Background of the Study:

Early in January 2012, I received an email from a Mr. Mark Pullen of Sandpoint, Idaho who inquired whether a couple of alignments he had identified at Pueblo Bonito in Chaco Canyon National Park might be related to a pair of similar alignments I had reported from Mexico in my volume titled “Cycles of the Sun, Mysteries of the Moon” published by the University of Texas Press in 1997. After examining the detailed evidence that Mr. Pullen enclosed, I was obliged to write back and inform him that even the two alignments in Mexico were unrelated to each other, because they involved sights taken on two different stars at two different times some 1600 years apart, so it was very unlikely that what he had discovered was related to either of my findings, and, most unfortunately, not in the sense his inquiry had expectantly anticipated.

However, from what Mr. Pullen reported in his email, it was clear to me that he was on the verge of a significant breakthrough in pre-Columbian archeoastronomy, and I strongly encouraged him “to take the next step”, “connect the dots”, and tell me what conclusion the significance of his discoveries revealed. I did so hoping thereby to ensure him the satisfaction and pleasure of working out the answer to his question by himself, but I also made the point that I believed I had already solved the problem on my own. As a final bit of advice, I suggested that he might wish to contact the local Indians to see what they had to say about his ‘discoveries’, knowing from personal experience that this could be a very questionable avenue of approach but might possibly be of some assistance as a last resort. However, to my great dismay, because I misplaced my printout of Mr. Pullen’s email and did not hear from him again for several months, I decided to write up my own account of what his clues had revealed to me, and the following is the result of that exercise.
The Critical Clue Provided by Mr. Pullen:

In his email, Mr. Pullen included a detailed, full-color representation of the core area of the Pueblo Bonito “apartment complex” on which he had highlighted the two alignments he believed were the most significant. One of these, at an azimuth of 262°, he identified as the sunset position on October 4th, but it was the more prominent alignment, that he located at an azimuth of 352°, he believed might have been similar to the two that I had described in southern Mexico. Indeed, the azimuth was identical to both of them, but, as I had explained in my email reply, could not have been employed in the manner he was postulating.

If the two azimuths discovered by Mr. Pullen were functionally linked, as he implied, then it occurred to me that they would have to have been employed sequentially, the first providing a clue as to where to look for the second. Thus, in order to utilize the Anasazi mnemonic model he was describing, I first confirmed that the azimuth of 262° did in fact correspond to the setting position of the sun on October 4th. With that fact established, I reasoned that sometime after sunset that evening, if I sighted along the second alignment, I would witness the “main event” taking place. Because of the extreme northerly orientation of the latter, I quickly concluded that this could only involve a stellar phenomenon, because neither the sun nor the moon reaches such an extreme position in the heavens. In short, I concluded that on the evening of October 4th, the stars in the northern sky must put on a “pretty memorable show” -- at least, one that the Anasazi considered important enough) to warrant taking notice of!

Having learned that the site of Chaco Canyon had been radiocarbon dated to about 826 AD and had been occupied for some three hundred years thereafter, I employed the Voyager computer program developed by Carina Software in San Leandro, California to display for me the northern sky as it would have appeared on the evening of October 4, 826 as seen from Pueblo Bonito. I realized at once that the key event that the Anasazi had witnessed was the transit of the outermost star in the handle of the Big Dipper, i.e. Alkaid, through the meridian precisely at midnight. Not only would this event provide them with the exact length of a day, when it was repeated the following evening, but it would also define the precise length of a year the next time the Big Dipper completed its circuit of the northern heavens and its handle once again pointed downwards toward the Earth as it transited the
meridian. Naturally, half way around its circuit, on the evening of April 4th, the Big Dipper’s handle would again intersect the meridian, but at this time, it would be pointing upwards, straight out to space. Thus, by using the annual circuit of the Big Dipper, the Anasazi had formulated the rudiments of a calendar whose two extremes most likely served as seasonal markers of critical importance to them. Only when I reconstructed the climate of the Chaco Canyon region did I find that April 4th marked the beginning of the agricultural year, in terms of both warmth and moisture, whereas October 4th marked not only the end of the growing season but also the beginning of a more challenging season characterized by cold, drought, and privation -- winter.

However, because the edge of the mesa rises in a sharp cliff some 90 meters (295 ft.) over the valley floor of Chaco Canyon on the northern horizon, as seen from Pueblo Bonito, to fully appreciate the significance of the October 4th event the local ‘sky-watcher’ would quickly have discovered that it would be necessary to view it from the top of the cliff instead, where a full 360-degree vista of the heavens is possible. This no doubt explains the presence of the small ruined structure at this location that is currently known as Pueblo Alto. Therefore, the discussion of this horizon-based event is based on having been viewed from this site, rather than from the valley bottom.
Figure 1. The northern sky at midnight on October 4, 826 as seen from Pueblo Bonito in Chaco Canyon National Park. The position of the October 4th sunset was one of the two alignments identified by Pullen at the site, marking an azimuth of 262° (8° south of west), whereas the second marked the azimuth of the star Kochab at 352°, (8° west of north). (It is not known whether the Anasazi attached any importance to the “right angle’ between them or not.) In any case, the star Alkaid, at the end of the handle of the Big Dipper, can be seen transiting the meridian, suggesting that this event played an important role in their annual life-cycle.
Figure 2. By the same token, the transit of Alkaid through the meridian a half-year later, on April 4th, must have likewise played a similarly significant role at the opposite ‘end of the year’. It is only when we examine these two dates in the context of the local climate that their significance becomes clear. See Figure 3 for an explanation.
Figure 3. A water budget diagram of Chaco Canyon, as it would be under the prevailing climatic conditions. Inasmuch as a Warmth Index of 2.00 is the minimum required for the successful cultivation of maize, it will be seen that the climate is currently more than warm enough to grow corn, but inasmuch as a minimum Moisture Index of .80 is also necessary, the Chaco Canyon area presently experiences a critical lack of water. Note that the growing season begins in April, when the temperature first climbs above the red line, but terminates abruptly in early October, when the temperature starts to fall precipitously. At present, it would require a minimum of 500 mm (19.7 in.) of moisture to produce a successful harvest of maize in this region.
Figure 4. This water budget diagram reveals that at Chaco Canyon it was possible to successfully grow maize even when the temperature was $-2^\circ$ C., (3.6 °F.) below what it is today, because at the lower temperature the effectiveness of the moisture would have been greater and a total precipitation of just over 420 mm (16.6 in.) would have been adequate. However, ever since the 12th century the region has been subject to rising temperatures and declining rainfall, so field agriculture today is restricted only to areas that can be irrigated.

References
