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Chapter 7
No-Hurricane Scenario and the "Great Storm"

As has already been touched upon in chapter 6, some previous writings have asserted that the "great storm" mentioned in 3rd Nephi 8:5 can be explained without a hurricane, while Sorenson has suggested that a hurricane might be involved.

Hurricanes are not unknown in the Isthmus of Tehuantepec, although they are not as common as in other areas in the Gulf of Mexico. The Isthmus is further south than most hurricane tracks and it is shielded by the Yucatan Peninsula from west-bound hurricanes. According to the NOAA Historical Hurricane Tracks database, there have been seven H1 hurricanes, one H2 hurricane, and one H3 hurricanes make landfall in the Isthmus since 1842. Based on the current historical data, a powerful hurricane is an unusual event in the Isthmus. Figure 57 shows all the known tropical storm and hurricane tracks going back to 1842.

In evaluating a 3rd Nephi scenario that lacks a hurricane, the first place we need to look for illumination on this issue is the Book of Mormon text itself. From 3rd Nephi 8:5–6, it is clear that there were two events, a "great storm, such an one as never had been known in all the land" and "also a great and terrible tempest." The prophecy of Zenos mentions only "tempest" (1 Nephi 19:11). Samuel the Lamanite cites the plural "great tempests" (Helaman 14:23) and makes no mention of a storm; however, later in Helaman 14:27 he refers only to a single "tempest."

Third Nephi 8:17 refers to the fact that the whole earth was deformed because of the "tempests," again in the plural, while 3rd Nephi 8:12 refers to the same event in the singular as a "tempest" and again in the singular in 3rd Nephi 8:19. 3rd Nephi 10:14 again refers to "tempests."

The situation is less than clear. The most consistent interpretation is that there was a tempest and a storm, which appeared to be separate. However, the storm was also referred to as a 'tempest' and as part of a plural 'tempests,' so there were still two separate events. It appears that Samuel the Lamanite identifies both the great tempest and the great storm as "tempests," with only one tempest actually changing the face of the land.

While there are arguments for and against identifying the "great storm" as a hurricane, the description of events by Zenos (where "storm" is not used) or by Samuel (where "storm" is also referred to as a "tempest") may better classify the "great storm" as part of the volcanic eruption, as perhaps a description of the initial mushroom ash cloud and subsequent airborne ash distribution combined with the initial blast shock wave, wind, and precipitation. Based on the assertion that the tempest(s) were one of the agents in the changing of the face of the land northward, it is fairly certain that the "great and terrible tempest" referred to volcanic pyroclastic or surge flows.

Figure 57. Tropical storm and hurricane tracks since 1842. Light blue is tropical/subtropical depression; green is tropical/subtropical storm; yellow is H1 level hurricane; orange is H2 level hurricane; red is H3 level hurricane; pink is H4 level hurricane; purple is H5 level hurricane (http://csc.noaa.gov/hurricanes/#, 2014, NOAA)

Arguments against the "great storm" being a hurricane are:

1. The Book of Mormon does not say anything about rain as an element of the destruction and there is reference to "exceeding dry wood." This issue was dealt with in chapter 6, and does not appear to be a strong argument;
2. Various cities were burned, which is incompatible with a hurricane;
3. The seasonality of a hurricane does not fit known meteorology.

Burning of Cities during a Hurricane

It would seem like common sense to assume that cities would not be subject to burning in the presence of a hurricane because of the associated precipitation. In this case, common sense is contrary to the historical record. Edward Bryant (2005, 210) recounts that a Tokyo earthquake known as the Great Kanto Earthquake on September 1, 1923, immediately collapsed over a half million buildings and created a tsunami. However, these events were not responsible for the ultimately large death toll, because many of the collapsed buildings consisted of lightweight materials. The deaths resulted from the fires that immediately broke out in the cities of Tokyo and Yokohama, and raged for three days, destroying over 50% of both cities. The outbreaks of fire were minor to begin with, but they occurred throughout both cities in large numbers, mainly because the earthquake occurred at lunchtime when many open fires were being used for cooking. Within a half hour, over 200 small fires were burning in Yokohama and 136 were raging in Tokyo. The spread of fire was aided initially by strong tropical cyclone winds, as a cyclone had arrived the previous day.

Sorenson (2013, 648) also cites an event in Yucatan, where a hurricane destroyed houses whose straw roofs caught on fire causing them to burn in the high winds.

Another reason why one cannot rule out a hurricane because of precipitation issues is due to the fact that Gulf of Mexico hurricanes typically have a drier southern side. Figure 58 shows the rainfall pattern for Hurricane Claudette, which would be a typical for an Atlantic/Gulf of Mexico hurricane.

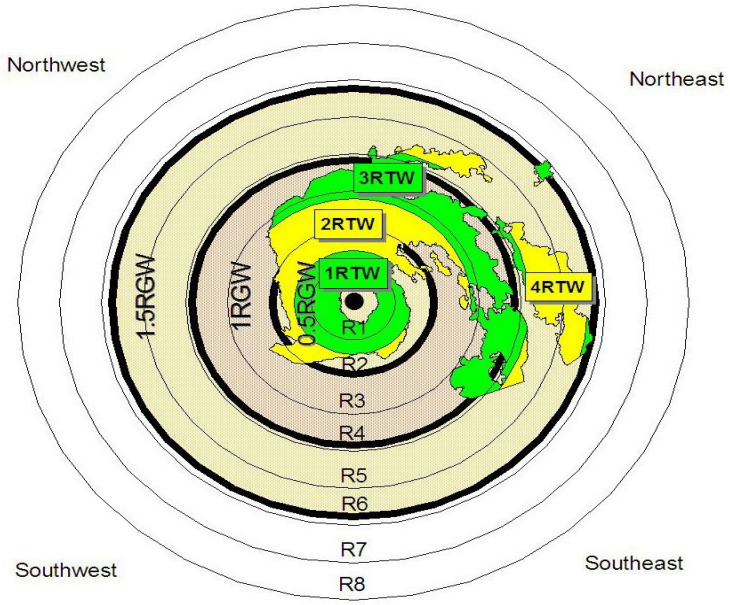

Figure 58. Rain shield and grid of Hurricane Claudette (2003) at the time of landfall (Matyas, 2007)

There are also hurricanes that are referred to as "dry hurricanes" at landfall because their winds arrive far ahead of the precipitation. One good example is Hurricane Hugo where rains arrived two days after the main hurricane winds. It has been roughly correlated that most "dry hurricanes" have a higher forward speed than average. The question of the speed of a hurricane in relation to

precipitation also raises the issue of the timetable given in 3rd Nephi with regards to the "great storm." It was indicated that the storm ended within roughly 3 hours, perhaps a little longer. Although we are not certain that the term 'hour' corresponds to a 60-minute hour (see chapter 5), for purposes of analysis it would be useful to assume that the hour was measured the same as today. The width of a hurricane averages 100 miles in diameter (from hurricane wind edge to hurricane wind edge) but can be as small as 80 miles. The Isthmus of Tehuantepec is roughly 130 miles across; one might consider a narrower width of the area that was significantly populated at the time to perhaps 90 miles.

Table 4 shows data generated by the National Oceanographic and Atmospheric Administration (NOAA), which maintains a database of historic hurricanes and their characteristics called HURDAT. Considering that the Isthmus of Tehuantepec is located at a latitude of 18 degrees north, the average speed of a hurricane would be 10.8 miles per hour. The highest speed in the database is for an unnamed Tropical Storm #6 in 1961. It got caught up by a midlatitude trough over the midatlantic states and went speeding off northeastward over Maine and New Brunswick at a maximum speed of 69.75 mph. The fastest hurricane in the record was Emily in 1987, whose maximum speed reached 68.65 mph as it raced over the North Atlantic.

Table 4. Average Speed of Hurricane (NOAA, 2014)

Forward speed of Atlantic hurricanes averaged by 5 degree latitude bins

Latitude bin	Speed			No. Cases
	km/hr	knt	mph	
0°- 5°N	25.9	14.0	16.1	186
5°-10°N	22.0	11.9	13.7	4678
10°-15°N	19.2	10.4	11.9	7620
15°-20°N	17.4	9.4	10.8	7501
20°-25°N	17.5	9.4	10.8	8602
25°-30°N	20.1	10.8	12.5	6469
30°-35°N	27.1	14.6	16.9	3397
35°-40°N	39.0	21.0	24.2	1120
40°-45°N	49.3	26.6	30.6	264

45°-50°N	51.5	27.8	32.0	34
50°-55°N	51.4	27.8	32.0	15
55°-60°N	55.8	30.1	34.7	1

Considering the size of a hurricane from landfall to dissipation (when the trailing edge passes), then the total distance of passage for a smaller sized hurricane would be 170 miles over the Book of Mormon population in the Isthmus of Tehuantepec. At an average speed of 10.8 miles per hour, a smaller hurricane would take 16 hours to pass. Assuming the speed of the fastest hurricane recorded, the travel time across the Isthmus would be 2.5 hours. Since we don't know exactly what the author in the Book of Mormon meant by the start time of the great storm, one might consider using the arrival and departure of precipitation as the length of time for the storm, which would give an effective travel distance of 130 miles. With that diameter, assuming a passage time of perhaps 3.5 hours, than the hurricane would have had a travel speed of 37 miles per hour.

Whatever the calculation, if a hurricane did in fact impact the Isthmus of Tehuantepec, it would have had to have been a fast moving hurricane to pass through the area within a 3-hour window.

Seasonality

According to the current activity of hurricanes, a hurricane in late March or early April (the theoretical time of the 3rd Nephi disaster) would have been a very unusual event. Climatologically speaking, approximately 97% of tropical cyclones that form in the North Atlantic develop between the dates of June 1 and November 30. The NOAA database shows that out of a total of 2580 there were only 8 tropical storms or hurricanes that occurred prior to the month of May for the years 1851–2013.

While we can try to use current data to evaluate current hurricane behavior, one cannot definitively say that March or April hurricanes were as unusual in the remote past. According to Murnane and Lui (2004, 4, 52) tropical cyclone activity is known to vary over time scales that range from days to millennia. One of the highest frequency variability is intraseasonal changes in tropical cyclone activity. The Madden-Julian Oscillation (MJO) is the best known, though incompletely understood, source of tropical atmospheric variability on intraseasonal time scales. Active phases of the MJO are associated with more frequent tropical cyclone formation. Once a tropical cyclone forms, other types of intraseasonal climate variability can have an impact on tropical cyclone track. For example, the strength and phase of the North Atlantic Oscillation (NAO) appears to influence preferred hurricane tracks in the North Atlantic Ocean. On interannual time scales, the El Niño-Southern Oscillation (ENSO) appears to be the dominant factor controlling tropical cyclone activity. ENSO alters tropical cyclone activity through its effects on atmospheric features (for example, vertical wind shear) and on ocean temperatures. Additional factors such as the phase of the Quasi-Biennial Oscillation and regional sea level pressure anomalies are correlated with tropical cyclone activity and appear to produce interannual variations in tropical cyclone activity. Whether these climatological phenomena

existed at the time of the 3rd Nephi disaster as they do now, or even existed at all cannot yet be definitively answered.

There is also a branch of science called paleotempestology that uses a variety of techniques to look at backwater depositional evidence of paleo hurricanes. Although I was unable to locate any studies within the Isthmus of Tehuantepec, studies along the Gulf and Atlantic states reveal that distinct millennial-scale variability exists in catastrophic hurricane activity along the Gulf Coast, with a hyperactive period from 1450 BC to 950 AD (Lui, 2004). Even if paleotempestology studies were performed in the Isthmus area it is highly unlikely that they could give a precise year that a particular hurricane occurred, and it is probably impossible to determine the month.

3rd Nephi Requirements

When looking at each and every characteristic of the disaster in 3rd Nephi, all characteristics can be explained by phenomena other than a hurricane. It is clear however that certain elements of the disaster would have been made worse by a hurricane, namely hurricane spawned tornados (whirlwinds), thunder and lightning, and flooding related hazards including volcanic lahars.

"Great Storm" Possibilities

We are still left with the possibilities of the great storm being (1) a rare early season, fast moving hurricane, (2) a volcanic eruption coupled with some sort of lower grade local storm, or (3) a volcanic eruption itself (perhaps coupled with volcano-triggered precipitation).

With regards to the volcanic eruption, it is notable that the persons who witnessed the 1793 eruption of the San Martín volcano in the Isthmus initially thought it was a thunderstorm, since heavy clouds covered the mountain and thunderstorms were not uncommon in the area (Espíndola, 2010). Perhaps that is why the 3rd Nephi witnesses considered it a storm simply because that's what it looked like when it started out. If there was in fact a local ongoing storm at the time of the eruption, the eruption itself might not have been visible as separate from the storm.

The separate references to "tempest" seem to be consistent with a pyroclastic flow or ash event, as tempests are associated with high winds and they were contributors to the actual reshaping of the topography according to 3rd Nephi. Lacking a hurricane or local storm, the most reasonable explanation that squares with all of the Book of Mormon text is that the "great storm" was the elevated airborne ash mushroom with its accompanying thunder and lightning, with the "tempest(s)" also referring to the volcanic phenomena occurring at the ground level such as ash surge or pyroclastic flows.

"Never Had Been Known in All the Land"

A final point that requires discussion is the moniker used to describe the great storm, namely that it had "never had been known in all the land." For a Book of Mormon chronicler to state that it "never had been known" there must be some presupposition that there may have been records kept of some storm events. It is hard to put that kind of statement in a historical context, as it may be limited

to the lifetime of the chronicler or back a few generations by oral history. It would not be expected that there were any written records of detailed meteorological standards of storms in Book of Mormon times, so the scope of this term may need to be treated with some latitude.

The statement can be interpreted that it was perhaps the biggest storm that had been witnessed, or that the type of storm never had been witnessed, or perhaps both. A strong hurricane certainly could meet that requirement as Isthmus hurricane frequency (based on current records) does not appear to be great (9 in 171 years); however, the hurricane intensities are consistently low when they do occur.

With the current data that we have on volcanic activity, this statement also seems to be applicable to volcanic eruptions in the Isthmus before 30 AD (with the caveat that the data is no doubt incomplete with regards to documentation of historic volcanic eruptions). For all volcanoes that are north of Guatemala City and south of Mexico City, using the Smithsonian Institution Global Volcanism Program data and excluding any eruption that has a data range that could place the eruption after 30 AD, the eruptions previous to that date are:

San Martín	710 BC
El Chichón	500 BC
Pico de Orzaba	730 BC
Popocatépetl	1815 BC
Chichinautzin	825 BC
Tacana	930 BC
Atitlán	870 BC
Acetenango	185 BC
Fuego	1505 BC

It is possible that some of the eruptions that were excluded could have occurred not much before 30 AD; in that case, the size and extent of the eruption may be what the 3rd Nephi chronicler was referring to "as never had been known in all the land."

Conclusions

An analysis of the "great storm" in relation to whether a hurricane is involved or not is not conclusive either way. Although an early season, fast moving hurricane would be rare, it is not outside the realm of possibility. A volcanic eruption alone or in conjunction with a local storm would seem to square reasonably with the Book of Mormon text as well.