

seconds—essentially the time it takes for the Moon to move about 10 km (the approximate height of the mountains on the limb). At the edge of the track, or even better, just outside the edge, the beads will rotate around the limb of the dark lunar curtain, and the observer will see a continually changing light show. Video cameras and a thin solar filter are tailor made for recording the high-resolution bead phenomena.

For those jaded by too many annular eclipses in the past (that is, at least one), the spectacle can be spiced up by heading for the end point, where the annular ring lies on the horizon. Think of the photography: the annular ring behind a person on the horizon, behind a prominent building, behind a telephone wire (well, that will happen without planning). During the sunset annular over southern California in 1992, my wife Judy watched a green flash when the lower arc of the ring touched the ocean, and another when the upper ring reached the horizon. A green flash is unlikely in this eclipse, but a view of a football-shaped Sun sinking below the Texas horizon might get an honourable place in the *Journal* if you submit it to me. ★

Jay Anderson is a member of the Winnipeg Centre and editor of this Journal. He has seen a bunch of eclipses.

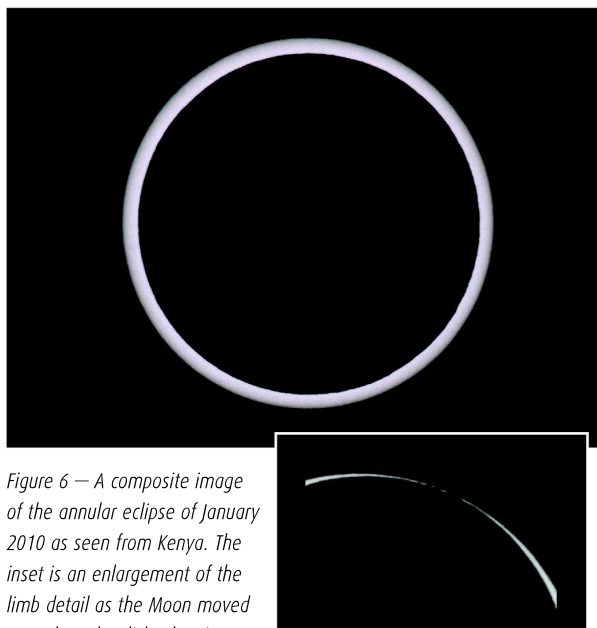


Figure 6 — A composite image of the annular eclipse of January 2010 as seen from Kenya. The inset is an enlargement of the limb detail as the Moon moved onto the solar disk, showing some of the beads.

An Early American Zodiac

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Abstract

This study builds on two previous articles and uses Aztec and Mayan sources to re-assemble an early American zodiac of 13 constellations.

Résumé

Cette étude se base sur deux articles précédents et se sert de sources Aztec et Maya pour reconstituer un zodiac paléoa-méricain de 13 constellations.

1. Introduction

In an earlier submission to this journal, “Star Patterns on the Aztec Calendar Stone” (McIvor 2000), I suggested that the dotted pattern at the 7 o’clock position on the stone was a group of stars that straddles the ecliptic in Sagittarius. In a more recent piece, “Aztec Constellations Preserved by Duran” (McIvor 2010), I identified five constellations from Aztec paintings preserved by this Spanish priest in 1579, and I plotted the five figures with stars along the ecliptic. I then had a partial zodiac, but I had exhausted Aztec sources. I now wish to turn to Mayan sources to continue my reconstruction of the

zodiac, for there is reason to believe that Maya and Aztec had a similar zodiac, and Mayan sources could add to my list.

The Aztecs of central Mexico and the Mayas of the Yucatan peninsula had a shared history. They also shared a calendar that had 18 “months” of 20 days each, plus 5 “useless” days. Similarity in time-reckoning suggests that they mapped the

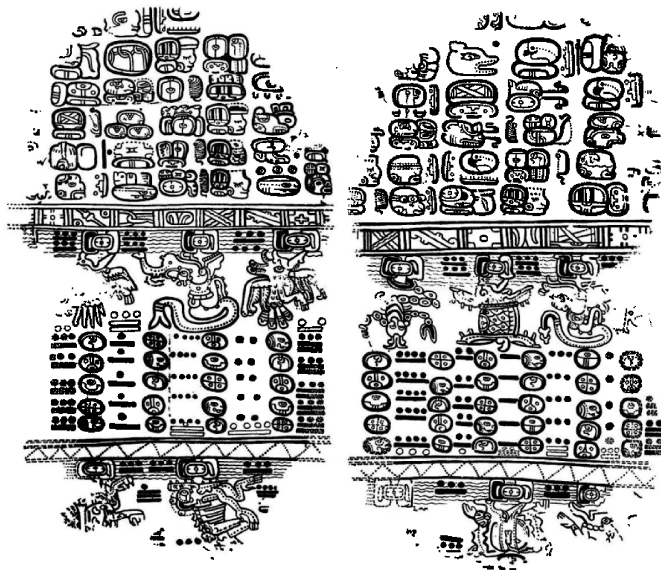


Figure 1 — Pages 21 and 22 from the Paris Codex. The zodiac figures mentioned in the text lie across the middle and bottom of the images (Villacorta & Villacorta, 1976). See <http://digital.library.northwestern.edu/codex/codex.html> for a larger view.

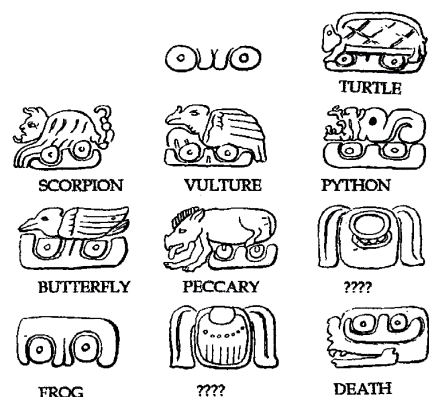


Figure 2 — Animals carved at the Nunnery at Chichen Itza, with names added.

heavens with similar constellations, as organizing the year and mapping stars along the ecliptic are flip sides of the same coin. The Aztecs and Mayas probably inherited their calendars and constellations from an earlier civilization in Mesoamerica. I am interested in two Mayan sources. One is the pre-conquest manuscript called the Paris Codex (Figure 1) that shows a row of animals hanging from sun symbols below a sky band; the other is the Nunnery at Chichen Itza (Figure 2), which displays a row of animals on the lintel that matches part of the Paris Codex sequence.

These sources offer tantalizing hints of a zodiac, although we need to bear in mind that a parade of animals is not a zodiac in the astronomical sense unless the animals can be matched with star patterns straddling the ecliptic. We are faced with two challenges: the first is to identify the animals on the codex and list them in the right order; the second is to plot each animal against the stars along the ecliptic. We do not come to this challenge empty handed, for we have already plotted five Aztec zodiacal constellations. The additional animals in the Paris Codex will hopefully fill some or all of the empty spaces.

2. The Animals in the Paris Codex

Herbert Spinden first proposed the idea of an early American zodiac in 1916. He realized that the Paris Codex once displayed 13 columns with 13 animals and a few had become effaced over time. He suggested cautiously that “The thirteen animals holding in their mouths the sign of the sun might represent thirteen signs of a zodiac” (1916:77). He thought these constellations appeared in the Mayan sky in the order set out in the codex and he felt the zodiac could have been “an independent invention” (1916:79), American-made, not borrowed or inherited from elsewhere.

Maya scholars tell us that these pages in the Paris Codex read from right to left and the first animal was once painted at the

top right of the right page. Most of it is effaced, and only an appendage of some kind remains (Figure 1). It is insufficient to identify the animal. The second animal is a rattlesnake; the third a turtle; the fourth a scorpion; and the fifth is a vulture. The sixth animal is a serpent. I think it is a python that has coiled itself around a tapir and is squeezing the life out of its victim. (A tapir is an animal indigenous to Mexico and it has a distinctive trunk.)

The seventh animal is a bird. The eighth animal at the lower right of the right page is almost completely effaced. Kelley (1976:47, 49-50) identifies it as a peccary on the basis of seeing a hoof on one forelimb. Its flat snout reinforces this identification. The ninth animal is another bird. The tenth animal is totally effaced. The eleventh is largely effaced although Severin (1981:12) suggests the squiggle may be the cloven hoof of a deer. The twelfth animal is a human skeletal ribcage and a fleshless head-death or a death-head. The thirteenth creature is partially effaced. Kelley (1976:49) points to its spotted skin and prominent claws and identifies it as a jaguar. Thus eleven of the thirteen animals can be identified, at least provisionally.

I identified five animals in Aztec cartography as Butterfly (western half of *Pisces*), Bird (*Taurus*), Frog (*Gemini*), Death (*Leo* +), and Rattlesnake (*Scorpius*). Four of the five appear on the Paris Codex. The Frog is totally effaced in the Codex. When we add Frog to the Mayan line-up, we have identified 12 of its 13 animals.

The Aztec calendar began on February 2 (February 12, Gregorian) according to Sahagun (1569). The Mayan calendar began on July 16 (July 26, Gregorian) according to Landa (1566). Their zodiacs had the same sequence of animals, but because their calendars began the year in a different season, their zodiacs began with a different constellation. The Aztec zodiac began with Butterfly. The Mayan zodiac began with the only animal we have not identified yet.

The following list names the animals in the Paris Codex. I have underlined the ones we can identify in the Aztec zodiac: Unknown, Rattlesnake, Turtle, Scorpion, Vulture, Python, Bird, Peccary, Bird, Unknown, Deer, Death, Jaguar. Our five Aztec constellations— Rattlesnake, Butterfly, Bird, Frog, Death— provide a framework that we can use to assign seating for the extra animals in the Paris Codex. For example, it is obvious which animal is located between Butterfly and Bird. It is Peccary.

3. Peccary

The Peccary is wedged between the Butterfly in *Pisces* and the Bird in *Taurus* so it must be located in *Aries*. The stars in *Aries*, with a few in *Triangulum* and *Cetus*, will configure this tail-less pig that is native to the Americas.

4. Deer

The Deer precedes Death on the Paris Codex. We have already placed Death in Leo and part of Virgo, so Deer can be positioned in Cancer.

5. Jaguar

The Jaguar follows Death on the Paris Codex. We have already placed Death in Leo and part of Virgo, so Jaguar can be positioned among the stars in eastern Virgo.

6. Turtle

The Turtle follows Rattlesnake in the Paris Codex. We have already positioned Rattlesnake in Scorpius so the Turtle must be in Sagittarius. The Aztec Sun Stone has a star pattern at the 7 o'clock position shaped like a box or parallelogram and it is matched by the parallelogram joining ψ , ζ , γ , and ϵ in Sagittarius. These four stars configure the body of this Turtle, which is probably a box turtle. It is swimming in the Milky Way but seems to be held in place by a lasso or a net of some kind. (A box turtle can retract its head and legs within its shell.)

7. Scorpion, Vulture, and Serpent

We placed Rattlesnake and Turtle in Scorpius and Sagittarius. The three animals following Turtle in the Paris Codex are Scorpion, Vulture, and Serpent, so they should be assigned seating in sequence in Capricornus, Aquarius, and Pisces.

The body of the scorpion can be configured with the northern row of stars in our Capricornus. Its head dips below the ecliptic. Its stinger is raised above the ecliptic at a bright star cluster to the west. It hangs by its tail from the ecliptic, like the scorpion in the Paris Codex. The vulture includes many of the stars in Aquarius, but it needs one star from Pegasus for its head. The python is known to wrap itself tighter and tighter around its prey, but I have coiled this python harmlessly around the Circlet of stars in the western half of Pisces.

8. The Missing Constellation

We have insufficient evidence to identify one of the animals. It must have been positioned in our Libra because that is the only space vacant along the ecliptic. I can make an educated guess about its identity. Duran names the 20 days in an Aztec month, and Heyden lists them as Alligator, Wind, House, Lizard, Serpent, Death, Deer, Rabbit, Water, Dog, Monkey, Wild Grass, Reed, Jaguar, Eagle, Buzzard, Motion, Flint Knife, Rain, and Flower (Figure 3). The 20 figures for the 20 days form an inner circle on the Aztec Sun Stone. At least five of them, Rattlesnake, Death, Deer, Jaguar, and Motion (Butterfly) are zodiacal constellations, and the missing constellation may be one of the other animals on the list.

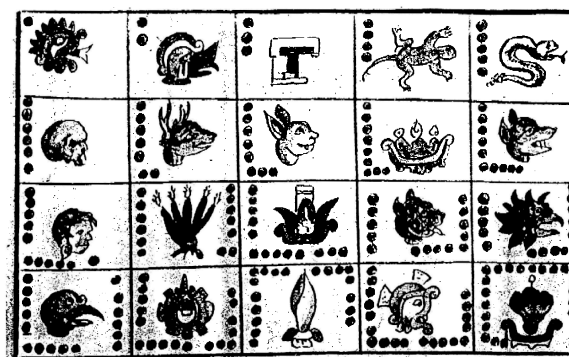


Figure 3 — The 20 Aztec day symbols.

I can choose from Alligator, Lizard, Rabbit, Dog, Monkey, Eagle, and Buzzard. I think Lizard is the best choice because the appendage for the first animal on the Paris Codex could be the right forearm of a Lizard.

9. Animals Carved at Chichen Itza

Coe (1975, Figure 9) describes a sequence of animals on the East Wing of the Monjas at Chichen Itza as “probable asterisms.” I have added names for most of them: Turtle, Scorpion, Vulture, Python, Butterfly, Peccary, Unknown, Frog, Unknown, Death (Figure 4). Eight form a sequence that matches a row of animals in the same order in my zodiac, which adds an independent layer of credibility to my scheme.

10. A Complete Zodiac

I have a complete circle of 13 animals and it has a symmetry that is esthetically pleasing. The figures look good up close as well (Figure 5).

I admit my proposal is not free from criticism. I acknowledge that Deer and Lizard barely made the cut (if I can use a term from golf). If archaeology uncovers better candidates in the future, one or both may be replaced. If that becomes necessary, the circle will remain an authentic zodiac of animals.

My arrangement is based on two equations: the first is that the Aztec Bird is our Taurus and the second is that their Rattlesnake is our Scorpius. I equated Bird with Taurus because Duran wrote in 1579 that it was “a star formation that appears in the heavens like a bird pierced with a bone. The imagination of the natives may be compared with that of the poets and the astrologers, who imagined they saw the sign of Taurus, made up of many stars. Thus these people imagined this sign in the sky.” Horcasitas and Heyden commented that “The constellation in the form of a bird pierced with a bone can be identified as Taurus.” Some Mayan support for equating Bird with Taurus is the Yucatec Maya Dictionaries that ambiguously describe the Pleiades as “a bird” and “a snake rattler star” and “an insect” (Lamb 1981:234).

I equated their Rattlesnake with our Scorpius and there is both direct and indirect evidence for this correlation. Milbrath (1999) suggests that “the White Bone Snake may be an image of Scorpius” and she interprets the sarcophagus at Palenque as showing Lord Pacal entering the Milky Way at our Scorpius. The indirect evidence comes from the Skidi Pawnee Indians of North America who viewed the stars in our Scorpius as “a big snake”, according to Chamberlain (1982). This tribe is known to have borrowed ideas from the Aztecs. Several other cultures also viewed the stars in our Scorpius as a snake, including the Kogi of Colombia (de Greiff & Hildebrand, 1987), several tribes in Brazil (Levi-Strauss, 1968), and a number of tribes in Java (Staal, 1988).

11. Comparing Schemes

Since 1976 there have been several attempts to reconstruct a Mayan zodiac. Table 1 compares my proposal with four previous efforts. Three of these earlier schemes assume that the Mayan scorpion is our Scorpius despite criticism from several scholars. Spinden (1916) did not think the assumption was credible. Thompson (1974) thought it was “highly doubtful that the same constellation is involved.” And, Love (1994) insisted that “modern researchers should not make the *a priori* assumption that the Maya scorpion is the Western Scorpio.”

When different cultures use the same name for a star group, they may not mean the same constellation. There are a number of obvious examples. The Chinese had a Ram constellation like us, but it was located in Cancer the Crab, not in our Aries the Ram (Allen 1963:5). The Inca had a Serpent constellation like us, but it was a “dark cloud” shape in the Milky Way, not our Serpens (Bauer & Dearborn 1995:139). Egypt and Brazil each had a Crocodile constellation, but the Egyptian reptile swims near Polaris (Krupp 1983:107), while the Brazilian version was configured by stars in Orion (Staal 1988). It is unlikely that the Mayan scorpion was our Scorpius.

Researchers agree that five of the animals in the Paris Codex can be identified in sequence as Rattlesnake, Tortoise (Turtle), Scorpion, Bat (Vulture), and Snake (Python). I think a sequence of animals in the Paris Codex demands a sequence of constellations in our zodiac. I therefore show their Western equivalents as Scorpius, Sagittarius, Capricornus, Aquarius, and Pisces, that form an uninterrupted sequence. However, the earlier efforts to reconstruct a Mayan zodiac propose five equivalents that are literally all over the place. None of them forms a sequence, and I consider this failure a serious flaw.

Bishop Landa (1566) recorded that the Mayas paid close attention to Venus, the Pleiades, and Gemini. I therefore began with the Pleiades, and I came to recognize it as the eye of the Bird pierced with a bone, which Duran equated with our Taurus in 1579. Trejo tells us that “Tianquiztli, meaning crowd or market, corresponded to the Pleiades” (2002:3).

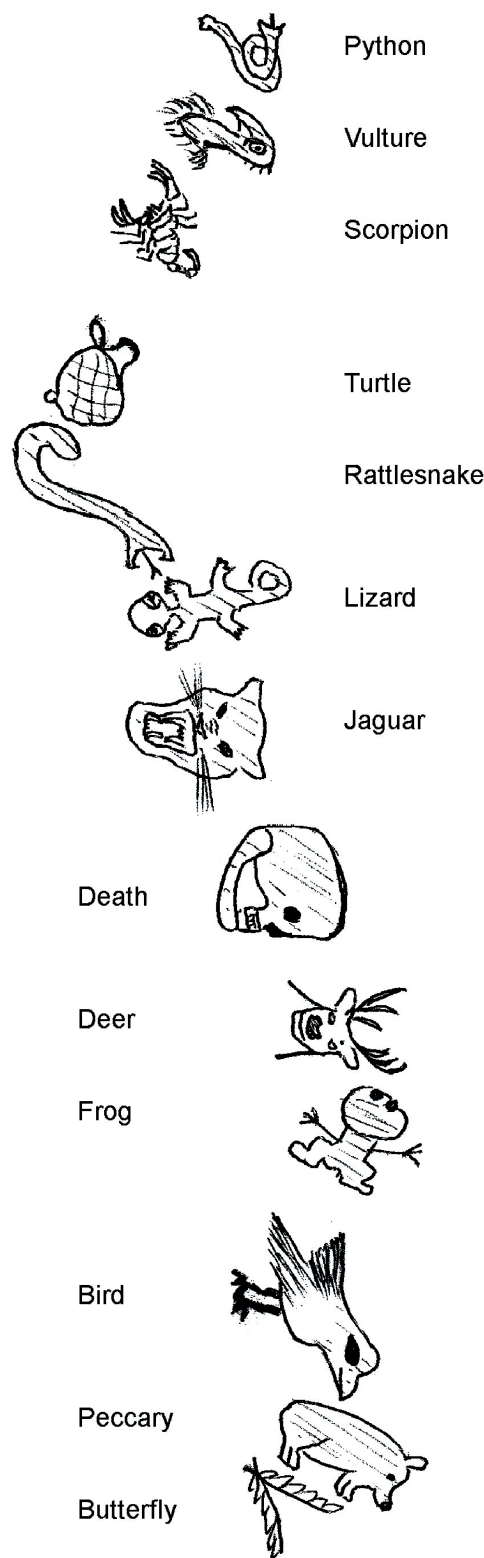


Figure 4 — A complete zodiac of 13 animals. The five added by the author from previous work are Rattlesnake, Death, Frog, Bird, and Butterfly.

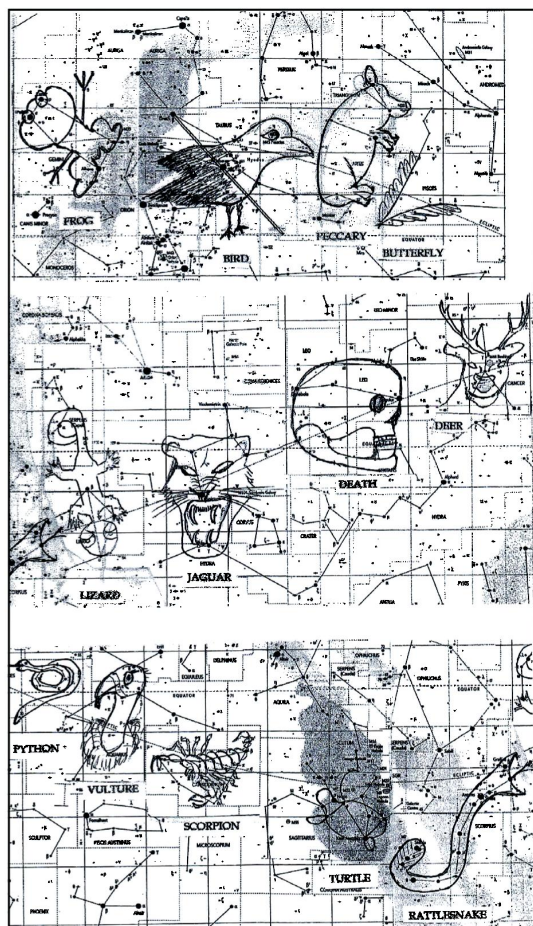


Figure 5 — Thirteen constellations, up close. Four of the constellations can be matched with Greek equivalents: Bird=Taurus; Frog=Gemini; Rattlesnake=Scorpius; Scorpion=Capricorn.

Anthony Aveni agrees it “likely represents the Pleiades” and he describes the Aztec depiction as “arrowhead-shaped” (2001:34). In my article of 2010, I suggested it resembles the sideview of an eye for it is oval-shaped on one side and pointed at the other. It is interesting that the Inca called this star cluster *eyes* (Aveni 2001:311) and the Maori in New Zealand called it *little eyes*.

In *The Golden Bough* (1912), Frazer describes how “the Pleiades plays an important part in the calendars of primitive peoples, both in the northern and in the southern hemisphere. They have commonly timed the various operations of the agricultural year by observation of its heliacal rising or setting.” I took great care in positioning the Bird on the ecliptic to make sure its eye coincided with the position of the Pleiades. Then I secured the Bird firmly in place by piercing it with a bone (actually, a straight line) from β Tauri through α Tauri to 10 Tauri. I think positioning the Pleiades correctly is the most critical first step in trying to reconstruct the early American zodiac, because this star cluster must have been as prominent in their zodiac as it was in their calendar and observations.

12. Foreign or American?

Did early Americans compose this zodiac or was it brought here from elsewhere? There are two good reasons for thinking that this zodiac was invented in America.

The first reason is that the animals are native to the Americas. Bishop Landa (1566) described the animals in Mexico at the time of the Conquest. He listed turtles, lizards, deer, tail-less pigs (peccaries), scorpions, and tigers (jaguars), and went on to describe snakes, including rattlesnakes and pythons, and a spectacular variety of birds. Every animal in this zodiac can be found in the Americas. Whoever invented this zodiac was familiar with all these creatures. Donald Menzel (1943) used the same line of argument when discussing the origin of our Western constellations in *The Heavens Above*: “Most of the animals shown among the constellation figures are those familiar to the people of the Old Testament who lived in Mesopotamia. This fact leads us to believe that the figures originated in that part of the world.” So, too, the animals in the early American zodiac suggest their constellations originated with people familiar with these animals, that is the early Americans themselves.

The second reason is that the ecliptic in this arrangement accommodates the unique American calendar of 18 months of 20 days. We learned from Duran that some Aztec figures (*i.e.* Bird) spanned two months while others (*i.e.* Butterfly) spanned only one month. Theoretically, this early American zodiac divides the ecliptic longitudinally into eight constellations of 20 degrees and five constellations of 40 degrees. Eight constellations spanned one month, five spanned two months, and altogether they composed a zodiac of 13 constellations that supported a calendar of 18 months of 20 days. This arrangement differs from the zodiac we have inherited from Greece that theoretically divides the ecliptic longitudinally into 12 segments of 30 degrees. It differs from the ancient Egyptian division of the ecliptic into 36 segments of 10 degrees that supported a calendar of 36 “weeks” of 10 days. And, it differs from Chinese cartography, copied by Korea and Japan, where a lunar zodiac divides the sky longitudinally into 28 segments of unequal widths. This early American zodiac resonates with the early American calendar. The 5 wide segments of 40 degrees I assigned to Bird, Frog, Death, Rattlesnake, and Turtle.

13. Reassembling an Early Zodiac

I never set out originally to assemble a zodiac. It happened more by accident than design. My initial interest in early cartography was sparked a decade ago by the dotted patterns on the Aztec Sun Stone. I like “joining the dots,” so I tried my hand at identifying these patterns with stars in the real sky. Years later, my reading of Duran’s manuscript offered up several more constellations. When I realized I had assembled five constellations along the ecliptic, it seemed logical to use

this framework to impose order on the row of animals on the Paris Codex.

Over the years, my views about an early American zodiac have changed. A decade ago, I thought their zodiac could have been brought to America from elsewhere. But, I cannot hold that view anymore because it has animals native to America and its division of the ecliptic is consistent with time-reckoning on this continent.

I have assembled 13 animals: Lizard, Rattlesnake, Turtle, Scorpion, Vulture, Python, Butterfly, Peccary, Bird, Frog, Deer, Death, and Jaguar. This arrangement vindicates the proposal made by Spinden in 1916 for 13 constellations in the order set out in the Paris Codex in a zodiac composed by sky observers in early America.

14. Is It Worth the Effort?

At a symposium of the IAU in 2009 on *The Role of Astronomy in Society and Culture*, Ivan Sprajc (2011) referred to efforts to reconstruct an early American zodiac: “The most interesting data concerning Maya constellations are contained in the prehispanic manuscript known as the Paris Codex. The images on pages 23 and 24 have been interpreted by various researchers as a Maya zodiac, even if there is no agreement about the functioning of the table and the identity of constellations.” He failed to mention the reason for these disagreements. I think McKillop (2004) described the situation much better when she emphasized that “researchers agree about the existence of a Maya zodiac” and she recognized that their disagreements are due to the “information from the codices [that] provide a fragmentary and sometimes contradictory picture of the Maya zodiac.”

F.R. Stephenson reminds us that “Charting the stars is an undertaking entirely different from delineating terrestrial features such as the continents and islands. Since the stars appear as scattered points of light, any attempt to divide them into groups must necessarily be subjective. The arbitrariness of such an exercise is increased by the wide range in brightness among the roughly six thousand stars that are estimated to be visible to the average unaided eye over the whole of the celestial sphere. It is thus remarkable that throughout history only two distinct schemes of astral cartography have enjoyed widespread usage. These are of Babylonian-Greek and of Chinese origin.” (1994:511)

Are there only *two* schemes of cartography that have enjoyed widespread usage, or was there a third scheme that originated in early America? We know a great deal about Babylonian-Greek and Chinese cartography because their records were preserved intact. It was entirely different in the Americas, where native culture was devastated in the Conquest in the 16th century. Some bishops burned thousands of codices and left us impoverished. The few bits and pieces of evidence for native astronomy are scattered and fragmented, and the challenge is to reassemble them as best we can. Disagreements are inevitable in these circumstances. The question of a zodiac in America is an archaeological as well as an intellectual quest. It is time consuming but worth the effort if we can conceive that the history of cartography will be re-written and a future author will write that “*three* distinct schemes of cartography have enjoyed widespread usage.” When that happens, the zodiac of early America will take its rightful place in the history of cartography.

	Paris Codex	McIvor 2012	Kelley 1976	Severin 1981	Bricker 1992	Milbrath 1999
1	Lizard (Serpent)	Libra	?	Sagittarius	?	?
2	Rattlesnake	Scorpius	Sagittarius	Taurus	Pleiades	Pleiades
3	Turtle (Tortoise)	Sagittarius	Gemini	Orion	Orion	Orion
4	Scorpion	Capricornus	Scorpius	Gemini	Scorpius	Scorpius
5	Vulture (Bat)	Aquarius	Aquarius	Virgo	Virgo	Aquarius
6	Python (Snake)	Pisces (E)	Libra	?	Sagittarius	Sagittarius
7	Butterfly (Bird)	Pisces (W)	Aries	Cancer	Capricornus	Capricornus
8	Peccary	Aries	Leo	Sagittarius	Leo	Leo
9	Bird	Taurus	Taurus	Scorpius	Gemini	Libra
10	Frog	Gemini	Virgo	Libra	Leo	Cancer
11	Deer (Bat)	Cancer	Pisces	Capricornus	Aquarius	Virgo
12	Death	Leo	Cancer	Aquarius	Pisces	Pisces
13	Jaguar	Virgo	Capricornus	Pisces	Aries	Aries

Table References: Milbrath (1999) Table 7.3, Aveni (2001) Table 23

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