wire-like lip cast integrally with the body.

Analyses are given in table XXV. The first six specimens are remarkably alike and all are probably made from the same ore. The lead must be a conscious alloy but other metals appearing in considerable quantity, such as silver and arsenic, must be impurities. This group approximates analyses 30 and 47 in table XXIV.

TABLE XXV: IMPURITIES IN COPPER BELLS OF STYLE A1 *

Analysis Number	Catalogue Number	Lead	Tin	Silver	Gold	Iron	Arsenic	Antimony	Bismuth	Remarks
45	...	2.0	.41	2.0	...	.1	>1.0	.1	.1	Bell and ring the same (stone clapper)
44	...	2.0	.2	2.0	...	.01	>1.0	.1	.05	"
46	...	2.0	.2	2.0	...	.01	>1.0	.1	.1	...
32	...	2.0	1.0	1.0	1.0	.1	>1.0	.05	.05	Bell and ring the same (stone clapper)
83	...	2.0	.1	1.0	.01	.1	.4	.05	.01	...
84	...	2.0	.1	1.0	.01	.1	.4	.01	.01	...
87	...	.5	.1	.1	.0001	.01	.2	.05	.01	...
86	...	.5	...	.1	...	.0001	.4	.05	.01	...
85	...	.01	.1	.1	.0001	...	.1	...	...	...

* No platinum, nickel, chromium, calcium, germanium, zinc or cobalt.

Bells of similar shape have been found in quantity at the famous "bell cave" near the Chamelecón River in Honduras (p. 24). Analyses of Type A1 bells from the bell cave appear in table XVI. The metal is almost pure copper, comparable to analyses 9 and 53 in table XXIV and analyses 85 in table XXV. Most of the Cenote specimens then probably did not come from Honduras but a few of them may have.

Fig. 77. Copper bell, Style B. Actual size.

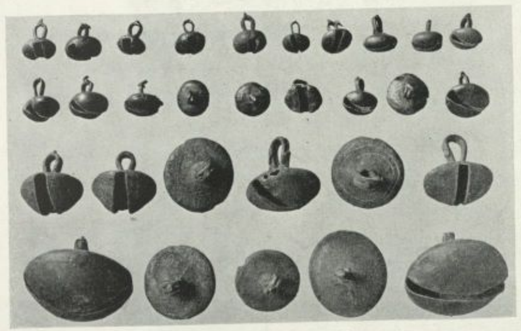


Fig. 78. Copper bells, Style B. Scale, ca. 2/3.

Some of the Cenote specimens are similar to those from Honduras but I do not think there is sufficient evidence to prove their point of origin.

Fig. 79. Copper bell, Style C. Actual size.

Style C (Flat shoulder, round body). This is a relatively small group, distinguished by flat, sloping shoulders and a rounded body (fig. 79). At present there is no indication where this type of bell was manufactured .

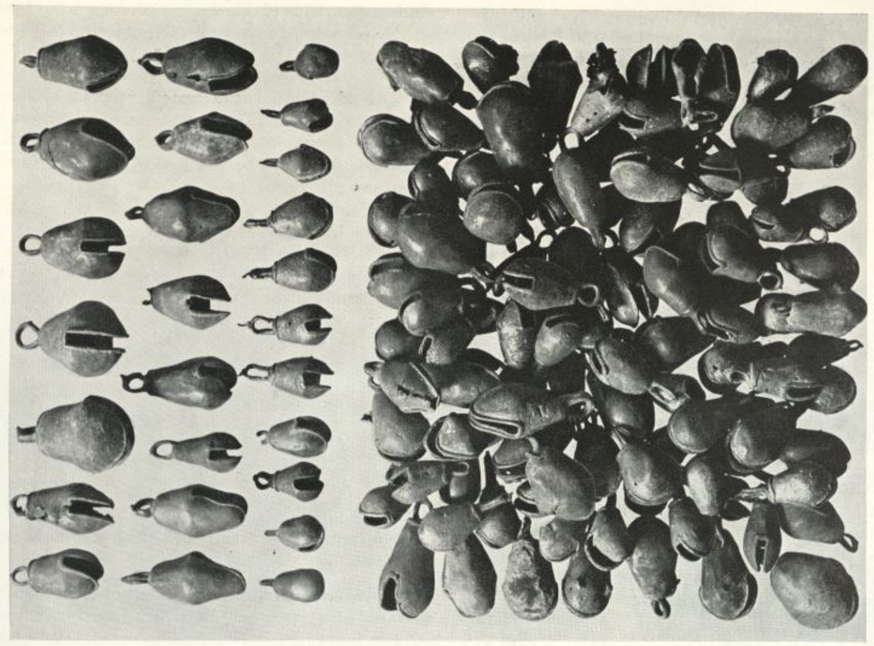
Fig. 80. Copper bells, Style D. Actual size.

Style D (Pear-shaped). This large group, of which there are six principal variants, may be described as pear shaped. These types, with one exception, are Mexican but the place of origin cannot yet be determined. The simplest form appears in figures 80 and 81, *b* – except the four specimens in the center of the left-hand row.

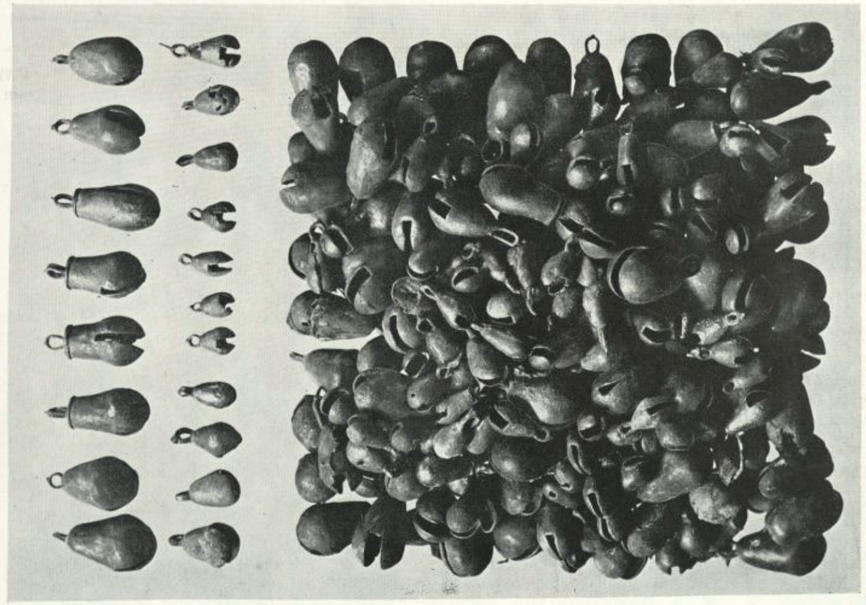
TABLE XXVI: IMPURITIES IN COPPER BELLS OF STYLE B *

Analysis Number	Catalogue Number	Lead	Tin	Silver	Gold	Iron	Arsenic	Antimony	Bismuth
74	C/4866	.01	.2	.1	...	.01	.1	.05	.0001
76	C/4867	.005	.2	.01	...	...	.01	.05	.0001
75	C/4867	.01	.1	.01	...	.01	.1	.05	...
77	C/4867	...	.01	.01	...	.005	.01	.01	...
73	C/4867	...	.1	.01	...	...	.01	.01	...
20	C/4865	.01	...	.1	...	.2	...	...	...

* No platinum, nickel, chromium, calcium, germanium, zinc or cobalt.



a



b

Fig. 81. Copper bells of Styles D, D1, D2 and D3. Scale, ca. 2/3.

Style D1. This type is similar to D except that the mouth is reinforced by a wire which was cast integrally with the body of the bell. The two forms have the same relationship as Styles A and A1. An additional characteristic of D1 bells is that the loop at the top usually is double, as seen in figure 82. This trait also occurs in many other forms of bells (figs. 83–85) but is not found in the wire-wound bells and is rare in Styles A, B and C.

FIG. 82. Copper bell, Style D1. Actual size.

Style D2. This group of bells is illustrated in figure 81, *a*, *middle row*. The treatment of the mouth is similar to the D1 bells but the mouth itself is elongated, resulting in a slight bulge in the center. This is not a common form.

Style D3. A large and widely distributed class of pear-shaped bell has a platform on top of which the ring for suspension is placed (fig. 83, *b*). Elongated gold bells of this style are typical of Mixtec jewelry such as was found in tomb 7 at Monte Alban. Copper examples are on record from Arizona,[38] the Mexican states of Tampico,[39] Sinaloa [40] and Michoacan,[41] also Guatemala (fig. 8) and the Bay Islands off Honduras.[42]

Style D4. There are two types of decorated pear-shaped bells, each represented by about a dozen and a half specimens at Chichen Itza. One of these, illustrated in figures 83, *c*, and 84, *e*, *g*, *h*, has incised decoration of simple type. With an exception in figure 84, *e*, this is confined to a band encircling the bell just below the shoulder.

Style D5. The second decorated group has cut-out designs just below the shoulder. The commonest form appears in figure 83, *a*, which represents one of seven almost identical specimens. Figure 84, *b*, shows a bell adorned with flat loops and a spiral appears in figure 84, *f*.

Thirty-three analyses of pear-shaped copper bells are given in tables XXVII and XXVIII. With the exception of three specimens in Styles D and D3 there are no alloys. Two of them are a copper-lead and the other a copper-tin alloy. This clearly indicates that the pear-shaped bells did not come from the Valley of Mexico where most bells were of bronze or a copper-lead alloy.

FIG. 83. Copper bells of Styles D3, D4 and D5. Actual size. See table XXVIII, analysis 27.

The impurities in pear-shaped copper bells from the Cenote of Sacrifice present a pattern which suggests that they were made of very similar ores and that they all may come from a single district. Thus all of them have silver, but only four have more than one per cent. All but three specimens also contain lead and arsenic in small quantity. Over two-thirds have small amounts of tin, antimony and bismuth. On the other hand, gold and iron often are absent or occur in minute quantities.

TABLE XXVII: IMPURITIES IN UNDECORATED PEAR-SHAPED COPPER BELLS, STYLES D, D1, D2, D3

Analysis Number	Catalogue Number	Lead	Tin	Silver	Gold	Iron	Arsenic	Antimony	Bismuth	Remarks
72	C/4848	>4.0	0.1	0.1	...	0.1	0.4	.05	.01	Style D
61	C/4947	0.1	>2.0	0.1	0.1	.01	.01	.05	.05	"
68	C/4542	0.1	1.0	0.1	...	...	0.1	.01	.005	"
70	C/6010	0.1	...	0.1	...	...	0.1	...	.01	"
62	C/4947	0.1	...	0.1	...	...	0.1	0.5	0.1	"
8	(?)	.01	.12	.001	...	...	0.4	0.2	.06	"
59	C/4947	.001	0.1	0.1	...	...	0.1	0.5	0.1	"
60	C/4947	0.1	...	0.1	...	...	0.1	0.5	0.1	"
69	C/4845	.0001	...	0.1	...	...	0.1	...	.005	"
4	C/4947	.05	.16	2.72	...	...	0.1	.05	.17	Style D1
28	(?)	...	0.1	2.0	...	0.1	0.4	.001	.0005	"
43	(?)	0.5	0.2	1.0	...	.01	>1.0	0.1	.01	"
23	(?)	.04	.17	0.1	0.1	.01	.44	0.1	.01	"
25	(?)	.02	.72	.03	0.1	.18	.87	.16	.04	"
33	C/4847	0.1	.01	1.0	.01	0.1	.01	.05	.01	Style D2
11	C/4847	0.1	0.1	0.1	0.1	.17	.01	.05	.005	"
24	C/4847	.01	0.2	0.1	...	0.1	0.1	...	.0001	"
10	C/6015	4.22	.24	.16	.001	.21	.36	.14	0.1	Style D3
57	C/4876	.01	.01	1.0	...	.01	.01	.001	0.1	"
27	C/4876	.001	...	.01	.0001	.001	.0001	.0001	...	"
56	C/4876	.01	.01	0.1	...	...	.01	.001	...	"
26	(?)	.0001	.01	1.0	...	.0001	.01	...	...	"
85	C/1876	.01	0.1	0.1	.0001	...	0.1	...	...	"
55	C/4876	.0001	0.1	2.0	...	...	.001	...	...	"
39	(?)	...	...	1.0	...	...	0.1	...	...	"
54	C/4876	.0001	...	0.1	...	...	...	...	...	"

[38] Haury, 1947, pl. IX.
[39] Ekholm, 1942, fig. 19, *g*.
[40] Ekholm, 1944, fig. 51, *a*, *b*.
[41] Aguilar P., 1946, lám. IV.
[42] Strong, 1935, pl. 17.

In the course of time, when many more analyses are available, it should be possible to locate the region where bells of D styles were manufactured. At present we have practically no data at all from important centers of metalworking such as Guerrero, Michoacan and Chiapas (table VI). We also lack data from Vera Cruz and Tabasco. We call attention somewhat dubiously to analyses from Oaxaca in table VI. Individual specimens, including a bell, are very similar to the pear-shaped bells from the Cenote. In the Oaxaca copper, silver is present, gold is absent and iron is rare. The other metals do not occur as frequently as in Cenote specimens.

TABLE XXVIII: IMPURITIES IN DECORATED PEAR-SHAPED COPPER BELLS, STYLES D4 AND D5

Analysis Number	Catalogue Number	Lead	Tin	Silver	Gold	Iron	Arsenic	Antimony	Bismuth	Remarks
81	C/5999	0.1	0.1	.01	...	.01	0.2	0.1	.01	Style D4
82	C/4557	.01	0.1	.01	...	0.1	0.1	.05	.0001	"
79	C/6908	.01	0.1	.01	...	.01	0.2	.05	.005	"
80	C/4858	.01	...	.01	...	.01	.01	.01	...	"
78	C/4966	.01	...	.01	...	...	.01	.01	...	"
29	C/6015	...	...	.01	...	...	...	...	...	" Figure 84, *g*
27	C/6008	.005	.0001	2.0	.01	.001	0.2	.01	.0001	Style D5, Figure 83, *a*

Style E (Head-effigy). This unit consists of small head-effigy bells. The commonest forms is globular and represents a jaguar (fig. 84, *a*, *i–l*). Nineteen of these were recovered from the Cenote. Human heads are of three types. In one (fig. 85, *e*) the mouth of the head is the mouth of the bell. Another (figs. 84, *d* and 85, *a*) has the mouth of the bell at the base and the rounded mouth of the head projects from the side. A third type has a face crudely

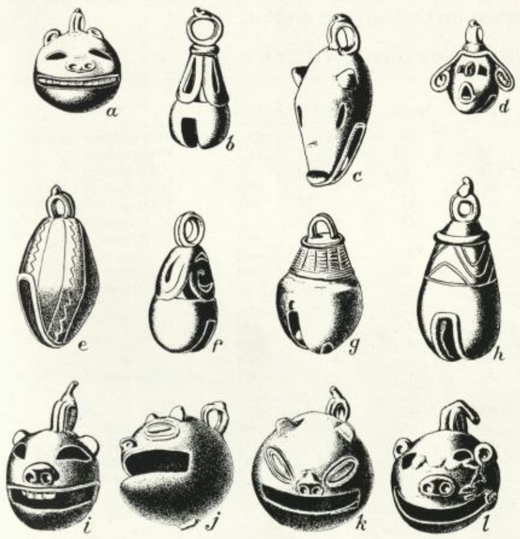


FIG. 84. Copper bells of Styles D4 (*e*, *g*, *h*), D5 (*b*, *f*) and E. Actual size. See tables XXVIII, analysis 29; XXIX, analyses 68–70.

indicated on the shoulder of the bell (fig. 85, *f*). Other animals include dogs (figs. 84, *c*, and 85, *c*) and birds (fig. 85, *b*).

Analyses of cat-face specimens are presented in table XXIX. They are unlike any copper yet discussed, for they contain no gold or iron and little antimony. We do not know where they were manufactured.

Style F (Wire-like). "Wire-like" copper bells of various styles are illustrated in figure 86. The name is misleading because, while they appear to be made of wire soldered together, in fact they were

FIG. 85. Copper effigy bells, Style E. Actual size.

cast as a unit. This can be seen in the magnified section appearing in figure 112, which shows the uniformity of a casting. These bells were doubtless made by winding wax threads around a core of the desired shape until the body was completed, cutting out the mouth, adding the loop and decorations, and then casting by the *cire perdue* method. The advantage of this technique is that it insures walls of uniform thickness. It is possible that most if not all bells were built up by this method and the outer walls usually were smoothed.

Apart from the Cenote of Sacrifice, wire-like bells have been found in quantity in the Valley of Mexico and in the State of

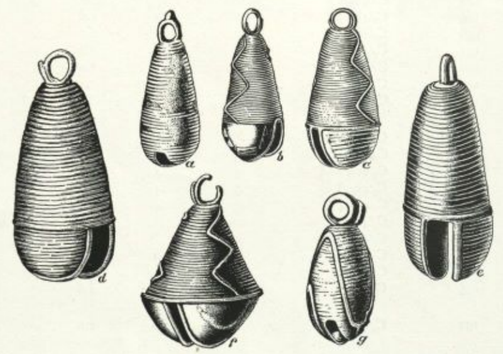


FIG. 86. Wire-like copper bells, Style F. Actual size. See table XXX, analyses, 64, 139, 140, 145, 146, 151.

Michoacan. They are also on record as far north as the United States. Examples, however, occur far to the south, but not in quantity. They have been reported from the northwestern portion of Honduras and from the vicinity of Guapiles in northeastern Costa Rica.[43] We illustrate in figure 87 an example in high-grade copper from the north coast of Colombia, which has a solid handle. Two specimens, one of copper and the other of *tumbaga*, are on record from Antioquía in Colombia.[44]

The fact that wire-like bells were manufactured in South America suggests that the technique may have been invented there and introduced to Mexico with the knowledge of metallurgy. At any rate, the greatest production took place in Mexico and with it came the introduction of a new alloy containing copper and lead. Rivet[45] found that 32 per cent of one hundred and fifty-three copper specimens from Mexico contained tin and were bronze, but our tables V and XXX indicate that 50 per cent or more of the wire-like bells are of copper and lead while only a few are of bronze.

TABLE XXIX: IMPURITIES IN CAT-FACE COPPER BELLS, STYLE E

Analysis Number	Catalogue Number	Lead	Tin	Silver	Gold	Iron	Arsenic	Antimony	Bismuth	Remarks
68	C/4842	0.1	2.0	0.1	...	...	0.1	...	.005	Figure 84, *i*
71	C/1245	0.1	0.2	0.1	...	...	0.1	.01	...	...
70	C/6010	0.1	...	0.1	...	...	0.1	...	.01	Figure 84, *j*
69	C/6011	.0001	...	0.1	...	...	0.1	...	.0001	Figure 84, *l*

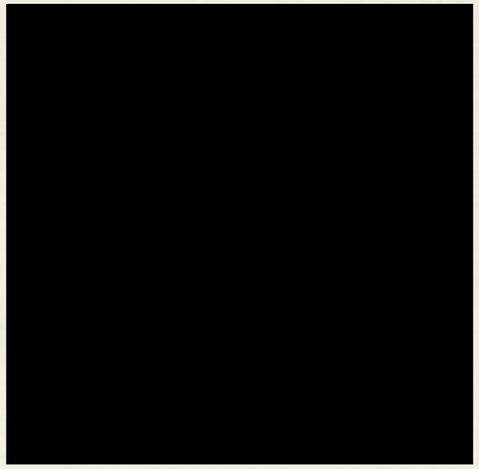


Fig. 87. Wire-like copper bell. North coast of Colombia. Actual size. Collection of Mrs. Roger Stone.

In table XXX we have placed the analyses in three groups, consisting of a copper-lead alloy, native copper and bronze. The silver content indicates two distinct ores, one with 2.0 per cent and the other with 0.1 per cent silver. The latter figure is typical of the Valley of Mexico (table V). We have only five analyses of copper from Guerrero but there exists an ore which contains 2.0 per cent silver (table VI). Our analyses from Michoacan contain 0.1 per cent silver. Until more analyses of Mexican specimens are available, all we can say is that the Cenote wire-like bells probably all came from that country and probably most of them from the Valley of Mexico.

Almost all wire-like bells are pear-shaped. The simplest type, seen in figure 86, *a*, has no decoration.

Style F1. This group has the mouth reinforced by a wire-like thickening of the rim. The example in figure 86, *d*, like many others, has the loop partly doubled.

TABLE XXX: ANALYSES OF WIRE-LIKE BELLS OF COPPER, STYLE F*

Analysis Number	Catalogue Number	Lead	Tin	Silver	Gold	Iron	Arsenic	Antimony	Bismuth	Remarks
7	C/5987	21.76	.12	.23	...	...	.16	.14	.01	Ring and bell the same
G	C/5909	18.9	(?)	Tr.	...	Tr.	(?)	(?)	(?)	Fiske analysis
D	C/5415	19.3	(?)	Tr.	Tr.	Tr.	(?)	(?)	(?)	Trace of silica
140	C/4856	>4.0	4	2.0	...	.001	4	.1	.001	No clapper (fig. 86, *b*)
139	C/4855	>4.0	4	2.0	...	.001	4	.1	.001	No clapper (fig. 86, *f*)
138	C/4855	>4.0	4	2.0	...	.1	4	.001	...	No clapper
141	C/4856	>4.0	.1	2.0	...	.1	.1	.05	.001	No clapper
150	C/6022	>4.0	...	2.0	...	...	.1	.001	.001	No clapper
149	C/6022	>4.0	...	.1	...	.1	.1	.001	.001	No clapper
151	C/6022	>4.0	...	.1	...	.001	.1	.001	...	No clapper (fig. 86, *c*)
65	C/6022	.5	.1	.1	.0001	.01	.2	.05	.01	...
66	C/4854	.5	.1	.1	.0001	.01	.2	.01	.005	...
31	C/6022	.5	.1	.2	...	.001	4	.2	.001	...
143	C/4958	.5	4	2.0	...	.1	.1	.05	...	No clapper
136	C/4854	.5	4	2.0	...	.1	4	.05	...	...
67	C/4852	.01	.1	.1	.001	.01	.2	.05	.01	...
142	C/4856	.01	...	.1	...	...	.05	.05	.001	No clapper
64	C/4853	.01	1.0	.01	...	.01	.1	.01	...	Figure 86, *e*
146	C/6017	...	.1	.1	...	.001	.1	.001	.01	Stone clapper (fig. 86, *g*)
145	C/4967	...	...	2.0	...	.1	.001	.05	...	No clapper (fig. 86, *a*)
137	C/4854	.01	>2.0	2.0	...	.1	.1	.001	...	Stone clapper (bronze)

* No platinum, nickel, chromium, cadmium, germanium, zinc or cobalt.

[43] Information from Mrs. Doris Stone, who kindly allowed me to sketch the specimen in figure 87. The Guapiles region yields many trade products including jewelry from Veraguas and Coclé and polychrome pottery from Cartago and Guanacaste. This is indicated by collections in the Museum.

[44] Créqui-Montefort, Rivet *and* Arsandaux, 1919, pl. VIII, 3, 5; analyses 4 and 27.

[45] Rivet, 1946, p. 18.

Style F2. Many bells have the thickened lip joined to a band which encircles the body of the bell at its maximum diameter, as in figure 86, *e*.

Style F3. In many cases, the body of the bell above the band just mentioned is decorated by raised zigzags evidently reproducing threads of wax. Examples are illustrated in figure 86, *b*, *c*.

Style F4. The specimen in figure 86, *g*, has no dividing band but the entire surface is covered by zigzags.

Style F5. The groups so far considered all have been pear-shaped. Figure 86, *f*, shows a bell with flat, sloping shoulders and a rounded under-body. This shape corresponds to what we have called Style C in the bells with smooth surfaces. In this case, the shoulders show coils and are decorated by zigzags.

OBJECTS OF CAST GOLD

Cenote specimens of cast gold or of *tumbaga*, a gilded gold-copper alloy which appears to be of gold, form two-thirds by weight of the total gold recovered. Practically all artifacts of cast gold were manufactured in Panama. Most of them are in the style of Veraguas but a few are of Coclé types. One specimen is from Colombia, another perhaps from Costa Rica. There is only one cast-gold object which can be attributed to Mexico, which is curious as a lot of cast copper reached Chichen Itza from that country.

Electrolysis and Corrosion. Corrosive data based on commercial experience are generally regarded as trade secrets and are seldom made public, yet many facts are of common knowledge. In the light of these we shall discuss the copper-gold alloys from the Cenote, which are much better preserved than those from the points of origin, notwithstanding the pummeling of individual specimens before sacrifice and the rough treatment received during dredging operations.

the Cenote. We have seen that the chalky water of the Cenote was beneficent to copper, but the copper in the gold alloys did not come in contact with the water owing to the exterior skin of high-grade gold. The answer probably is that the Isthmanian specimens has been subject to electrolysis, or decomposition by the action of electric current.

Contact of one of the noble metals, such as gold or silver, with a baser metal, such as copper, under certain conditions forms a galvanic cell, and the baser metal becomes an anode or positive terminal. Once copper salts have appeared, electrochemical corrosion will proceed rapidly. Electrolytic action may be started in various ways, including: inequality of stress, local variants in composition, temperature differences, stray electric currents, foreign matter on the surface and formation of oxygen concentration cells.[1]

Re-use of Cast Gold. It has been suggested that the sheet gold from the Cenote of Sacrifice was shaped by Maya smiths by beating

TABLE XXXI: GOLD OBJECTS CONTAINING COPPER AS AN ALLOY (*TUMBAGA*)

Analysis Number	Catalogue Number	Object	Style	Copper	Gold	Silver	Remarks	Illustration
1261	C/7707a	Double human pendant	Coclé	77.8	19.4	2.8	...	Figure 92
1264	C/7707d	Human pendant	Coclé	55.2	41.9	2.9	...	Figure 89, *e*
1280	C/7726	Monkey pendant	Coclé	54.4	43.0	2.6	...	Figure 93, *c*
1272	C/7715b	Figurine	(?)	51.7	46.5	1.8	...	...
1259	C/7704	Pendant, human figure	Coclé	50.0	47.3	3.0	...	...
1276	C/7723	Large pendant, human figure	Coclé	46.6	48.8	4.6	...	Figure 89, *g*
1252	C/7669	Bell	Veraguas (?)	41.7	48.6	9.7	$\frac{\text{Ag.} \times 100}{\text{Au.} + \text{Ag.}} = 16.6$	...
1255	C/7697	Pendant, human figure	Coclé	37.8	52.0	10.2	" = 16.4	Figure 89, *f*
1279	C/7724	Figure	(?)	36.3	60.0	3.7	...	...
1237	C/7663b	Bell	Veraguas	34.4	61.6	4.0	" = 6.1	Figure 102, *a*
1263	C/7707c	Human head from pendant	Coclé	32.7	65.5	1.8	...	Figure 89, *a*

Nearly all copper-gold specimens from the Cenote were manufactured in Panama — in the Provinces of Coclé and Veraguas. They have been treated by the *mise en couleur* process by which the surface copper is removed chemically, leaving a skin of high-grade gold. In the Isthmus, especially in Veraguas, the interior core often has turned black and has the consistency of charcoal. Only high-grade gold is not affected, but one specimen thus corroded contained over 80 per cent gold and two others over 70 per cent. Gold grains in the black material are visible under the microscope but not to the naked eye. *Huaqueros* in Panama, having melted up broken objects, have been surprised at the amount of gold recovered from the black interior and consequently have increased the price on what they call "carbon" specimens.

It is obvious that there is some factor in the soil of the Isthmus which affects copper-gold alloys and is not present in the water of

out the sheets from imported cast artifacts of Isthmian origin. In tables XXXI–XXXV it will be noted that slightly over half of the specimens are of metal suitable for manufacturing gold disks.

We regard the prospect of local manufacture and re-use of cast metal as extremely improbable. The Maya could not have selected the proper gold by eye, for all specimens had a surface of equal quality. They were not chemists and they could not have detected the interior contents of copper and silver in many pieces any more than the Isthmian tribes could have foreseen that some of their products would be subject to electrolysis. The beating of metals presupposes a knowledge of annealing, and there is no evidence that the Maya ever possessed this. Analyses show that the sheet gold is of very high-grade and uniform quality. On this local designs could easily have been pressed by simple means.

COLOMBIAN GOLD

Of all the imported metal artifacts found in the Cenote of Sacrifice, the gold pendant shown in figure 88 must have traveled the farthest, for the style is well known in the Cauca Valley in the central Andes of Colombia, a region inhabited by the Quimbaya Indians at the time of the Conquest. Whether or not the style called Quimbaya should be attributed to that historic tribe we cannot say. At present there is a tendency to believe that it flourished several centuries earlier.[2]

[1] Gregg, 1934, p. 146. Addicks, 1940, p. 359.

[2] Bennett, 1944, p. 110, table 9.

The Museum possesses a number of Quimbaya gold objects found at the Sitio Conte in the Province of Coclé, Panama. They could be identified both by style and by the fact that the gold ores

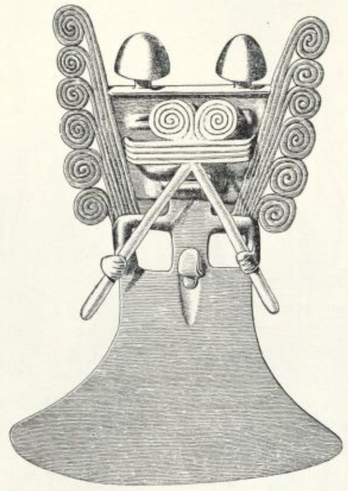


Fig. 88. Gold pendant in Quimbaya style. Actual size. (The three top scrolls at the left are restored.)

of Colombia contain a higher percentage of silver as an impurity than those of Coclé.[3] Unfortunately most of these specimens were acquired by purchase. The few examples later secured by excavation in stratified graves were of the Early period at the Sitio Conte, dating perhaps a couple of centuries before the Conquest.

Quimbaya metalwork is distinguished by large burnished surfaces combined with delicate detail. Both technically and artistically it is outranked only by the finest products of Mexico and Peru.

The specimen in figure 88 belongs to a type of which a dozen or more are known,[4] most of them with unrecorded provenience. It is a fairly heavy casting. The face has coffee-bean eyes and the mouth is obscured by a projecting nose which covers the entire width of the face. On top of the head there are two mushroom-shaped ornaments. The rows of spirals flanking the face perhaps represent wings.

Neck, arms and torso appear below the face. The hands grasp two rods, the ends of which are held against the mouth. This is a well-known concept in southern Central America and has been interpreted as a flute player. It is found in pottery, stone and gold in Coclé, Veraguas, Chiriquí and Costa Rica, usually with only a single flute. Other examples from the Cenote appear in figure 89.

The hips and legs in figure 88 are replaced by a flat sheet of metal shaped like a celt or like a type of chopping knife found in Peru. It is probable, however, that it represents the tail of a bird which is often shown in this fashion in Veraguas. The whole specimen then symbolizes a flute-playing Bird-god whose function is now forgotten.

COCLÉ GOLD

A large number of gold objects have come from graves of the Province of Coclé, Panama, and have been described in recent years.[5] It has also been pointed out [6] that a considerable number of Coclé ornaments, both metal and agate, were traded to the west and north. They have been identified in Chiriquí, southern and eastern Costa Rica (fig. 108) and in the Mexican states of Oaxaca,[7] Michoacán [8] and Yucatan (figs. 89–94).

In the case of Yucatan, where there were no local minerals, it is easily understood that foreign jewelry was in demand and was imported. It is not clear, however, why Coclé products also turn up near the Pacific coast of southern Mexico in a region which produced perhaps the finest goldsmiths of the New World. Yucatan was accessible by sea from the southern gold fields but Oaxaca and Michoacán presumably were reached on foot. A possible explanation is that outstanding Mexican jewelry was manufactured only immediately before the Conquest. This would account for the importation of the cruder Coclé pieces at a slightly earlier date.

The question may well be asked how metal ornaments from the Cenote of Sacrifice can be identified as originating in the distant Province of Coclé. Several years ago, this problem was solved solely on the grounds of style.[9] This included figurine types and small details of dress. Most important, however, was the fact that Coclé figurines of metal almost always are hollow, cast in the round over a clay and charcoal core, whereas others are not, except in Mexico and Colombia. The styles of these three areas are so distinct that there is small chance of error.

A second approach to identification is through chemical analysis of metals, which will be discussed more fully in connection with Veraguas (p. 99). Experiment shows that similar ores or alloys, tabulated together without reference to the objects themselves, result in groups which have stylistic unity. Thus, as seen in table XXXI, all except two examples of *tumbaga* (gold-silver-copper alloy) prove to be of Coclé type.

Pendants. Coclé-style effigy pendants representing men appear in figures 89–92. These specimens had been savagely pounded and broken and, in the drawings, they are restored to their original appearance so far as possible. They fall into two principal classes, one of which consists of flute players, so-called (fig. 89, *c*, *e*), who appear to be blowing through a flute or ocarina. The other group comprises individuals who hold identical objects in each hand with the elbows at the sides and forearms parallel with the ground.

[3] Lothrop, 1937–42, part I, table XII.

[4] Kelemen, 1944, pl. 216. Also Museo del Oro, 1944, láms. 7–10; 1948, láms. 41–47. The last group are attributed to the Antioquía region in the Cauca Valley but, for some unknown reason, they are called "Chiriquí style."

[5] Lothrop, 1937–42, part I. Mason, 1943, figs. 35–38.

[6] Lothrop, 1950, pp. 85–88.

[7] Batres, 1889, lám. XIX. Saville, 1929, p. 283. Also, photographs of the Sologuren collection and two examples in the U. S. National Museum.

[8] Borbolla, 1944, fig. 4. For Mexican finds of Coclé style without provenience, see Caso, *et al.*, 1946, p. 3, *bottom*.

[9] Lothrop, 1937–42, part I, fig. 201.

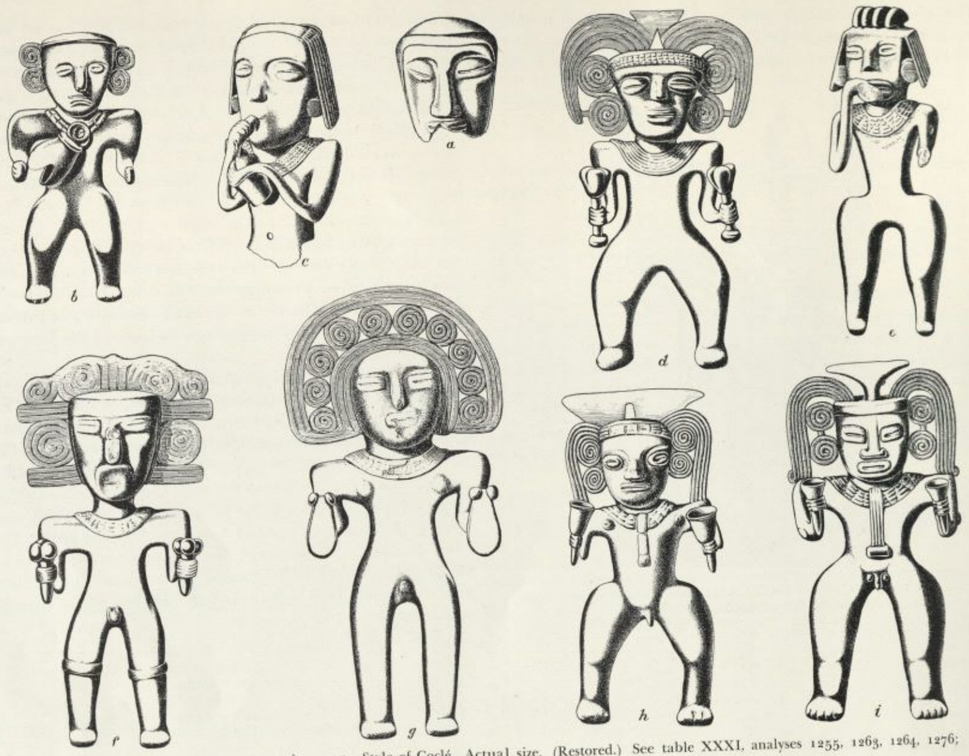


FIG. 89. *Tumbaga* pendants representing men. Style of Coclé. Actual size. (Restored.) See table XXXI, analyses 1255, 1263, 1264, 1276; table XXXIII, analysis 1255.

These objects in some cases may be definitely identified as rattles. The multiple form in figure 89, *d*, *f*, has been found in gold in Panama and is manufactured today by the Cuna Indians who attach gourds to a handle.[10] The double-headed, dumb-bell-like objects in figures 91–93 may be dance wands or some kind of double rattle. The individuals in figure 89, *h*, *i*, hold what looks like dinner bells. These correspond closely in form to metal plume holders from the coast of Peru (fig. 90).

No clothing is shown on any of the figurines but they all are adorned by various ornaments, of which the most conspicuous is a cap, often used as the base for an elaborate headdress. Figure 89, *c*, shows a specimen which may be an exception for apparently the hair has been shaved on top of the head and allowed to grow long at the sides. Rounded skull caps appear in figure 89, *a*, and 93, *a*. A pointed cap is shown in figure 91. Figure 89, *e*, illustrates a serrated headdress of a type found in quantity in bone and ivory at the Sitio Conte on figures of Crocodile gods. Figure 89, *d*, *f–i*, shows a series of large and elaborate headdresses which frame the face and hide the ears. In some cases there appear to be plumes, perhaps quetzal feathers. The top of the headdress in figure 89, *i*, resembles a head ornament of the Mochica and Chimu cultures of the Peruvian coast. It will be noted that this specimen and the one in *h*, although not identical, correspond in most details and must portray the same individual or deity.

[10] Lothrop, 1937–42, part I, figs. 75, *c*; 77.
[11] Lothrop, 1937–42, part I, fig. 147.
[12] Lothrop, 1937–42, part I, fig. 40.

Ear ornaments of two kinds occur on Coclé-style effigy pendants. Those shown in figure 89, *c* and *e*, are ear spools. At the Sitio Conte this form was used during the Early period only and was replaced by ear rods in the Late. Figure 91, *a*, illustrates ears adorned by a spiral wire inserted through a series of holes. A similar figurine was found at the Sitio Conte [11] but no examples of the spirals. A number of specimens in gold have been found in Ecuador.[12]

All the pieces discussed wear what at first glance seems to be several necklaces. As seen in figure 92, however, it appears that the chest and shoulders are covered but not the back. Evidently the ornament represented is a bead collar such as we have seen on Guaymí men assembled for a festival at the mouth of the Cricamola River in northwestern Panama. This identification is confirmed by figure 89, *e*, *i*, which clearly shows patterns covering the entire width of the band. The modern collars are of glass beads assembled to form striking patterns in vivid colors.[13] In figure 89, *h*, and *i*, narrow pendants hang from the collars.

The only other adornment consists of bands worn around the calves (figs. 89, *f*, and 92). The material is not indicated.

Figure 92 illustrates a unique pair of Coclé-style effigy pendants. The heads have been bashed in and the bodies have become partly fused, doubtless because they were cast into the Cenote embedded in a ball of blazing copal or rubber. It will be noted that the smaller specimen has five holes drilled in the body and legs and the larger has nine holes. These were filled with clay and probably were painted.

[13] In retrospect, we believe that the mass of material illustrated in Lothrop, 1937–42, part I, fig. 33, may be the remains of a similar collar. For a modern example, see Johnson, 1948, pl. 45, *bottom (right)* or Lothrop, 1950, fig. 106.

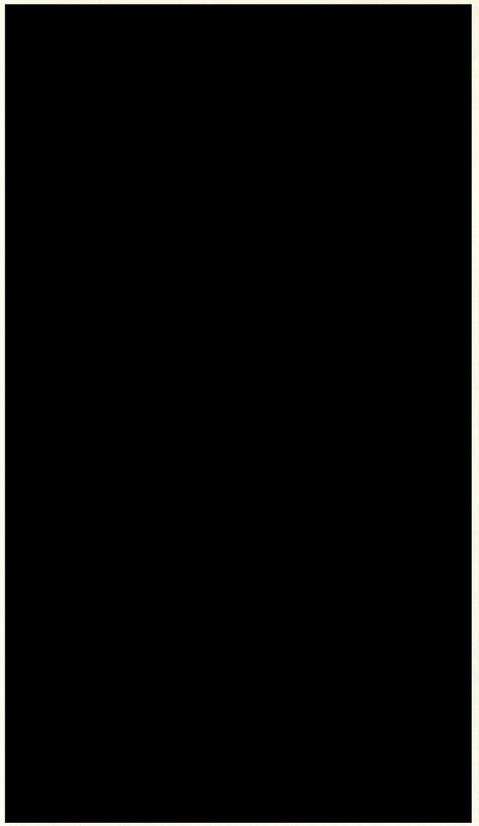


FIG. 90. Peruvian scepters. *a*, wood handle, gold cup with plumes. Ica. Length, 112 centimeters (44 inches). After Schmidt. *b*, copper. Pacasmayo. Length, 78.3 centimeters (30⅞ inches). After Baessler.

FIG. 91. Fragments of *tumbaga* pendants of Coclé style. Actual size.

One of the common finds at the Sitio Conte was pendants representing monkeys. Usually these were of agate but examples occurred in gold. A specimen from the Cenote appears in figure 93, *c*. Evidently it hung head down and the cord for suspension was passed through the holes in the hind paws, which run parallel to the body, and tied to the rings in the front paws. In some cases, bird heads appear on monkey bodies, of which figure 93, *b*, gives an example.

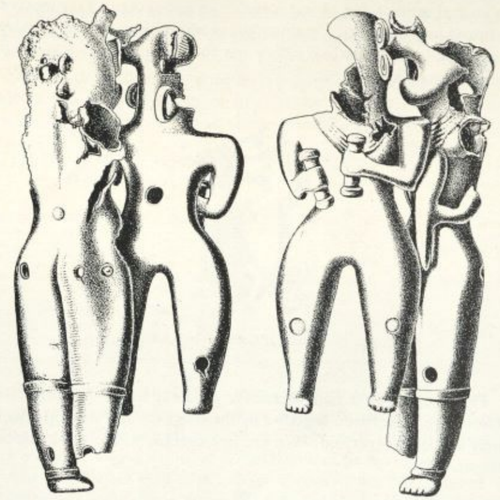


FIG. 92. Inlayed *tumbaga* pendants of Coclé style. Actual size. See table XXXI, analysis 1261.

FIG. 93. Gold (*a*, *b*) and *tumbaga* (*c*) pendants of Coclé style. Actual size. See table XXXI, analysis 1280.

Bells. Figure 94 illustrates a small gold effigy bell representing an animal eating some object, possibly an ear of corn. This motive is found in the gold of Veraguas but rendered in a different style. An example representing a deer was found in 1947 at Las Mercedes, Costa Rica.

FIG. 94. Gold bell of Coclé style. Actual size.

The picture of Coclé metalwork given by the material from the Cenote of Sacrifice occupies but a small area in the larger picture obtained from the Museum's three seasons of field work in Coclé itself, principally at the Sitio Conte. Most of the Cenote specimens

FIG. 95. Pair of gold ear spools partly fused together. Actual size. See table XXXIV, analysis 1285.

Figure 95 shows a pair of massive gold ear spools (or labrets?). They have been fused together by intense heat and the top specimen has largely melted. We are not certain where these pieces originated .

are *tumbaga* pendants in the form of men, a comparatively rare type at the Sitio Conte. Most of the many recorded Coclé styles of jewelry did not reach the Cenote at all. The full complexity of Coclé metals and alloys are not reflected in the Cenote finds.

VERAGUAS GOLD

Approximately eight times as much gold from Veraguas reached the Cenote of Sacrifice as from Coclé. The reason for this probably was the larger amount of gold available for export from Veraguas, but it might lie in the high demand for Veraguas bells, many of which have been recovered from the Cenote.

As was the case with Coclé, the known Veraguas archæological remains are from the Pacific side of Panama. Yet the north coast evidently produced a lot of gold, for Columbus wrote,[14] "In this land of Veragua I saw more signs of gold in the first two days than I saw in Española during four years." He secured no less than forty-six gold plaques on his eastward voyage and more on his return. In all probability the Cenote specimens are from the north coast, for both overland and ocean trade routes tapped it.[15]

Trade Routes. To recapitulate briefly what we have described with full documentation elsewhere, the existence of an aboriginal overland trail from Mexico to the western border of Panama is established by a group of Indians on the frontier of the latter called the *Sigua* or "Strangers" by their neighbors. These people spoke to the Spaniards in Aztec and stated that they had come to collect gold for Montezuma but had decided to remain when they heard of his downfall. They added that they had traveled over 600 leagues by land, approximately the distance covered today by the Pan American highway between Mexico City and the western border of Panama.

Traffic by sea between Panama and Yucatan is established through statements of various Indians to Spanish authorities. Columbus learned that the natives of northeastern Costa Rica spoke the same tongue as the coastal tribes as far as Veraguas, and traded with them. A document declares that Aztec traders had established an outpost at the mouth of the San Juan River, Nicaragua, near the present Costa Rican boundary, in order to ship gold to Montezuma. Elsewhere we learn that Chetumal Bay in southeastern Yucatan was the terminal port for trade to the south. In addition, it can be shown that the coastal inhabitants of Yucatan and Central America possessed sailing canoes capable of making the long voyage, often with favorable winds and currents. Finally, the reality of this trade is demonstrated by the discovery in the Cenote of Sacrifice of the Panamanian jewelry which we describe.

Metallurgy. As already pointed out, the Cenote specimens in Veraguas style probably came from the Atlantic coast, whereas the published analyses come from the Pacific. Nevertheless, it is pos-

TABLE XXXII: CAST GOLD OBJECTS CONTAINING NO COPPER BUT SILVER AS AN IMPURITY

Analysis Number	Catalogue Number	Object	Style	Gold	Silver	Remarks	Illustration
1233	C/7658	Bell, bird top	Veraguas	100	0.0	Unique casting	Figure 99, *f*
1254	C/7693b	Bell, effigy head, human	Veraguas	97.6	2.4	...	...
1234	C/7659	Bell	Veraguas	97.4	2.6	...	Figure 100, *c*
1276	C/7721	Pendant, human figure (?)	Veraguas	96.7	3.3	...	Figure 97, *a*
1287	C/7767a	...	...	96.7	3.3	...	...
1244	C/7664e	Bell	Veraguas	96.5	3.5	...	...
1257	C/7702	Pendant, human figure	Veraguas	96.4	3.6	...	Figure 97, *e*
1281	C/7734	Monkey bell	Veraguas	96.4	3.6	...	Figure 105, *f*
1249	C/7667c	Bell	Veraguas	96.3	3.7	...	...
1284	C/7740	Bell-crab effigy	Veraguas	95.8	4.2	...	Figure 107, *a*, *b*
1242	C/7664c	Bell	Veraguas	95.6	4.4	...	...
1241	C/7664b	Bell	Veraguas	95.4	4.6	...	...

[14] Columbus, 1870, p. 202.

[15] Lothrop, 1950, pp. 77–90; 1941a.

sible to demonstrate that metals imported to Yucatan often correspond to what has actually been found in Veraguas, although the relative importance of individual ores may vary.

We should add that the grouping of specimens in tables XXXI–XXXIV was done solely on the basis of chemical analyses made by Professor W. C. Root. Several months later the specimens themselves were divided into stylistic groups believed to represent Coclé and Veraguas and then checked against the analyses. The reader will note that all objects of native gold, representing various ores, are products of Veraguas but the *tumbaga* (copper-silver-gold) alloys are chiefly from Coclé.

Table XXXII presents the analyses of gold objects containing no copper. Number 1233 has no copper or silver. Four similar specimens from Veraguas were analysed, two of which probably were trade pieces.[16] In Coclé, no such objects were found but there was a gold ore without silver, invariably alloyed with copper.[17]

The remaining specimens in table XXXII have 2.4 to 4.6 per cent silver as an impurity. Such an ore existed in southern Veraguas and Coclé but it is not common in either region.[18] We believe not only that these Cenote specimens are from northern Veraguas but that this is the metal from which the disks with battle scenes were made, for they are of the same unusual ore (table XVIII).

A metal consisting of gold with copper as an impurity but no silver has been found in small quantity in Coclé and southern Veraguas. No examples have come from the Cenote.

TABLE XXXIII: GOLD OBJECTS WITH HIGH SILVER CONTENT

Analysis Number	Catalogue Number	Object	Style	Silver	Gold	Copper	Ag. × 100 / Au. + Ag.	Remarks	Illustration
1262	C/7707b	Pendant, human figure	Veraguas	23.3	66.9	9.8	22.5	...	Figure 97, *b*
1236	C/7663a	Bell	Veraguas	12.8	75.8	11.4	14.4	...	...
1255	C/7697	Figurine	Coclé	10.2	52.0	37.8	16.4	*Tumbaga* alloy	Figure 89, *f*
1252	C/7669	Bell	Veraguas	9.7	48.6	41.7	16.6	*Tumbaga* alloy	...
1251	C/7667e	Bell	Veraguas	6.8	87.7	5.5	7.3	...	...
1239	C/7663d	Bell	Veraguas	6.1	88.6	5.3	6.4	...	Figure 101, *b*
1238	C/7663c	Bell	Veraguas	5.5	83.6	10.9	6.2	...	...

The Museum collections from southern Veraguas include a number of gold specimens which average about 10.0 per cent silver, including several pieces with over 30.0 per cent silver.[19] The Cenote objects in table XXXIII evidently correspond to this group. Colombia gold ores average about 16 per cent silver.[20] A number of trade pieces from Colombia of this nature have been found in Coclé and some of these seem to have been recast in local styles. The average amount of silver in Coclé gold is less than 4.0 per cent. In Mexico, the silver content of gold ores is even higher than in Colombia and there is no copper except in minute quantities (tables III and VII).

About two thirds of Cenote gold specimens in Veraguas style which have been analysed contain both copper and silver as an

TABLE XXXIV: GOLD OBJECTS CONTAINING BOTH COPPER AND SILVER AS AN IMPURITY

Analysis Number	Catalogue Number	Object	Style	Copper	Gold	Silver	Remarks	Illustration
1269	C/7712a	Monkey bell	Veraguas	11.2	85.6	3.2	...	Figure 105, *d*
1238	C/7663c	Bell	Veraguas	10.9	83.6	5.5	...	...
1235	C/7660	Bell	Veraguas	10.6	87.8	1.6	...	Figure 99, *a*
1268	C/7712b	Monkey bell	Veraguas	10.2	87.0	2.8	...	Figure 105, *c*
1283	C/7739	Turtle	Veraguas	10.1	88.3	1.6	...	...
1262	C/7707b	Effigy pendant, frog (?)	Veraguas	9.8	66.9	23.3	...	Figure 97, *b*
1243	C/7664d	Bell	Veraguas	9.3	87.6	3.1	...	...
1247	C/7665	Bell	Veraguas	8.0	89.5	2.5	...	...
1285	C/7741	Ear spools	Veraguas	6.1	89.6	4.3	Two stuck together	Figure 95
1275	C/7719	Effigy pendant, human	Veraguas	5.7	93.0	1.3	...	Figure 97, *h*
1251	C/7667e	Bell	Veraguas	5.5	87.7	6.8	...	...
1239	C/7663d	Bell	Veraguas	5.3	88.6	6.1	...	Figure 101, *b*
1245	C/7664g	Bell	Veraguas	5.3	92.5	2.2	...	...
1274	C/7718	Figurine, human	Veraguas	4.9	91.7	3.4	...	Figure 96, *b*
1286	C/7760b	Bell	Veraguas	4.8	90.5	4.7	...	...
1282	C/7735	Monkey bell	Veraguas	4.5	93.4	2.1	Black fracture	...
1266	C/7710b	Figurine, frog	Veraguas	4.3	93.0	2.7	...	Figure 98, *a*
1277	C/7722	Figurine, human	Veraguas	3.8	91.9	4.3	...	...
1262	C/7710c	Pendant, frog	Veraguas	3.8	95.0	1.2	...	Figure 98, *b*
1270	C/7712c	Monkey(?)	...	2.9	96.1	1.0	...	...
1240	C/7664a	Bell	Veraguas	2.7	95.9	1.4	...	...
1248	C/7667b	Bell	Veraguas	2.3	94.8	2.9	...	...
1256	C/7699	Effigy pendant, human	Veraguas	2.3	94.2	3.5	...	Figure 97, *c*
1253	C/7693a	Bell	Veraguas	1.8	94.9	3.3	...	...
1271	C/7715a	Top of bell	Veraguas	1.8	97.8	0.4	...	...
1258	C/7703	Pendant, human	Veraguas	1.7	93.7	4.6	...	...
1245	C/7664f	Bell	Veraguas	1.3	96.9	1.8	...	...
1273	C/7717d	Effigy pendant, human	Veraguas	1.3	97.1	1.3	...	Figure 97, *g*
1265	C/7710a	Pendant, frog	Veraguas	1.2	95.0	3.8	...	Figure 98, *d*
1250	C/7667d	Bell	Veraguas	0.5	95.9	3.6	...	...
1260	C/7705	Jaguar-god figure	Veraguas	0.1	98.4	1.5	Heavy	Figure 96, *a*
1267	C/7710c	Pendant, frog	Veraguas	0.1	95.5	4.4	...	...

[16] Lothrop, 1950, table II.
[17] Lothrop, 1937–42, part I, table IX.
[18] Lothrop, 1950, table II. Lothrop, 1937–42, part I, tables X, XIII.
[19] Lothrop, 1950, table V.
[20] Restrepo, 1908, pp. 30–31.

impurity, as shown in table XXXIV. Probably several ores are represented. Comparable ores existed in Coclé [21] and southern Veraguas [22] but not in large quantity, unless their nature is masked by the addition of copper to make *tumbaga* alloys.

Enough has been said about Veraguas-style gold from the Cenote to indicate that it includes native metals which are known on the south side of the Isthmus, but the relative abundance of given ores varies. This creates the suspicion that most if not all the Cenote specimens originated on the archæologically unknown north coast.

PENDANTS

The chief difference between Coclé and Veraguas pendants is that the former usually were cast in the round over a clay core but the latter always were cast with an open back. Among over

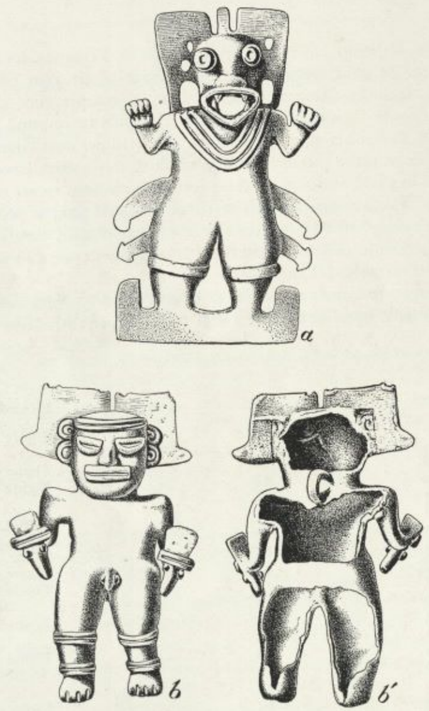


Fig. 96. Gold pendants in the style of Veraguas. Actual size. See table XXXIV, analyses 1260, 1274.

a thousand Veraguas specimens we have examined there have been no exceptions. The Cenote pendant in figure 96, *b'*, therefore, is unusual because it has a partly open back. This may be a fault in casting and the piece perhaps should be classified as Coclesano.

Another difference between Coclé and Veraguas metal figures, which does not happen to apply to the Cenote material, is that, when the sex is indicated in Veraguas, it is invariably male but in Coclé it may be either sex.

[21] Lothrop, 1937–42, part I, table XIV.
[22] Lothrop, 1950, table IV.

In previously describing Veraguas pendants, we divided them into fifteen major groups and their variants.[23] Only three of these groups were represented in the Cenote finds.

Human Figure Pendants. Figure 97 illustrates pendants which portray men. They wear headdresses consisting sometimes of a simple cap (*a*, *e*, *f*), which is often the base for a more elaborate construction. In general, the head ornaments are simpler than those of Coclé. No example occurs of the collars seen on comparable human figures from Coclé. Leg (*g*, *h*) and arm bands (*a*) occasionally occur.

The specimens in figure 97, *d*, *e*, are dancing figures who carry rattles consisting of gourds set on a staff. In *h*, the objects in the hands may be dance wands and in *g* they are a pair of birds.

Fig. 97. Gold pendants representing men, cast with open backs in the style of Veraguas. Scales, *f*, 5/6; *others*, actual size. See table XXXII, analyses 1257, 1276; table XXXIII, analysis 1262; table XXXIV, analyses 1247, 1256, 1273, 1275.

[23] Lothrop, 1950.

Crocodile-God Pendant. Figure 96, *a*, shows a simple figure of a Crocodile-god with human body and saurian jaw. The projections from hips and thighs can be identified as snakes from more realistically rendered specimens. The rectangular headdress and the base illustrate the Veraguan tendency to frame figures on two or four sides.

Frog Pendants. The largest group of pendants from southern Veraguas represents a kind of bird which has been called an "eagle" since the days of Columbus. The second largest group represents frogs. None of the former and few of the latter were found in the Cenote. Of the examples in figure 98, only *a* can be considered typical of southern Veraguas. All these specimens lack the characteristic huge hind feet and the customary spirals or double tongues projecting from the jaws.

Frogs were represented in metal from Colombia as far north as Oaxaca. Some examples from the latter closely resemble Isthmian forms which may be prototypes (fig. 3, *c*, *e*).

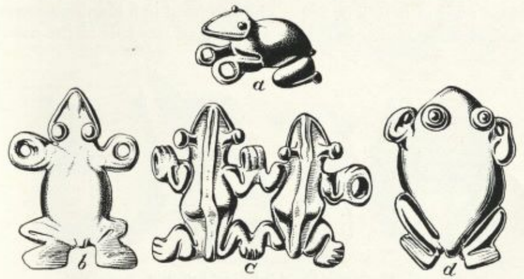


Fig. 98. Frog pendants. Actual size. See table XXXIV, analysis 1262, 1265, 1266.

BELLS

The questions of the origin and distribution of New World metal bells has been discussed in connection with copper bells (p. 85). Gold or *tumbaga* bells are much less common than copper. There are four major centers of manufacture: in the Cauca Valley and Tairona region in Colombia, in the Province of Veraguas, Panama, anl in the State of Oaxaca, Mexico. Cauca Valley and Tairona gold bells are known through several necklaces.[24] For the most part they are pear-shaped with a small molding on the neck. Apart from these, we have seen only five South American gold bells, three from Peru [25] and two from Chile.[26]

Gold bells are rare in Coclé. In three field seasons, we dug up only nine gold and two copper specimens. Four others were acquired by purchase. The commonest type does not have a loop for suspension but a tube for inserting a handle (fig. 108, *b*, *e*.)

Gold bells are fairly common in southern Veraguas and are of several styles.[27] By far the largest group of Veraguas bells, however, are those dredged from the Cenote of Sacrifice, which are over eighty in number. Twenty-five of these are undecorated The others either have a small figure on a platform with the loop on the top of the bell (figs. 99–102) or they are effigies with the entire surface modified to form a head or complete animal (figs. 104–107).

No definite bell metal was used in Veraguas, either on the south coast or in the specimens which reached the Cenote. Bells were of various gold ores, at times combined with copper to form *tumbaga*. Cenote bells, presumably from the north coast, are heavy and massive compared to those we have examined from southern Veraguas. No traces of the duct through which they were cast appears on the ring as is the case with Mexican bells.

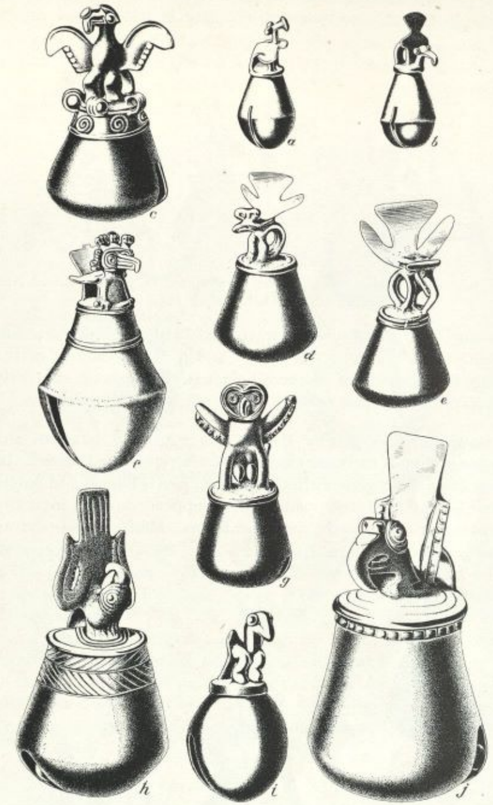


Fig. 99. Gold bells of Veraguas styles. Scales, *a*, *b*, 5/8; *f*, 2/3; *others*, actual size. See table XXXII, analysis 1233; table XXXIV, analysis 1235.

Copper bells of Mexican origin often were silenced before throwing them in the Cenote by removing the clapper, usually without damage to the bell. Gold bells almost always were pounded flat. In our illustrations they have been restored to their original appearance so far as possible.

A third major manufacturing center of gold bells was Oaxaca, where Mixtec jewelry of late date often is fringed with elongated pendant bells. No examples have been found in the Cenote.

Bells Surmounted by Birds. Twenty-four Cenote gold bells, some of which are illustrated in figures 99 and 100, have a flat platform on the top which is adorned by a small bird. The bell chambers are of four shapes, shown in figure 99, *b*, *c*, *f* and *i*. The edge of the platform is emphasized by a small molding, below which

[24] Farabee, 1920, p. 122, fig. 69. Holmes, 1919, p. 359, *top*. Ramos-Ruiz, N.D. pl. IV. Mason, 1936.
[25] Farabee, 1920, p. 125.
[26] Lothrop, 1937, pl. XLI, *u*, *v*. These specimens were of beaten gold with an open mouth. We found them in the oldest level of a stratified Diaguita cemetery of pre-Inca date.
[27] Lothrop, 1950, figs. 118–20.

there may be a narrow incised geometric band (*h*) or a pattern in relief (*c*).

The birds are of several kinds, the parrot being the most frequently represented (figs. 99, *h*, *j*; 100). He is usually shown with his tail in the air and, in two cases, he rests on the back of his neck. The parrot is not important in the metalwork of southern Veraguas. In this region, however, what are known as gold eagles

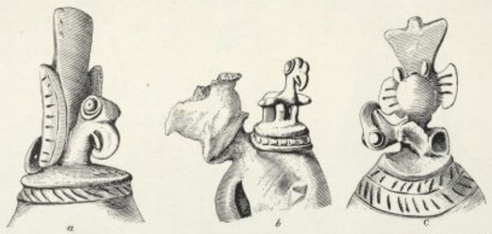


FIG. 100. Gold bells of Veraguas style surmounted by parrots. Actual size. See table XXXII, analysis 1234.

are numerous. The type is represented in the Cenote collection by the specimens in figures 99, *b*, *c* and *f*. The treatment of the wings in *c* is typical of southern Veraguas. Figure 99, *g*, evidently portrays an owl. The others we shall not attempt to identify.

Bells Surmounted by Deities. In southern Veraguas, the largest and most intricate castings usually represented deities. In most cases, these were anthropomorphic, partly human and partly beast or bird. A corresponding group appears on bells from the Cenote but with greatly simplified forms. Most of these portray

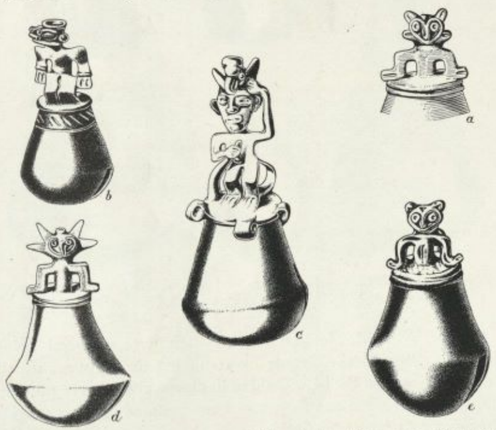


FIG. 101. Gold bells surmounted by deities. Style of Veraguas. Actual size. See tables XXXIII and XXXIV, analysis 1239.

an Owl-god (figs. 101, *a*, *d*, *e*; 102, *b*, *c*, *d*), a deity unknown in southern Veraguas, where, however, a Crocodile-god was of prime importance. He is pictured on bells from the Cenote in figures 101, *b*, and 102, *a* and *e*. Figure 101, *c*, shows a man holding a staff and carrying a bird on his head.

The symbolism of these specimens must have been very real to the makers but is completely lost to us today. It seems probable that they had no ritualistic significance to the Mayas either, who mutilated them and threw them in the Cenote.

[28] Aguilar P., 1946, lám. IV, variante A 1.

Undecorated Bells. Two undecorated gold bells from the Cenote appear in figure 103, *b*, *c*. They are representative of a group of twenty-five.

FIG. 102. Gold bells of Veraguas style surmounted by deities. Actual size. See table XXXI, analysis 1237.

Half Bells. The curious objects in figure 103, *a* and *d*, appear to be bells cut in half with the edges rubbed smooth. There are two other examples from the Cenote which have not been illustrated. Actually they are a little less than half a bell and there is no trace of mouth or loop. The specimen in *a* has three small holes for suspension in the top and *d* has a tiny hole in the base.

FIG. 103. Undecorated gold bells and half bells. Actual size.

Why anyone should want to cut a gold bell in half is not immediately apparent. If it were ceremonial killing, one would not expect such neat workmanship. Perhaps, after the operation, the pieces were sewn on clothing.

In Oaxaca, bells sometimes were suspended by a string run through two holes rather than a ring.[28] This was not the case with the specimens here discussed as the holes are off center, nor is it probable that they came from Oaxaca as the workmanship is too crude.

Effigy Bells. The remaining gold bells from the Cenote of Sacrifice can all be linked with Veraguas on stylistic grounds although the connection with authenticated remains from the south is not always direct. The specimens so far considered have been primarily symmetrical bells with or without decoration. The group now to be discussed comprises hollow heads or animal figures with a pellet inside. Thus their function as a bell is secondary. A somewhat similar class of copper bell has already been considered (p. 91). Although some of the subjects represented are the same, the two groups differ so much in style and technique that it is improbable that they both came from the same area.

Human-Head Bells. Five bells representing human heads appear in figure 104, *a–e*. One specimen (*a*) is surmounted by a bird very similar to one already considered (fig. 99, *a*), thus linking the two groups.

It is probable that these effigy bells, of which a total of nine were found, represent trophy heads. One of them (fig. 104, *d*) hangs neck up, a position in which Coclé warriors are shown carrying heads suspended on braided cords.[29] Two of the heads wear nose clips (*c*, *d*), which were of metal in Panama [30] and of jade in Yucatan. One (*b*) has holes in the ears and a forelock is shown. The elaborate headdresses seen on figurines which presumably represent the living (fig. 97) are absent.

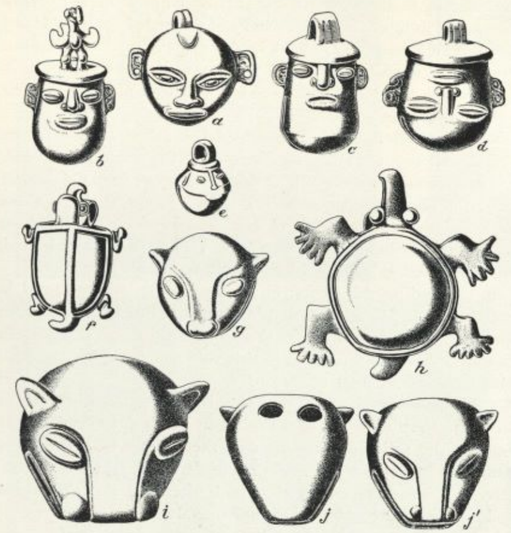


FIG. 104. Gold effigy bells representing human heads, turtles and jaguar heads. Style of Veraguas. Actual size.

Monkey-Effigy Bells. All the specimens in figure 105 represent seated monkeys and all are bells except *b* which is a solid casting. The monkey characteristically is shown as holding his tail which curves upward over his head, terminating in a small spiral. The other hand grasps a small rod which may represent a flute or whistle as one end usually is held against the lips. Cenote specimens exhibit several variations of this motive. In one case (*d*) a flute is held in each hand. Another specimen (*g*) has two tails, each grasped in a hand. A third (*b*) has a hand held across the lips in a "speak no evil" position. Eyes may be round buttons, of the coffee-bean type or circular openings. All specimens have loops for suspension at the back.

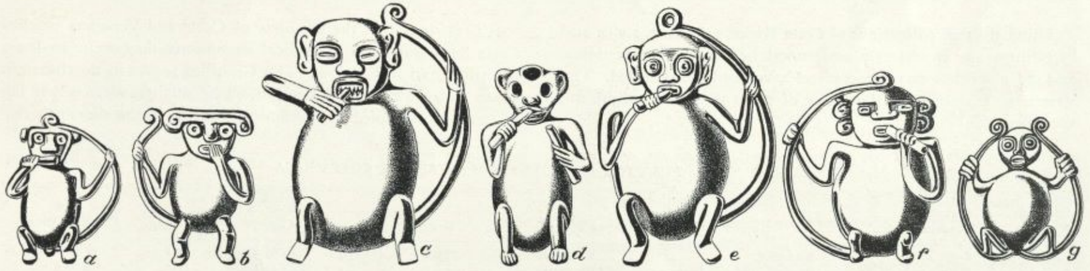


FIG. 105. Gold bells (except *b*, which is solid) representing monkeys. Style of Veraguas. Actual size. See table XXXII, analysis 1281; table XXXIV, analyses 1268, 1269.

[29] Lothrop, 1937–42, part I, fig. 150.
[30] Lothrop, 1937–42, part I, pl. II, figs. 120, 121.
[31] Lothrop, 1950, figs. 1, *c*; 90.
[32] Lothrop, 1937–42, part II, fig. 64.

Gold and tumbaga pendants depicting monkeys holding their tails, similar to the Cenote examples, are found in southern Veraguas, where the tails may be so elongated that they completely encircle and frame the body. Sometimes there are two heads on a single body.[31] The concept of a monkey with an encircling tail is also pictured on a Early period polychrome plate from the Sitio Conte in Coclé [32] and a gold disk found near Cartago in Costa Rica.[33] It is also found in modified form on alabaster [34] and obsidian [35] vessels from central Mexico. While this motive is widespread, it is nowhere found in quantity as are certain other manners of representing monkeys.

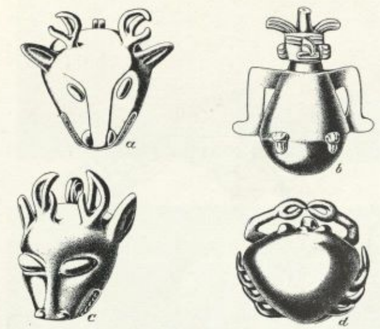


FIG. 106. Gold bells in Veraguas style, representing deer, a bird and a crab. Actual size.

Jaguar-Head Bells. Figure 104, *g*, *i*, *j*, *j'*, show bells in the form of animal heads which can be identified as jaguar owing to pendants from southern Veraguas which show this animal in toto. This small group from the Cenote offers no peculiarities except that in some cases (fig. 104, *j*) they were hung not from a cast metal loop but from two holes in the top of the head. This rare fashion of suspension also occurs in Oaxaca and Ecuador.

Deer-Head Bells. A pair of deer-head bells, complete with ears and antlers, appears in figure 106, *a*, *c*. Gold pendants in the form of complete figures of this animal occasionally are found in southern Veraguas and an example recently was excavated at Las Mercedes in northeastern Costa Rica. Deer were of great economic importance as food in many areas but were not of symbolic significance as were the jaguar and serpent. Hence deer rarely appear in native art, although methods of capturing them are depicted on Mochica pottery and Maya codices.

[33] Lothrop, 1926, fig. 182.
[34] Bliss collection, No. 96, pp. 100, 101.
[35] Toscano, 1944, fig. 209.

In Coclé, we may note, the deer is represented in Mochica style with tongue protruding as a sign of exhaustion. On the Peruvian coast, deer were driven into nets and speared. Veraguas deer and other representations farther north do not show the tongue. To judge by the codices, the Maya normally captured deer in traps rather than by hunting.

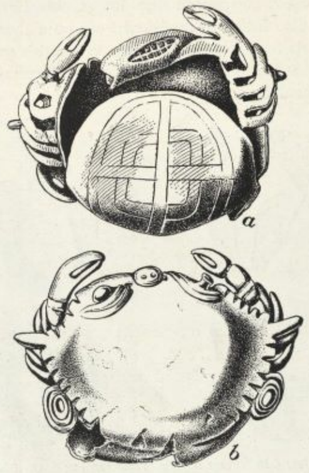


Fig. 107. Gold bell in Veraguas style, representing a crab. Actual size. See table XXXII, analysis 1284.

Bird-Effigy Bell. Figure 106, *b*, illustrates a bell which represents a bird with the head protruding from the top, and wings and legs from the sides. Several similar bells have been found in southern Veraguas.

Turtle-Effigy Bells. In figure 104, *f*, *h*, we show a pair of bells representing turtles. The clapper is enclosed by bending in a flap of metal as in figure 107. A few bells of this style have been found in southern Veraguas. Ocarinas in the shape of turtles are known from Costa Rica. In general, however, turtles rarely appear in art although much appreciated as food. This is attested by their remains found in graves.

Crab-Effigy Bells. Two crab-shaped bells, illustrated in figures 106, *d*, and 107, are a rare type in metal. Crabs and a Crab-god, however, turn up sporadically in pottery or stone from Guatemala to Peru. They occur in greatest quantity in northwestern Costa Rica and the adjacent part of Nicaragua and on the northern coast of Peru where most examples date from the Michica period. One specimen in gold of Chavín style represents a crab.

In concluding this section on Veraguas-style jewelry found in the Cenote of Sacrifice, we should point out that bells have been found in greater quantity in the Cenote than in Veraguas. In fact the specimens illustrated in this volume outnumber the combined published total on record from Chiriquí, Veraguas and Coclé.[36] For this the reason probably is that the Maya of Yucatan liked the simpler products of the south which did not obviously embody the religious symbolism of the Isthmus. On the other hand, Panamanian tribes doubtless preferred to retain for themselves the images of their gods, which often included the largest and most intricate examples of their metalwork.

CHIRIQUÍ GOLD

In this discussion, nothing has been said about Chiriquí culture, to which all Cenote specimens of Isthmian origin would have been assigned until recently. The reason for this is that over half of the published Chiriquí gold objects are now recognized as being in the styles of Coclé or Veraguas. Such pieces are attributed to trade, and the local styles of the western Isthmus remain to be determined by recorded excavations and analyses.

COSTA RICAN GOLD

Although large collections of Costa Rican gold exist, styles and metallurgy are imperfectly understood because the provenience and grave associations of most pieces have not been recorded. The writer has examined in the course of years well over a thousand specimens.

It is evident that the products of Coclé and Veraguas reached Costa Rica but, with some local exceptions, they occur in lesser quantity than in Chiriquí. The Guapiles region in northeastern Costa Rica is such an exception. The small modern town lies in territory occupied by the Suerre Indians in the sixteenth century. For some unknown reason Guapiles was a trade center, importing both pottery and gold. In figure 108 we illustrate a number of metal specimens of foreign styles. The analyses, given in table XXXV, reflect various types of metals in both Coclé and Veraguas styles. The copper content, with one exception, is well over the eutectic melting point (18 per cent copper).

Costa Rican jewelry which was not imported from Panama presumably was of local manufacture. No comprehensive attempt has yet been made at classifying this material, although regional traits undoubtedly exist and will be detected. In addition, it seems that foreign styles were copied locally in Costa Rica. The bells in figure 108 and table XXXV may well have been made near Guapiles, we believe, because they have been found there in large numbers. The Museum possesses six and there are about a dozen more in a private collection in San José. The form, with a tube for inserting a handle, evidently was manufactured in Coclé but the small loop seems to be a Costa Rican characteristic. One bell of this type was found in the Cenote (fig. 109).

TABLE XXXV: *TUMBAGA* OBJECTS FROM GUAPILES, COSTA RICA

Analysis Number	Catalogue Number	Object	Style	Gold	Silver	Copper	Ag. × 100 / Au. + Ag.	Remarks
1296	47–18–20/17527	Bird effigy	Veraguas	55.6	7.7	36.2	12.2	Figure 108, *c*
1300	" /17531	Double bird pendant	Veraguas	50.5	6.4	43.1	11.3	Red gold
1301	" /17532	Double bird pendant	Veraguas	58.0	3.1	38.9	5.1	Figure 108, *e*
1299	" /17530	Double bird pendant	Veraguas	59.2	0.1	40.7	0.16	...
1292	" /17521	Bell	Coclé	50.3	6.4	43.3	11.3	Figure 108, *b*
1293	" /17522	Bell	Coclé	76.5	7.6	16.8	10.9	...
1297	" /17528	Deer effigy	Coclé	42.0	2.0	56.0	4.5	Figure 108, *f*
1303	" /17523	Bell	Coclé	49.6	1.5	48.9	2.9	...
1298	" /17529	Bird effigy	Coclé	47.6	1.8	50.6	2.7	Figure 108, *a*
1294	" /17525	Bell	Coclé	48.4	1.0	50.6	2.0	...
1304	" /17524	Bell	Coclé	49.8	0.4	49.8	0.8	...
1295	" /17526	Bell	Coclé	61.5	0.3	38.2	0.5	Figure 108, *d*

[36] To judge by photographs from the American Museum of Natural History, the Keith collection contains about sixty gold bells of unknown provenience. Seven of these have birds on top, two represent crabs and two portray two-tailed monkeys.

Fig. 108. *Tumbaga* pendants and bells of Coclé (*a–d*, *f*) and Veraguas (*e*) styles. Guapiles, Costa Rica. Actual size. See table XXXV, analyses 1292, 1295–98, 1301.

Fig. 109. Gold bell from the Cenote of Sacrifice, perhaps manufactured in Costa Rica. Actual size.

DISCUSSION

The metal objects from the Cenote of Sacrifice at Chichen Itza form a variegated collection, the component parts of which present an epitome of metallurgical skills in Mexico, northern Central America and Panama for several centuries before the Spanish Conquest. Although larger finds of ancient artifacts have been made, notably in Peru,[1] no such diversified lot has ever been discovered in one place and preserved in toto.

The circumstances which caused this concentration of metal were peculiar if not unique. Chichen Itza was a holy city to which pilgrims flocked with offerings. Instead of being presented to the priests for the use of the gods, these were cast in the Cenote of Sacrifice and were preserved, beyond human reach without the aid of modern machinery.

OTHER DISCOVERIES OF ABORIGINAL GOLD

Historical Records. Other places of pilgrimage existed in Middle America in prehistoric times. To the Maya of Yucatan, to judge by the writings of Landa (p. 3), the Island of Cozumel was no less sacred than Chichen Itza, but there is no tradition of valuable offerings.

Asunción Mita in southern Guatemala also was a center of pilgrimage. This stands in territory traditionally belonging to the Pokoman branch of the Maya, although the sixteenth-century rites seem more Nahua than Maya.[2] Again there is no Spanish suggestion of accumulated treasure. After the Conquest and the subsequent suppression of the Mita ritual, there soon arose the worship of the Black Christ at near-by Esquipulas. This was and is a particularly Indian cult under a Catholic veneer, which brought in vast treasures, as attested by the size and elegance of the existing sanctuary.[3] Until recently, Esquipulas has been inaccessible to wheeled transportation and we see no reason why what went on there has not reflected to a large extent the conditions of aboriginal pilgrimages.

The closest parallel to the Cenote cult seems to have existed in Chibchan territory in Colombia where pilgrimages were made to five sacred lakes, notably Lake Guatavita, and offerings of gold ornaments and emeralds were cast into the waters. Although human sacrifice of various types existed in Colombia, there is no record of human victims being offered to the deities dwelling in the lakes as was done at the Cenote. During the famous El Dorado ceremony, the supreme ruler swam in the lake to wash off the powdered gold with which he had been dusted.

In Peru there were many temples and oracles where pilgrims deposited rich gifts. Apurimac and Pachacamac are famous examples. The wealth in metal at these sanctuaries seems either to have been applied to the ransom of Atahualpa or else successfully hidden. A large part of Montezuma's possessions also were concealed.

Buried Treasure. It was quite natural that the Spaniards soon learned of these secreted treasures and attempted to obtain them — by torturing those who might know of hiding places, or by tearing down walls and opening tombs. Thus archæology was initiated in the New World and the first detailed report comes from the historian Fernández de Oviedo who opened a Darien tomb in 1522.[4] Previous to this, however, much gold had been extracted from Sinú tombs in Colombia under unrecorded conditions.[5] We may add that one of Cortes' lieutenants made a lucrative study of Oaxacan burials.[6]

Before the end of the sixteenth century, "mining" companies were organized to work on a large scale. One of the earliest of these, organized in 1557, attempted unsuccessfully to drain the Lake of Urcos near Cuzco, into which the famous gold "chain" of Huascar supposedly was cast. The historian Garcilaso de la Vega [7] claimed, "I entered the tunnel two or three times when the work was going on."

A more ambitious and successful project was undertaken near Trujillo, Peru, in 1602, where more than a million pesos in gold had already been extracted from Chanchan in previous years. This scheme was to divert the Rio Moche against the 130-foot-high Pyramid of the Sun, destroying about half of it. Gold to the value of 800,000 ducats (2,788,000 grams) thus was found,[8] and an archæological section even larger than that at Copan was exposed.

In 1839, two natives of Panama discovered an Indian cemetery in the high mountains above David. From a single grave they extracted gold which weighed 2 arrobas or 23.6 kilograms (52 pounds). Efforts to relocate this cemetery failed, including an expedition organized by General Francisco Morazán, exiled President of the Central American Federal Republic.[9]

We mention these discoveries and show the scale of endeavor because they indicate how thoroughly the New World gold-bearing lands have been searched and looted. It is unlikely that a present-day archæologist will encounter anything comparable. The astronomical figures given are not exaggerations because they represent the base on which taxes were paid. No doubt the news of many discoveries was suppressed and the total value of others minimized.

Recent Finds. Recent archæological discoveries of precious metals are modest indeed compared to the wealth unearthed in previous centuries. Probably there are many small finds of which no account exists. In the case of the larger hoards, however, a partial field record may be preserved simply because people talk and

[1] Lothrop, 1938, pp. 55–56, 63–67.
[2] García de Palacios, 1860.
[3] Lothrop, 1927a, 1927b.
[4] Oviedo, t. III, lib. XXXIX, cap. XXXI, p. 154.
[5] Hernández de Alba, 1948, p. 336.
[6] Saville, 1920 p. 143.
[7] Garcilaso, 1869–71, lib. 3, cap. 25.
[8] Garland, 1896.
[9] Lothrop, 1919.

others repeat what is said. Important discoveries of this type have been made at Chongoyape,[10] Batán Grande [11] and Cerro Zapamé [12] near Lambayeque on the north coast of Peru and at Chanchan [13] near Trujillo. Rich gold-bearing tombs have been opened under formal archæological control by Dr. Alfonso Caso at Monte Alban [14] in Mexico and by Mr. Henry B. Roberts, Dr. J. Alden Mason [15] and the writer [16] in the Panamanian Province of Coclé.

explorers such as Grijalva were delighted to secure small amounts in the coastal towns because this suggested that more was to be had in the interior. During the Conquest, however, the largest sum captured amounted to only 2000 pesos (8360 grams or 294.4 ounces).[17] This was found in the town of Chetumal which was the terminal port for trade with Honduras and the Isthmus.

There has been much speculation about the value of the Cenote gold and astronomical figures have been mentioned. For instance, T. A. Willard,[18] purportedly quoting E. H. Thompson, wrote that the gold "would net several hundreds of thousands of dollars in bullion." The actual weights of all objects containing gold are given by groups in table XXXVI, including a few individual specimens. The corrected weights represent the pure gold after eliminating the copper or silver which our tables of analyses show to be present. The bullion value of gold is then $6,870.92 with gold selling at $35.02 and ounce. This figure is not absolutely accurate because some of the thin decorated gold disks have been permanently mounted on wood and their weight was estimated.

TABLE XXXVI: WEIGHT OF CENOTE GOLD

Objects	Actual Weight		Corrected Weight	
	Ounces	Grams	Ounces	Grams
Undecorated gold disks (fig. 9)	10	283.5	9.7 *	275 *
Decorated gold disks (figs. 1, 29–37, 40–44	15	425.3	13.6 *	412.5 *
Gold cap (fig. 54, *a*)	17	482.	16.5 *	467.5 *
Gold face (fig. 54, *b*)	4.5	127.6	4.4 *	123.8 *
Other sheet gold	27.75	788.7	26.9 *	776.3 *
Sheet Gold Total	**74.25**	**2107.1**	**72** *	**2055.1**
Gilded copper	24.5	694.6	0.5 †	14.2 †
Veraguas cast gold	128	3628.8	107.4‡	3045.8 ‡
Coclé cast gold	26	777.1	14.2 §	402.5 §
Quimbaya cast gold (fig. 88)	2.5	70.9	2.1 ‖	59.5 ‖
Totals	**255.25**	**7236.4**	**196.2**	**5562.3**

* Eliminating 3 per cent silver or copper.
† Eliminating 98 per cent copper.
‡ Eliminating 10 per cent silver and also 17 per cent copper in 40 per cent of the total.
§ These are all *tumbaga* with 47.2 per cent copper and 4.3 per cent silver.
‖ Eliminating 16 per cent silver.

The Cenote finds do not loom large against these other discoveries of metals and various museum collections. Of course the entire contents of the Cenote were not recovered, but they represent not the products of local manufacture at a given moment as in a grave, but an accumulation of over five hundred years, drawn from many sources. Evidently the Maya of Yucatan had little metal. Apart from the Cenote only a few archæological specimens of copper have been found in all Yucatan, and three or four of gold.

The scarcity of gold artifacts in Yucatan is surprising in view of the commercial contacts and enterprise of the Maya. The early

TYPES AND PROVENIENCE

At the beginning of this study we pointed out that Yucatan is a limestone country and that it contains no metal or precious stones such as jade. Hence every piece of metal or jade found in the Cenote of Sacrifice was transported thither from other regions. We also noted that the objects from the Cenote were secured by dredging a mud floor about 10 meters (35 feet) thick which lay under 6 meters (20 feet) of water. The water level averaged about 20 meters (ca. 70 feet) below the surface of the land. Normal archæological controls could not be utilized under these conditions. Hence any discussion of what was recovered has been based on the intrinsic nature of the individual specimens.

From the detailed exposition in the main text, it appears that Cenote metals can be divided into groups which are unified by types of object, style of decoration and chemical composition of the metal. These three aspects enable us to point out, if not a definite home, at least a specific culture area in which most of the Cenote specimens were manufactured. In certain cases it is also possible to assign a probable period of production (table XXXVII).

In brief summary, almost all the gold found in the Cenote — cast or hammered — came from Panama, but the embossed sheet gold had been worked in either Yucatan or Mexico. The gilded sheet copper was probably from Mexico but sometimes was worked in Yucatan or British Honduras. The copper alloys (copper-tin, copper-lead) came from central Mexico. Virgin copper objects originated in Mexico or Honduras.

[10] Lothrop, 1941a.
[11] The total weight of this hoard is said to have been about 80 kilograms (176 pounds). Part of it is in the museum in Lima (see Valcarcel, 1938) but many pieces are in private hands. I have seen a portion which filled several suitcases and, when displayed, covered the floor of the room.
[12] Antze, 1930. Parts of this collection are in Hamburg, the Museum of the American Indian and the Peabody Museum, Harvard University.
[13] From what I heard in Peru, this hoard came not from a tomb but a storeroom. It contained the throne now in the Lima Museum, over a hundred ponchos and other beautiful textiles, one of which is in the Montreal Museum and eleven silver vases. The largest vase, a meter (39 inches) in height, was presented to the Lima Museum by the late Dr. Julio C. Tello, who had rescued it when President Leguía's house was looted in 1930. One of the two smallest is now in the Museum of Art, Providence, R. I.; the other is in a private collection in New York.
[14] Caso, 1932a, 1932b.
[15] Mason, 1943.
[16] Lothrop, 1937–42, part I.
[17] Oviedo, lib. XXXII, cap. VI, vol. 3, p. 246.
[18] Willard, 1926, p. 131.

As a matter of fact, considering that ceremonial offerings were cast in the Cenote for over five hundred years and that metal artifacts were obtained from such distant lands as Colombia and Mexico, there is surprisingly little diversity in Cenote metals. The reason for this is that the full complexity of various metallurgical centers was never represented at the Cenote. Only a limited number of artifacts from individual areas became articles of commerce.

TABLE XXXVII: PERIOD AND TYPES OF CENOTE METALS

Objects	Mixteca-Puebla Period 1450–1520	Mayapan-Tulum Period 1200–1450	Tula-Toltec Period 968–1200	Maya Great Period
Sheet Gold				
Undecorated gold disks	X	X	X	...
Battle-scene disks	...	...	X	...
Gold masks	X	(?)	...	...
"Horse collars"	...	...	...	X(?)
Gold sheathing	X	...	X	...
Gilded Sheet Copper				
Santa Rita disks	X	...	...	...
Ear plugs	X	...	...	...
Bracelet	X	...	...	...
Sandals	X	...	...	...
Cups	X	...	...	...
Cast Copper				
Rings	X	...	...	...
Bells — miscellaneous	X	X	X	...
Bells — wire-wound	X	(?)	...	...
Cast Gold				
Quimbaya	...	X	...	...
Coclé figurines	X	X	...	...
Coclé bells	X	X	...	...
Veraguas figurines	X	X	...	...
Veraguas bells	X	X	...	...

Objects from Panama. The Province of Coclé and Veraguas in central Panama manufactured artifacts of gold which were exported in considerable quantity. Products of this trade have been noted in Central America (fig. 108), the Mexican states of Michoacan and Oaxaca and in the Cenote. A great deal of gold has been found in the Panamian Province of Chiriquí and in Costa Rica. These regions produced gold but usually not in large quantities as they also imported gold objects from central Panama.

Present-day knowledge of both Coclé and Veraguas is based on excavations on the Pacific or southern slopes of the Isthmus. Our chief sources concerning native culture and the use of gold on the north coast still stem largely from accounts of the fourth voyage of Columbus (1502 A.D.). Yet the north coast probably produced the specimens which reached the Cenote. We therefore must expect Cenote styles and ores to differ from those of the south coast. These differences are not great or important at present, but they may lead eventually to the identification of manufacturing centers when more archæological material from the north coast is available. One of the important contributions of Panama to Yucatan and central Mexico consisted of disks of sheet gold. They evidently were worn in quantity on the north coast of Veraguas, for Columbus, as we have pointed out, secured forty-six in a few days. These disks can be identified by the fact that they contain only about 3 per cent silver as an impurity. Similar sheet gold occurs in Coclé but not enough authenticated specimens from southern Veraguas are available for comparisons. In Yucatan these disks sometimes were processed locally by adding embossed designs and by trimming.

Objects from Northern Central America. Precious metals of aboriginal manufacture from Honduras and Guatemala are so rare and so diversified in type that it seems probable that all examples were imported. Copper was cast just before the Conquest on the Bay Islands and in the Chamelecón Valley in Honduras, also in the Lower Motagua Valley and probably elsewhere in Guatemala. Some of the Cenote copper bells, including all examples of style E, have no gold or iron as impurities and small quantities or arsenic, antimony and bismuth. These probably were imported from Honduras. There is historical evidence of such trade.

Objects from Mexico. In view of the known wealth of the Mexican peoples in gold and silver and their historical contacts with Yucatan, it is surprising that so few of their products appear in the Cenote collection. No object of silver was found nor any gold with high enough silver content to be classed as Mexican.

TABLE XXXVIII: COMPARISONS OF COPPERS ANALYZED BY W. C. ROOT

Location or Type	Number of Specimens	Percentage* of Specimens Containing: Lead	Tin	Silver	Gold	Iron	Arsenic	Antimony	Bismuth	Copper-Tin	Copper-Lead
Arizona	17	12	...	*71*	6	...	...	...	...	...	...
New Mexico	15	...	7	*67*	...	...	...	...	...	...	...
Casas Grandes, Chihuahua	11	...	...	*100*	...	(?)	9	18	...	...	...
Valley of Mexico bells	12 (7) †	75	50	100	85	43	85	71	43	34	50
Oaxaca	28	57	32	89	7	19	54	40	18	7	...
Guerrero	5	80	40	*80*	20	40	40	20	...	40	1
Michoacan	5	40	40	100	...	...	20	...	...	...	...
Tajumulco, Guatemala	13	...	...	28	...	...	...	6	...	...	...
Honduras	19	53	63	53	...	...	42	11	11	5	...
British Honduras	6	17	...	100	...	...	...	...	...	...	...
Cenote, gilded copper	5	60	100	*100*	*100*	40	80	60	...	...	...
Cenote, rings	6	100	50	100	33	67	100	17	33	...	...
Cenote, bells, Style A	12	92	92	*100*	33	75	83	50	75	...	...
Cenote, bells, Style A1	9	*100*	89	*100*	56	89	*100*	89	89	...	...
Cenote, bells, Style B	6	67	83	100	...	67	83	83	33	...	...
Cenote, bells, Style D	9	100	56	100	11	22	100	78	100	11	11
Cenote, bells, Style D1	5	80	100	*100*	40	80	*100*	100	100	...	...
Cenote, bells, Style D3	9	89	67	100	33	44	89	44	22	...	11
Cenote, bells, Style D4	6	83	50	100	...	67	83	83	50	...	...
Cenote, bells, Style E	4	100	50	100	...	...	100	25	75	...	...
Cenote, bells, wire-like	21 (17) †	90	67	100	19	86	100	100	35	5	48

* Italicized figures indicate that elements occur in relatively large quantities.
† Some specimens not analyzed for all metals.

The group of masks shown in figures 46, 48 and 49 must be of Mexican manufacture if not of Mexican metal because one of them (fig. 46, *b*) is decorated with the sign for gold found in Aztec and Mixtec codices. A pair of earrings, one of which is illustrated in figure 58, may also be Mexican. Linked jewelry of a vaguely similar type was made in Oaxaca.

Probably the bulk of the copper objects in the Cenote came from central Mexico. In table XXXVIII it will be seen that the Cenote bells are closest in composition to the Mexican, and the wire-like Style F groups are very similar to those from the Valley of Mexico. Copper rings and celts probably came from Oaxaca.

HISTORY OF NEW WORLD METALS

The exact time and place where metal was first worked in the New World has not and probably never can be determined. It is known, however, that gold and to a slight extent silver were utilized by the Chavín and Paracas Cavernas cultures. Radiocarbon dates from each culture are respectively 715 ± 200 B.C. and 300 ± 200 B.C. The length of time these cultures flourished at present can only be a guess. In the case of Chavín metalwork, we presume that the typical Chavín style of stone carving had been developed before the gold jewelry, which repeated the lithic motives. The known specimens probably date from the end of the period, a conclusion supported by the introduction of such an advanced technique as soldering. Casting did not appear in northern Peru until the discovery of copper during the Gallinazo period several hundred years later.

In view of repeated claims of trans-Pacific influences based on American metallurgical techniques, we should point out that copper was cast in the Near East over 3500 years before it was so employed in the Americas and that bronze had been known throughout Asia for a very long time. Along both the northern and southern Peruvian coast, on the contrary, there was a definite golden age which preceded cast copper, and bronze did not appear until many centuries after copper. Metallurgical techniques and chronology on either side of the Pacific definitely do not coincide.

It is by no means clear how knowledge of metals was acquired outside Peru and even the development of techniques within Peru can be followed only on a broad basis. In table XXXIX we have analysed the metal traits of certain important cultures and areas. The reader will note that each has its distinctive pattern and the only feature shared by all is the hammering of gold. Yet presumably these cultures and areas are interrelated – except the United States, where an independent invention and development took place, which antedated the metal industry in Mexico.

The early Peruvian coastal cultures shaped gold by hammering and annealing. In later times on the south coast, silver and silver alloys largely replaced gold, but copper, bronze and casting, although known, did not become important. On the north coast, gold and silver continued to be hammered but casting, first of copper and later of bronze, became an important industry.

Very little is known about metals in the interior of Peru except in the vicinity of Cuzco and Lake Titicaca, where most specimens are of Inca style. The metalwork of the Titicaca Basin definitely did not follow the historical pattern of the coast, for the first metals are copper and gold, both of which appeared in the Chiripa culture. Classical Tiahuanaco produced the earliest known bronze and also sheet ornaments of gold and silver. The fact that the Aymara Indians dwelling around Lake Titicaca still use the Quechua word for gold (*cori*) suggests the source of their knowledge of that metal.

Practically no objects of metal have been found on the Peruvian coast north of Lambayeque or on the southern coast of Ecuador. This is true both from archæological and historical points of view. The followers of Pizarro lamented their lack of booty. In the interior of southern Ecuador there was a well-developed metal industry, influenced by Peru. This may be in part of early date, as Chavín pottery has been found. Farther north, Colombian influence may be noted, and local developments occurred such as the casting of minute gold beads and the use of platinum.

The history of metallurgy in Colombia must remain largely an enigma until stratigraphic studies provide more data. From table XXXIX one would surmise that an independent development had taken place which resulted in the introduction of *tumbaga* alloys into Peru. On the other hand, the fact that *cori*, the Quechua word for gold, is associated with a mythical underground river by an Isthmian tribe (p. 27) implies that knowledge of that metal had come from Peru.

TABLE XXXIX: TYPICAL NEW WORLD METALS IN SELECTED AREAS AND CULTURES*

	United States	Mexico	Colombia-Isthmus	Chavín	Mochica	Chimu-Inca	Paracas Cavernas	Late Chincha-Ica
Hammered copper	X	+	...	...	+	+	...	X
Hammered gold	O	+	+	X	X	X	X	+
Hammered silver	O	...	...	O	+	X	O	X
Cast gold	...	X	X	...	...	+	...	...
Cast *tumbaga*	...	+	X	...	O(?)	+	...	...
Cast silver	...	O	...	...	...	+	...	...
Cast copper	...	X	O	...	+	+	...	O
Cast bronze	...	X	...	...	...	X	...	O
Cast copper-lead	...	X	...	...	...	...	...	...
Cast lead	...	...	...	...	...	O	...	...
Solder	...	O	O	+	+	X	...	+

* X – typical. + – not common. O – very rare.

There is no indication at present that the metal industry of Colombia is of great antiquity. To be sure, a couple of gold objects have been found in the vicinity of San Agustin,[19] but association with the so-called "early" sculpture is uncertain. Also the assumed chronological plane of this culture may be questioned, as stylistic parallels have been noted between San Agustin carving and Coclé metal. The styles known as Sinú and Quimbaya are at least in part contemporaneous with Coclé. A Quimbaya specimen was found in the Cenote.

Colombian manufacturing techniques had expanded into Panama and Costa Rica. Stratigraphy in Coclé suggests that metal had been used at least for two or three hundred years before the Conquest. In Costa Rica, association of pottery styles with metal implies a late date. In southern Costa Rica, ancient refuse beds have been found beneath the historic cultures, but they contain no metal. On the other hand, we have seen that Veraguas gold reached Mexico at a period early enough to influence Mixtec jewelry.

[19] Bennett, 1944, p. 33.

So few objects of metal have been found in Nicaragua and the eastern two-thirds of Honduras that it appears that no metal industry ever existed in this region. One wonders what first induced traders from the north to cross this territory and reach the gold-bearing lands farther south. The search for quetzal feathers might be the explanation.

The oldest worked metal now known from Mesoamerica was found in a vault under stela H at Copan which bears the date 9.17.12.0.0 (782 A.D.). It consists of the legs from a cast *tumbaga* figurine of Panamanian style.[20] It has been suggested that these legs might have been placed in the vault long after the erection of the stelæ. We do not see how this is possible and, in any case, Boggs' still unpublished finds of metal at Tazumal, El Salvador, with pottery approximately contemporaneous with Stela H prove that metal was beginning to trickle into the Maya area in the eighth century A.D. The Copan legs are of cast *tumbaga*, containing 51 per cent gold, 5 per cent silver and 44 per cent copper.

Apart from metal there are other indications of early trade in Mesoamerica. A Maya jade has been found in Costa Rica[21] and Olmec jades have been found in all the Central American republics except Nicaragua. The Museum has an example from the Province of Veraguas in Panama.[22] Olmec ornaments are sometimes pictured on Maya stelæ in Guatemala.[23] We thus have evidence of reciprocal trade in various commodities from north and south, which association with Maya chronology places near the end of the Great period.

The Copan legs indicate that specimens in Coclé and Veraguas styles found in the Cenote of Sacrifice may be of comparatively early date but this cannot yet be confirmed by the local archæology in the Isthmus. Dating in Panama, apart from an Olmec jade and a Plumbate ware jar, depends on grave stratifications at the Sitio Conte in Coclé, which probably cover only two or three centuries.[24] As a result of trade, the Coclé stratification can be linked with local manufactures in the Provinces of Los Santos, Herrera, Veraguas and Chiriquí. We believe that no published specimens of metal from Panama are much older than the thirteenth century and that Cenote artifacts of Isthmian style are mostly of equivalent date. The presence of Sinú and Quimbaya gold in Coclé graves, however, may indicate a somewhat earlier date when the archæology of those regions is better understood.

The only metal specimen from the Cenote which we believe may possibly be pre-Toltec is the gold "horse collar" seen in figure 56. These objects, of unknown use, usually are made of shell and a number have been found under controlled archæological circumstances which fix the date of manufacture in the middle of the Maya Great period (p. 72). We do not know for how long a time they were produced. It is held by some that offerings were not made to the Cenote gods at this early date and that the Great period jades from the Cenote are heirlooms. This remains to be proved.

The Itza nation, under Tula-Toltec leadership, settled at Chichen Itza in a katun 4 Ahau which covered the years 968 to 987 A.D. This date, which is given in several Maya chronicles, is in the short count and therefore is not subject to the controversies which cloud the correlation of long-count dates with our own. It is of importance in this study because it marks the introduction to Yucatan of sheet gold disks and cast bells, probably of copper.

The sheet gold consists of disks and cut-out motives, often executed partly in Great period Maya and partly in Tula-Toltec styles. A similar overlapping of styles can be seen in some of the large bas-reliefs at Chichen Itza, and it also occurs on a lesser scale at other Yucatan cities such as Uxmal, Sayil and Kabah.[25] The presumption is that the gold and stone were worked by Maya craftsmen who depicted the victorious Tula-Toltec as they were bidden by conqueriors, but that they added purely Mayan motives when they were allowed to follow their own tastes.

The first evidence of bells in the Cenote comes from the disks, for Tula-Toltec warriors are shown wearing them. We believe that these were copper bells from Mexico rather than gold bells from the Isthmus. If so, it places the date of cast copper in Mexico slightly earlier than has hitherto been revealed by archæology but this is in accord with native tradition that the Toltec of Tula were the first Mexican metallurgists. We may add that no Teotihuacan-Toltec art forms have been found in the Cenote.

The fact that cast bells were manufactured by the Tula-Toltec before the end of the tenth century agrees with the fact that copper bells either were cast or imported by the inhabitants of Snaketown in Arizona during the Sacaton Phase, which is dated from 900 to 1100 A.D. These limits are set by tree-ring dating and are not open to much argument. They allow a reasonable time for the spread of a cultural trait from Mexico to the Southwest.

After the Tula-Toltec period, during what corresponds to the Mayapan-Tulum period in Yucatan, there comes a partial void in our knowledge of Mexican metalwork, which terminates with establishment of Aztec and Mixteca-Puebla cultures. Presumably, during this period, advances were made in technical skills, but, if so, they cannot be detected from the material now available.

Cenote metal finds probably dating from the corresponding Mayapan-Tulum period consist mostly of Isthmian imports, for it is known that metalwork flourished there at this time. In Coclé, it is possible to segregate most of the pottery into two successive periods. Some of the metal jewelry can also be placed chronologically but, unfortunately for the archæologist, these forms did not reach Mexico and Yucatan.

Mixteca-Puebla art, as now known, seems to date only from just before the Conquest. It had existed long enough, however, to exercise strong influence in Campeche and British Honduras, i.e., across the base of the Peninsula of Yucatan. In the Cenote it is represented by copper gilt disks. Where the metal was manufactured is unknown. The decorating evidently was done in a region where Maya glyphs were used and Mixteca-Puebla influence had spread.

Aztec products are represented in the Cenote collection by bells, notably by the wire-like bells made of a copper-lead alloy. Comparisons of the chemical components of copper bells are shown in table XXXVIII. This indicates that the Cenote bells as a whole are closest to those from the Valley of Mexico and adjacent states. On the other hand, specimens exist which may well have come from Honduras, where most copper artifacts probably date from the Aztec period.

[20] Morley, 1946, fig. 55, *c*. The other specimens in this illustration and in figure 56, said to have come from the Cenote of Sacrifice, are forgeries.
[21] Hartman, 1907, pl. XLV, 10.
[22] Lothrop, 1950, fig. 141.
[23] Lothrop, 1941a.
[24] Older cultures have recently been discovered in Panama by Dr. M. W. Sterling and in Boruca by the writer, but no metal objects have yet been found with them.
[25] Roys, 1943, p. 177, fig. 11. Morley, 1946, pl. 73, *f*.

THE MAYA AS METALLURGISTS

Our present evidence is that, although they valued metal ornaments, Maya knowledge of metalworking was limited to embossing and trimming previously manufactured sheets. This statement assumes that the mysterious Toquegua tribe inhabiting the lower Motagua Valley at the time of the Conquest was not Maya. It is entirely possible, of course, that metallurgical centers may yet be discovered in Maya territory.

There is no obvious reason why this gifted and æsthetically minded people did not adopt and perfect an art practised by their neighbors. It is true that much of the Maya area consists of limestone with no metals, but gold dust might have been imported as was done by the Aztec to be cast locally in forms of their own creation. It was not isolation which prohibited the working of metals because for centuries the Maya continued to acquire the products of foreign lands. It is also curious that none of the Mexicans who settled in Yucatan practised metalworking as they had presumably done in their former homes.

The Pipil of El Salvador and Guatemala, probably of the same stock as the Tula-Toltec of Yucatan, also seem to have lacked any but imported metals. The Aztec colony at Naco in Honduras, however, probably made the copper objects in the adjacent bell cave, for strips of copper were found which may be ingots, and a wooden mask of the Aztec deity Ëecatl was discovered. It seems probable that this Aztec group taught their Paya neighbors to smelt copper.

The suggestion has been made that the Maya of Yucatan made gold disks locally by hammering imported cast gold objects. This we reject because the disks are of unusually pure gold, which often differs radically from the imported gold castings. The *tumbaga* specimens become as hard as bronze when hammered and thus are not suitable for pressed-out designs unless they are annealed. Furthermore, *tumbaga* specimens have a gold surface. Hence analysis would be necessary to determine which pieces were suitable for hammering.

Although we do not believe the Cenote sheet gold was manufactured at Chichen Itza, we think that the decoration sometimes was applied locally. The reason for this is that Toltec figures and details of their equipment correspond so closely to certain bas-reliefs, particularly in the lower Temple of the Tigers and the outer Temple of Kulkulcan.

Granted the limited metallurgical knowledge of the Maya, they nevertheless managed to turn out products of high artistic merit. Had they mastered the art of casting, they undoubtedly would have manufactured artifacts adorned with the flamboyant charm of their monumental sculpture and their jade jewelry. Though confined to the medium of sheet gold and largely to the subject of forgotten wars, Maya craftsmen attained the high artistic level of their murals and sculptures and they recaptured the pageantry and savage incidents of contemporary life.

CENOTE METALS AND THE CORRELATION PROBLEM

Although Maya and Christian calendars are each well understood, the point at which they should be geared together has been the subject of much controversy. In our main text we have tried to explain our material in the light of the Goodman-Teeple-Thompson-Martínez correlation, because it is at present the most widely accepted and because the writer had found plausible the complicated evidence brought forth to support it. Inasmuch as this volume contains material of a type not previously studied or published, it seems well to check various other correlations in the light of newly ascertained facts.

The metal specimens which furnish pertinent evidence on dating are the pictorial gold disks illustrated in figures 1, 29–37, 40–44. Concerning these, the following points have been established:

1) *The central panels of the disks as well as many stone carvings at Chichen Itza exhibit symbolism and paraphernalia such as are found at Tula in central Mexico.* This includes headdresses, arm bands, back shields, bird gorgets, spear throwers, jaguar and eagle symbols and emblems of Kukulcan. Numerous writers have discussed and illustrated these parallels. Any dating of Tula-Toltec art in Yucatan must be correlated with the dating of archæological remains at Tula, Hidalgo, in central Mexico and vice versa.

2) *The Cenote disks show warriors wearing bells of Mexican type.* This is in accord with the tradition that the Toltec were the first metalworkers in Mexico. It indicates, however, that copper was cast in Mexico before 1000 A.D., a slightly earlier date than hitherto has been established.

3) *The Cenote disks must be assigned to the very beginning of the Tula-Toltec period at Chichen Itza* because they are close in style only to the carvings in admittedly early buildings such as the Caracol and the lower part of the Temple of the Tigers. In fact the disks may pre-date all buildings of the Toltec period. The Toltec occupation of Chichen Itza supposedly was not violent. The wars recorded on the disks then probably preceded an era of peace and construction. In one case, a naval battle is pictured which could not have taken place near Chichen Itza because there is no lake in the vicinity.

4) *The disks commemorate individual achievements.* They therefore were manufactured during the lifetime of their owners. In this they differ from frescoes and reliefs which may record ancient victories or historic ceremonies.

5) *The disks depict victorious Toltec warriors and Toltec Sky deities in the central panel only. Otherwise they are completely of the Maya Great period, both in style and subject matter.* We have established this, we trust, beyond argument through literally scores of art parallels between the disks and the classical sculptures of southern Maya cities (pp. 31–42).

It has been generally recognized that elements stemming from classical Maya art of the Great period occur in sculptures credited to the Tula-Toltec at Chichen Itza. A similar situation also exists to a minor extent at Kabah, Sayil and Uxmal. This situation has not aroused much interest and has never been critically appraised, although certain parallels have been illustrated by Maudslay and Spinden. Customarily the presence of mixed art styles in Yucatan has been vaguely dismissed as archaism, the deliberate retention or resuscitation of defunct art forms.

Does this fit the facts? Is it not probable that the Cenote disks and various Yucatan carvings provide definite evidence that Maya Great period, the Puuc period in Yucatan and Tula-Toltec art were in part contemporaneous and flourished together for a con-

siderable period of time? If so, any correlation of Maya and Christian calendars which does not provide a period of overlap must be questioned. Assuming for the moment that such contemporaneity is a fact, let us see how it affects the proposed adjustments of the calendar.

The correlation of the long-count dates with our own depends on which Maya calendar round of 256 years is applied to a given date in our own system. Spinden [26] advocates pushing the dates 256 years back of the Teeple-Thompson-Martínez or 11.16 system, and Vaillant and others [27] have suggested that they be advanced an equal amount. These are termed 12.9 and 11.3 correlations. Kreichgaur [28] has suggested an 11.10 correlation.[29] The long-count correlation most generally favored in recent years has been the Teeple-Thompson-Martínez scheme (11.16). This system and the Spinden dating (12.9) are alike in that they are based both on conflicting historical evidence found in the books of Chilam Balam (p. 4) and also on long-count astronomical records, either carved in stone or painted in codices and frescoes. The Kreichgaur dating (11.10) is based solely on astronomical calculations. Vaillant's system (11.3) was proposed because he believed that the known pottery sequences could only be logically explained by a shorter time span than was reflected in the Spinden and the Thompson correlations.

Dr. A. V. Kidder [30] has recently discussed the problem on the basis of the finds of early copper in El Salvador. He remarked that, in the light of new ceramic evidence and cross dating, "one cannot, as confidently as before, dismiss the possibility of an 11.3 (Vaillant) correlation." Kidder's objection to this system was that knowledge of copper had presumably reached the southwestern United States from Mexico between 900 and 1100 A.D. and the 11.3 correlation did not place the use of copper in Mexico early enough to fit in with the tree-ring dating of the Southwest. We believe this objection has now been removed because the Cenote material has yielded short-count evidence that the Tula-Toltec exported copper bells from Mexico to Yucatan before 1000 A.D.

A new approach to the correlation problem and additional evidence supporting the Vaillant scheme (11.3) had previously been published by Wauchope,[31] who discussed the results of his stratigraphic excavations at Zacualpa, Guatemala, in relationship to the genealogies of kings preserved in native documents.

We suggest still another approach based on the comparative dating of metals both in the controversial long count and also in the generally accepted short count, concerning which there now is only minor disagreement.

Numerous facts have been presented in this volume to indicate that metals came to Chichen Itza at the very beginning of the Tula-Toltec occupation. Various native records place this event in katun 4 Ahau, a short-count date covering the years between 968 and 987 A.D. This katun 4 Ahau corresponds to the following long-count dates under the various correlations which have been mentioned:

12.9 (Spinden) correlation — 11.1.0.0.0
11.16 (Thompson) correlation — 10.8.0.0.0
11.10 (Kreichgaur) correlation — 10.2.0.0.0
11.3 (Vaillant) correlation — 9.15.0.0.0

After this volume was in proof, an important study of Maya sculpture was published [32] which added greatly to knowledge of chronological changes in style. It has not been possible to make many desirable additions in the present text on account of the expense involved. We may say briefly, however, that such features on the Cenote gold disks as headdresses, ear plugs, collars, cuffs, featherwork and scrolls repeatedly fall into definite categories in Miss Proskouriakoff's chronological classification of sculpture. Furthermore, the characteristic styles found on Cenote disks first appeared in the Great period sculpture at dates ranging between 9.10.0.0.0 and 9.16.0.0.0, continuing until the end of the stela cult. Were the gold disks to be judged purely as Maya art, we would date them between 9.18.0.0. and 10.2.0.0.0.

Miss Proskouriakoff's study of stone sculpture leads her to the "inescapable conclusion" that some contact existed between Tula-Toltec and Classical Maya art but she does not seek a mechanism to explain it. We suggest, however, that the dating of the gold disks under the Kreichgauer (11.10) or Vaillant (11.3) correlations provides an era of cultural overlap. When two styles of art interlock as at Chichen Itza, the most logical conclusion is that they are contemporary.

We have seen that metal was introduced to Copan before the long-count date of 9.17.12.0.0 and, on ceramic evidence, copper was used in El Salvador at about the same time. We have also seen that metal was known at Chichen Itza during or shortly after a katun 4 Ahau which covered the years 968–987 A.D. How much time passed between the introduction of metal at the two cities? According to the Spinden correlation, metal came to Chichen Itza 468 years after it reached Copan. The Thompson scheme makes it 208 years and the Kreichgaur correlation makes it 96 years later. The Vaillant system places metal at Chichen Itza 52 years before the Copan date.

We should also contrast the gap between the last-known Initial-Series (long-count) date, 10.4.0.0.0, and the short-count date of Toltec settlement at Chichen Itza, katun 4 Ahau or 968–987 A.D. Under the Vaillant and Kreichgaur correlations, the Maya continued to carve Initial Series for 180 and 40 years respectively after the Itza settlement. Under the Thompson and Spinden systems, the Maya stopped recording Initial-Series dates respectively 80 and 340 years before the occupation of Chichen Itza by the Tula-Toltec.

In assessing these figures, we should point out that classical Great period Maya art flourished at Chichen Itza not only at the beginning of the Tula-Toltec period but well into it. This is established, for example, by carvings in both the outer and the later Temple of Kukulcan, which was built over and enclosed the earlier building. How long it took to construct these two huge edifices and how long the first was occupied before the second was erected over it can only be a guess at present. Our minimum estimate would be not less than half a century. This or a longer period should be added to the figures for the Thompson and Spinden correlations in the preceding paragraph in order to express the time gap they imply between the last Maya Initial Series and still flourishing classical Great period art in Yucatan.

The Spinden and Thompson dating thus call for epochs of 390 plus or 130 plus years respectively when Maya Great period sculpture presumably had died out in the southern cities but continued to flourish in Yucatan in combination with Tula-Toltec art. This could scarcely be explained as lingering tradition in an isolated area, for Chichen Itza was then at its cultural apogee and was a great center of pilgrimage and trade, nor can we construe the classical-Maya forms in Yucatan as a revival like Victorian Gothic, for there is no evidence that they had ever dropped out of use.

Both the 11.10 (Kreichgaur) and 11.3 (Vaillant) correlations, on the other hand, admit an era of approximate contemporaneity for Tula-Toltec and Maya Great period styles. On the basis of the material discussed in this volume, we now prefer the 11.10 correlation, but before abandoning the Thompson correlations, which we have followed because it seemed the most plausible when we started this study, other archæological problems must be considered, notably ceramics and architecture. In addition, questions raised by historical records and astronomy should be considered. The archæological problems of Yucatan also must be co-ordinated with those of other areas, notably Mexico and northern Central America. In short, to reach a fully acceptable correlation of Maya and Christian dates many factors must be harmonized. At the moment, architectural and ceramic studies are in progress which should facilitate a final solution. And this we hope can be confirmed when the radiocarbon technique of dating has been perfected.

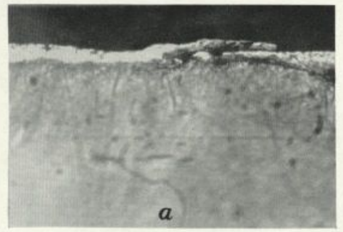
[26] Spinden, 1924.
[27] Vaillant, 1935.
[28] Andrews, 1940.
[29] In the Maya numerical system, the right-hand digits each represent a period of about twenty years. The left-hand digits each represent about four hundred years.
[30] Kidder, 1948.
[31] Wauchope, 1947.
[32] Proskouriakoff, 1950.

APPENDICES

APPENDIX I:
METALLOGRAPHIC EXAMINATION OF GILDED SHEET COPPER AND WIRE-LIKE BELLS

By William Harvey

Gilded Copper. Two examples of gilded copper of the type illustrated in figures 59–69 were examined by microscope. The analyses of these specimens appear in table XXII, numbers 1306 and 1309. The thickness of the gold layer, determined by measurement of the projection at 1000X, ranged in value from 1 to 5 microns, the average being about 2 microns. Figure 110, *b*, shows a typical section of the gold film photographed at 2000X. The gold layers on both pieces were comparatively continuous which accounts for their remarkable preservation as demonstrated in figure 111, *b*. In places, however, overlapping of the gold layer was observed (fig. 110, *a*), affording strong evidence that the gold was applied as a foil. The fact that the gold layer follows closely the contours of the copper surface indicates that application of the gold foil was followed by mild hammering.



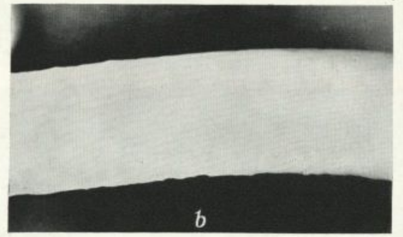
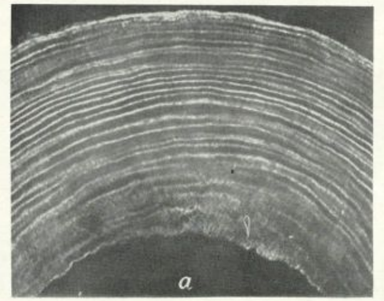


Fig. 110. Photomicrographs of gilded copper sandal. *a*, strongly etched, 75X; *b*, 2000X. See table XXII, analysis 1306.

Although both specimens are quite similar, slight differences in hardness and cohesive strength were noted. The hardness values for 1306 and 1309 are in the ratio 2.2:2.3. When specimen strips were bent at an angle of 135°, surface cracks occurred at the bend in 1306 but not in 1309. The presence of grain boundaries and twinning planes within the copper grains indicates that cold working had taken place and that the strips were subsequently annealed. Elongated non-metallic inclusions prove that the copper had suffered elongation by rolling or hammering. Under polarized light, numerous silicate inclusions were identified.

When etched, both specimens revealed a laminated structure as shown in figure 111, *a*. The alternative light and dark striations, when viewed at 2000X, did not reveal any particles which could cause this laminated appearance. A staining of selected areas by the etchant (acidified $K_2Cr_2O_7$) intensified the striations. These striations also represent zones of weakness, since longitudinal separations (cracks) were observed to follow these lines at the ends of the specimens. The suggestion has been made that the strips were formed in the manner of Damascus swords, *i.e.*, copper sheets were beaten thin, folded over and again hammered, and the process continued through a number of cycles.



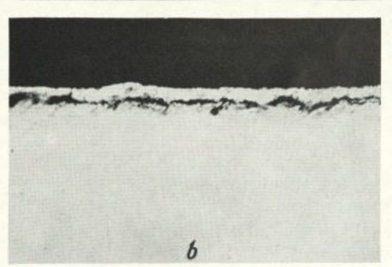


Fig. 111. Photomicrographs of gilded copper sandal. *a*, 2000X; *b*, 50X. See table XXII, analysis 1309.

A Wire-like Copper Bell. Photomicrographs of a wire-like copper bell appear in figure 112. This specimen is illustrated in figure 86, *c*, and the analysis is given in table XXX, no. 151. This object certainly is made in one piece and not of soldered wire as one would judge from its appearance. It shows unmistakable cast dendritic patterns, and the absence of elongated inclusions indicates that it has not been hammered. Also it is probable that the dark areas are not corrosion products but an eutectic of copper

and some impurity (lead) deliberately added to lower the melting point and improve castability.

Figure 112 shows the extent of corrosion in the copper of which the bell is composed. Several shades of gray corrosion were observed (CuO, Cu_2), in addition to relatively large non-metallic inclusions which had probably been dislodged from the crucible used in melting the copper. The corrosion, which did not occur along grain boundaries, appears to have converted 40 per cent of the metal to oxide. Under high magnification, the corrosion of the copper was seen to follow along crystallographic planes (fig. 112, *d*). Equiaxed copper grains indicate annealing of the metal subsequent to casting.

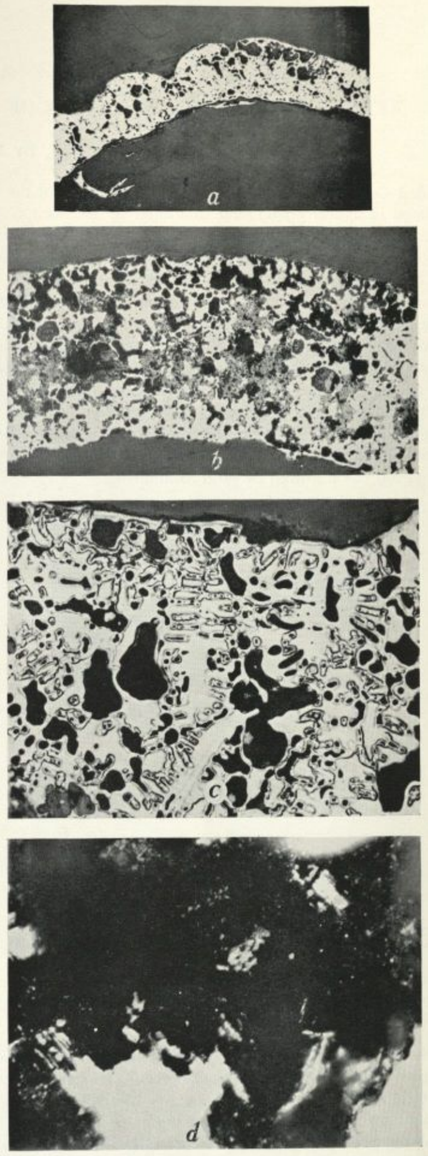


Fig. 112. Photomicrographs of sections from a wire-like bell. *a*, 20X; *b*, 50X; *c*, 100X. Etched with $H_2O_2 + NA_4OH$. *d*, 2000X. See figure 86, *c*, and table XXX, analysis 151.

APPENDIX II: METALLURGICAL TOOLS AND MATERIALS

There is a constantly growing body of literature concerning New World metal artifacts and how they were made, but scarcely anything is known about the tools with which they were manufactured. The reason for this is that the Spaniards were more interested in the bullion values than in the workmanship. Hence descriptions of metalworking are none too clear and are regrettably brief. The only detailed description of the sixteenth century comes from the pen of Sahagún and applies to central Mexico. This we have quoted *in toto* (pp. 16–19).

Sahagún's text is accompanied by twenty-nine water-color sketches which supposedly illustrate metallurgical processes. We illustrate several from his *Codice Florentino* in figure 6. A full reproduction in color was published in Mexico in 1938. In this edition the individual drawings dealing with metals carry the numbers 41 to 69 (láms. LVI–LIX), by which we shall refer to them in the following discussion. Details of the tools illustrated are so uncertain that few of them have been recognized among Mexican archæological specimens in our museums today.

For comparative purposes we have woefully little material — from Peru, Argentine and Chile only. In the last two countries, small pottery crucibles have been found, one in the Province of Salta, one near the Rio Quitratue, an affluent of the Toltén.[1] Both are in the Museum of the American Indian, Heye Foundation. They are thick-walled, crudely made cups about the size of half a ping-pong ball. The Chilian specimen was identified by traces of slag on the interior and by the fact that the Mapuche Indians still use the same type of crucible today.

Sahagún's drawing 62 supposedly shows the smelting of metal in two crucibles. These are easily identified as pottery incense burners, one of the long-handled frying-pan type, one of globular form with lattice-work openings in the side. Both are well known in Mexico, but they are too large to serve as a crucible. A smaller container was needed, to which intense heat could be applied to melt only a few ounces of metal. Sahagún's text (paragraph 86), however, compares the Mexican crucibles to a spoon, presumably both in size and shape.

Drawings 50 and 61 illustrate domed ovens such as are now used for baking and sometimes for firing pottery. We doubt that it would be possible to generate sufficient heat in them to liquify metals. If this form of oven existed in Mexico in pre-Conquest times, it was for use as a sweat bath rather than for smelting.

Drawing 62 also shows the use of a blow pipe to increase the heat. This device was known in Peru and probably was employed wherever metals were melted.

It is evident that the native Americans melted pure gold, silver and copper only with great difficulty, and they realized that alloys had lower melting points. Sahagún's drawing 65 apparently illustrates a basket containing lumps of metals which are colored red and gray. This may be interpreted as copper and silver, a combination which has not been established by analysis as a pre-Conquest Mexican alloy but which was used in Sahagún's day.

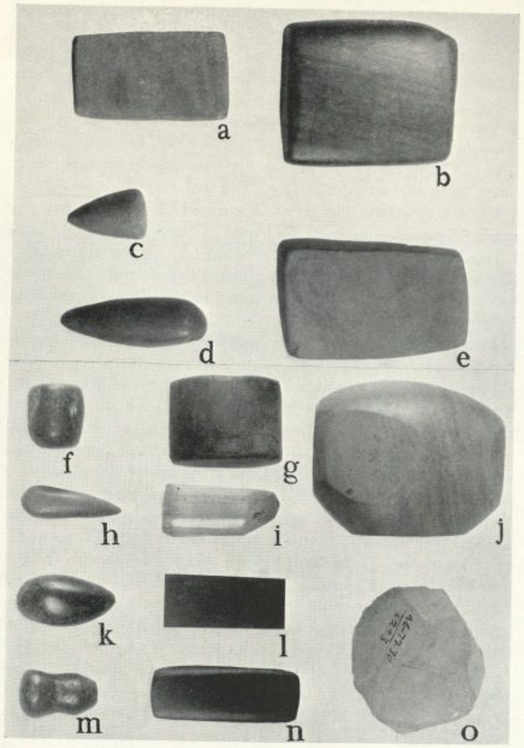


Fig. 113. Peruvian metallurgical tools. *a*, *b*, *e*, *j*, *n*, *o*, hammers; *c*, *d*, *h*, *i*, *k*, *m*, embossing tools; *f*, *g*, rollers; *l*, stone for smoothing wax. Scale, 7/8.

To make *cire perdue* castings, it was necessary to form sheets of wax, "thin like the web of a spider." According to Sahagún's (paragraphs 18, 19, and 66; drawing 47) this was done with a wooden roller and a flat stone. These can be identified in a set of Peruvian metalworking tools in figure 113. The Peruvian rollers (*f*, *g*) are of stone rather than wood. The flat stone (*l*) is like a modern whetstone and is as smooth as glass. If it seems small for the purpose, the extreme delicacy of the workmanship must be remembered, and Sahagún (paragraph 21) expressly states that wax was applied to the mold in small pieces.

[1] The southern limit of pre-Spanish metalworking in Chile is unknown. In a refuse site near the mouth of the Paicaví River (S. Lat. 38°) we found apparently aboriginal copper. Near Osorno (S. Lat. 40° 35′) we opened a grave of early colonial date containing copper ear ornaments and a trace of iron. This is close to the southern limit of pre-Conquest pottery in Chile.

Molds were constructed of powdered charcoal mixed with very fine clay. These ingredients were ground on a metate (drawings 51 and 57). Perhaps the very small metates which supposedly were used to grind chocolate were employed for this purpose.

According to Sahagún (paragraph 6), the Mexicans carved molds with a little scraper of copper. His illustration (drawing 47), however, shows a turtle being fashioned with what looks like a bone awl. Small metal chisels are found in the Isthmus which seem appropriate for carving molds.

Sahagún states (paragraphs 23 and 74) that the wax was applied to the mold with a small piece of wood called *quahuitztli* (thorn). This must have been employed to build up wax sheets and threads over the inner part of the mold. The wax was then encased in an outer layer of charcoal and clay. The vent was called *anillotl*.

Various types of hammers are illustrated by Sahagún. Some of these (drawings 54 and 67) are hafted in European fashion. Long bars, sometimes with a curved end (drawings 53 and 64) also were employed. In addition (drawings 46 and 67) there are rectangular hand hammers which may correspond to the Peruvian examples in figures 113 and 114.

Metallurgical hammers have been identified in Peru from historical sources,[2] and the other implements in figure 113 presumably also were tools for working metals as they were found with hammers. Benzoni speaks of "black stones shaped on purpose" which served as hammers. Garcilaso de la Vega is more explicit, for he writes that the metalworkers of Cuzco ". . . used certain very hard stones, of a color between green and yellow, instead of anvils. They flattened and smoothed one against the other, and held them in great estimation because they were rare. But they worked with certain instruments made of copper and brass [tin?] mixed together. These tools were the shape of dice with the corners cut off. Some are large, so that the hand can just clasp them [fig. 114, *c*], others middling size, and others small, and others lengthened out to hammer on a concave [fig. 113,*n*]. They hold these hammers in their hand to strike with as if they were pebbles."

These descriptions fully cover the specimens illustrated. One (fig. 113, *n*) is black; the others, with an exception of crystal (fig. 113, *o*), are made of an olive-green rhyolite. In weight they range from 29 to 1119 grams (1 to 36 ounces). For the most part they are beautifully finished with a texture like ivory, and one can well imagine that their owners held them in high esteem.

In figure 114 we have analyzed the working surfaces on three hammers. These are thirteen, nine and twelve in number. In some cases, especially at the narrow ends, the working surfaces are in pairs (*b*, 2 and 7, but not 4 and 9; *c*, 1 and 3, 10 and 12). Just how the different surfaces were employed we cannot say today. It is obvious, however, that these are not tools for novices but for craftsmen who have fully mastered their trade.

According to Sahagún, hammered gold sheets (paragraph 48) were embossed with a pointed stone (paragraph 51). In his illustrations (drawings 54, 55 and 66) the tools are shown as long and slender like a pencil. Peruvian embossing tools, identified by their association with the hammers, are shown in figure 113, *c*, *d*, *h*, *i*, *k*. Like their Mexican counterparts, they are of stone but they are not long and slender. The butt may be rounded or flat and has apparently been used as a polishing stone.

Two other implements are depicted by Sahagún. One is apparently a sieve, shown in the background of drawing 46. This may have been used to sift the powdered charcoal and clay employed in making molds. The other (drawings 42 and 58) is a long bone trimmed diagonally at both ends to form points. The center of the shaft is wrapped in cloth to serve as a handle. We have seen no archæological object of this type. We suggest that it may be a hand pick used for mining clay and breaking up lumps so that they could be ground on a metate.

Other materials used by Mexican smiths include alum, in a solution of which castings were bathed. We do not know why. In addition, they employed an ointment of clay and salt to make gold "very yellow," perhaps by extracting surface silver. Drawing 46 may illustrate one of these processes.

The implements and materials here described probably could have produced any or all of the artifacts found in the Cenote. It has been possible to list them, however, only by examining all evidence over a very wide area. No doubt many local tool types existed of which we are totally ignorant today.

[2] Lothrop, 1938, p. 13, fig. 2; p. 16.

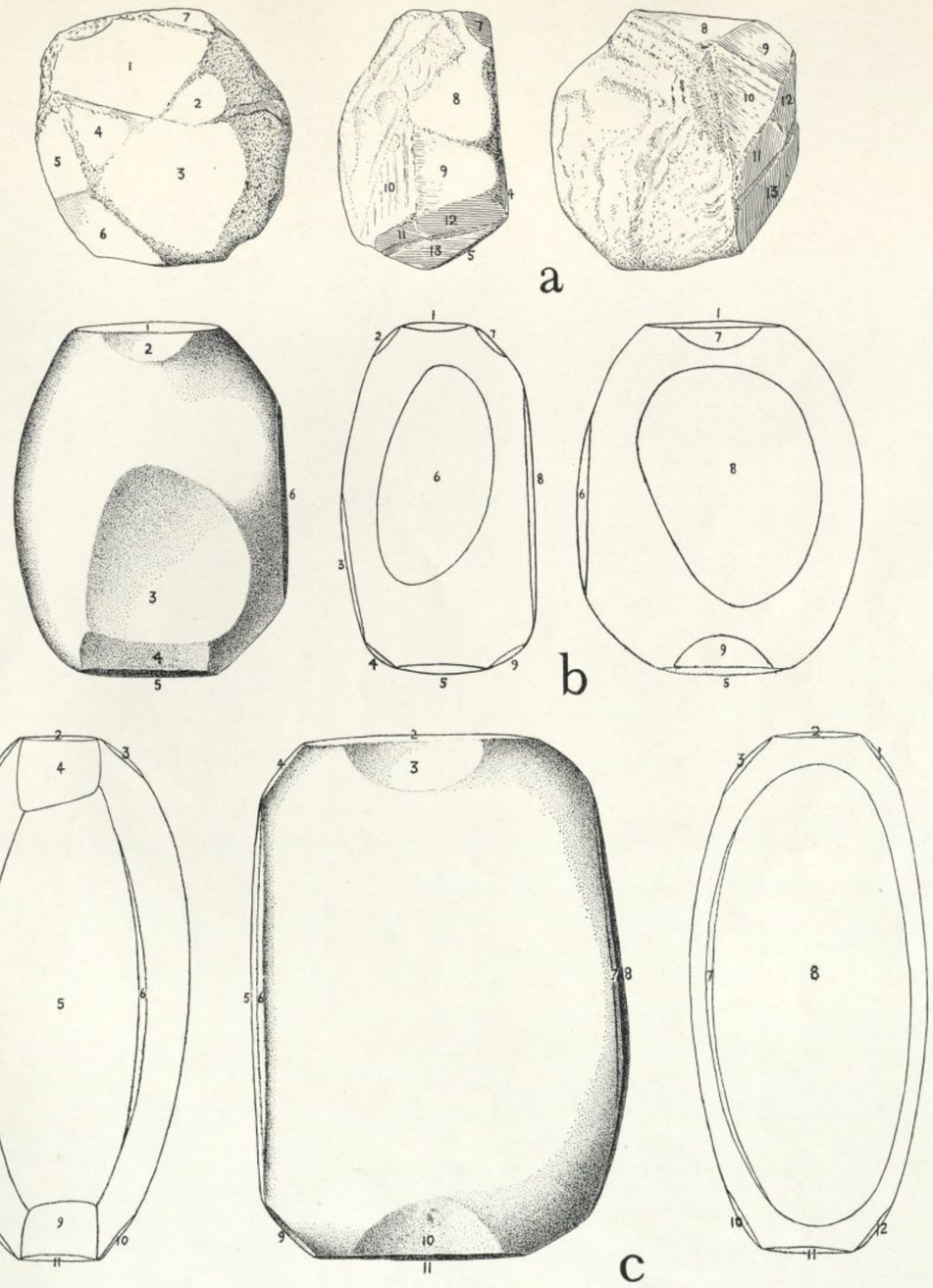


Fig. 114. Peruvian metallurgical hammers. Actual size.

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INDEX

INDEX[1]

[1] This index includes cultures and tribal and geographical names, with selected subjects given below individual headings.

(*Continued from inside front cover*)

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