"THEN A STAR FELL:" FOLK-MEMORY OF A CELESTIAL IMPACT EVENT IN THE ANCIENT EGYPTIAN *TALE OF THE SHIPWRECKED SAILOR*?

Lloyd D. Graham

The motif in the centre of the Egyptian Middle Kingdom *Tale of the Shipwrecked Sailor* (*ca*. 2000-1900 BCE) concerns a star that fell to earth and caused the extinction of a population of giant serpents on an enchanted island, whose location is traditionally ascribed to the Red Sea. These creatures could apparently breathe fire, but they themselves were "burned utterly" in the fireball that followed the celestial body's impact with the earth. If the recently postulated Late Holocene meteorite impact (<5000 years ago) at Umm al Binni/al Amarah in southern Iraq is indeed the cause of a regional impact fallout layer dated to *ca*. 2350 BCE, then a folk memory of this event could be preserved in the Egyptian story; the proposed impact site and the story's likely setting both lie due east of Egypt, and oral reports of the loss of life wrought by the impact in Mesopotamia would soon have reached Egypt. A less likely candidate is the putative comet strike of *ca*. 2807 BCE that has been proposed to account for the undersea "Burckle crater" south-east of Madagascar. Both of these sites are as yet unproven as impact craters. A confirmed meteorite impact in south-western Egypt <5000 years ago, which caused the Kamil crater, is another possible contributor to the fireball motif in the *Tale*. In light of modern theories that a meteorite, comet or asteroid impact caused the Cretaceous–Paleogene extinction event in which the non-avian dinosaurs were eliminated 66.5 million years ago, it is uncanny to find the destruction of a unique population of flightless, dragon-like giant reptiles attributed to just such a collision in this ancient narrative.

1 INTRODUCTION

Unusual and dramatic celestial phenomena are often recorded in the written heritage that survives from ancient cultures and are similarly preserved in the oral traditions and/or graphic inscriptions of modern-day traditional societies. For example, the Assyrian Eponym Chronicle records a solar eclipse that is known to have taken place on 15 June 763 BCE, thereby providing a reliable absolute chronology for the 261 years for which a full sequence of eponyms has been preserved (van de Mieroop, 2016: 255). In Central Australia, the present-day oral traditions of local Aboriginal groups describe impact origins for the meteorite craters at Gosse Bluff, Henbury and Wolfe Creek (Hamacher and Goldsmith, 2013).

Similar commemorations are found in writings from Ancient Egypt. The Tempest Stele of Ahmose I, the founder of the Egyptian New Kingdom (Dynasty 18, accession *ca*. 1570-1544 BCE), may record the after-effects of the Thera volcanic eruption *ca*. 1627-1600 BCE (Ritner and Moeller, 2014). Later in the same dynasty, lines 33-37a in an inscription of Thutmose III from Gebel Barkal (near the Fourth Cataract of the Nile) describe a miraculous star that unnerved the enemy's troops and gave Thutmose the victory (Hoffmeier, n.d.).

> ...[sentr]ies were in the very act of being posted at night in order to do their regular watch. There were two astronomers (present). A star approached, coming to the south of them. The like had not happened before. It shot straight toward them (the enemy), not one of them

> could stand […] falling headlong. Now then […] was behind them with fire in their faces. Not one of them retaliated; no one looked back. Their chariotry is gone, they (the horses?) having bolted...

While the incident is attributed to divine intervention on the part of Amun-Re, it may reflect a genuine astronomical event – a shooting star or meteorite – that occurred during Thutmose's military campaign against the Nubians.

The Egyptian *Tale of the Shipwrecked Sailor*, which was written in the Middle Kingdom, relates how a star fell to earth on an island traditionally placed to the east of Egypt in the Red Sea. It is this motif, and the possibility that it might represent the folk-memory of a regional meteorite impact not long before the time of the story's composition, that forms the main subject of the present paper. An ancillary topic is the ancient story's remarkably prescient attribution of the extinction of giant reptiles to a holocaust which arose from a collision between the earth and an extraterrestrial body.

2 *THE SHIPWRECKED SAILOR*

2.1 Structure and Narrative

The *Tale of the Shipwrecked Sailor* (ShS) (Blackman, 1932: 41-48; De Buck, 1948: 100-106; Allen, 2015: 9-53) is the oldest surviving ancient Egyptian story (Allen, 2015: 9). Its composition dates from early- to mid-Dynasty 12 (Wilkinson, 2016: 245), i.e., somewhat after 2000 BCE (Simpson 2003:45). It is preserved in a single hieratic copy on papyrus from *ca*. 2000-1900 BCE, which is currently preserved as p.Hermitage 1115 in St. Petersburg (Allen, 2015: 9). The story's setting, which is not defined either temporally or geographically, has the vagueness that characterises many folk-tales – unnamed characters who are types rather than individuals, and locations that are poorly defined. The frame story opens with an unsuccessful boat expedition arriving back in Egypt, at which point one of the sailors tries to cheer up his despondent commander by promising to relate the tale of his own maritime misfortune (ShS 21-24; verse-line numbering from Allen, 2015).

The sailor's adventure, which constitutes the main narrative of the *Tale*, begins with him serving as a crew member in a ship on the Great Green (an Egyptian phrase denoting the ocean) that was headed for "the mining region of the Sovereign" (ShS 24-27). The sailor relates how he alone survived his ship's destruction in a fierce storm and was washed up on an enchanted island by a huge wave (ShS 32-42). Having sampled some of the island's abundant delights, the sailor was suddenly confronted by a giant serpent of 30 cubits length (15.7 m), whose beard was more than 2 cubits (1 m) long (ShS 56-66). The giant snake threatened to reduce the sailor to ashes if he did not say who had brought him to the island (ShS 70-73), from which we may deduce that the serpent was able to breathe fire – a standard attribute of the *uraeus* (rearing cobra) adorning the brow of the Pharaoh (Shaw and Nicholson, 2008: 76), but equally making the island's inhabitant a conceptual forerunner of the dragons of medieval European legend. Unlike the European dragon, however, the snake of the enchanted island – as far as we can tell – had no wings and could not fly. The serpent-god described himself as "Lord of Punt" (ShS 151). This location, which today is usually identified as Somalia or Yemen, was the target of many Egyptian maritime missions (Allen, 2015: 41).

In a story-within-a-story, the serpent empathizes with the sailor's hardship by telling briefly of his own personal tragedy (ShS 125-132). At a time when he, his siblings and all of their children – 75 serpents in total – had been living happily on the island paradise, catastrophe struck (Fig. 1). In the translation of Simpson (2003: 51):

> Then a star fell
> And because of it these went up in fire
> It happened utterly.
> But I was not with them [when] they burned;
> I was not among them.
> Then I died for them
> When I found them as a single heap of corpses.

126
|*wn=i im=f ḥnᶜ sn.w=i*|
| I existed in it [the island] together with my siblings,

127
ḥrd.w | *m-ḳ3b=sn*
children | in their midst.

km.n=n ḥf3.w 75
(That) we amounted to 75 snakes (was)

128
m | *msi.w=i ḥnᶜ sn.w=i*
as | my children together with my siblings,

129
nn sḫ3=i n=k | *s3.t ktt(.t) ini.tn=i m sš3*
without my mentioning to you | a small daughter whom I brought about through prayer.

130
ᶜḥᶜ.n sb3 | *h3i.w*
Then a star | fell.

pri.n n3 m ḥ.t m-ᶜ.w=f
(That) these went (was) in fire together with it.

131
ḫpr.n (i)r=s nn wi ḥnᶜ |
(That) it happened (was) even (as) I was not with (them), |

3m=ny nn wi m ḥr(.y)-ib=sn
they burning when I was not in their midst.

ᶜḥᶜ.n=i mwt.kw n=sn
Then I died for them,

132
gmi.n=i | *st m ḫ3y.t wᶜ.t*
after I found | them as a single heap of corpses.

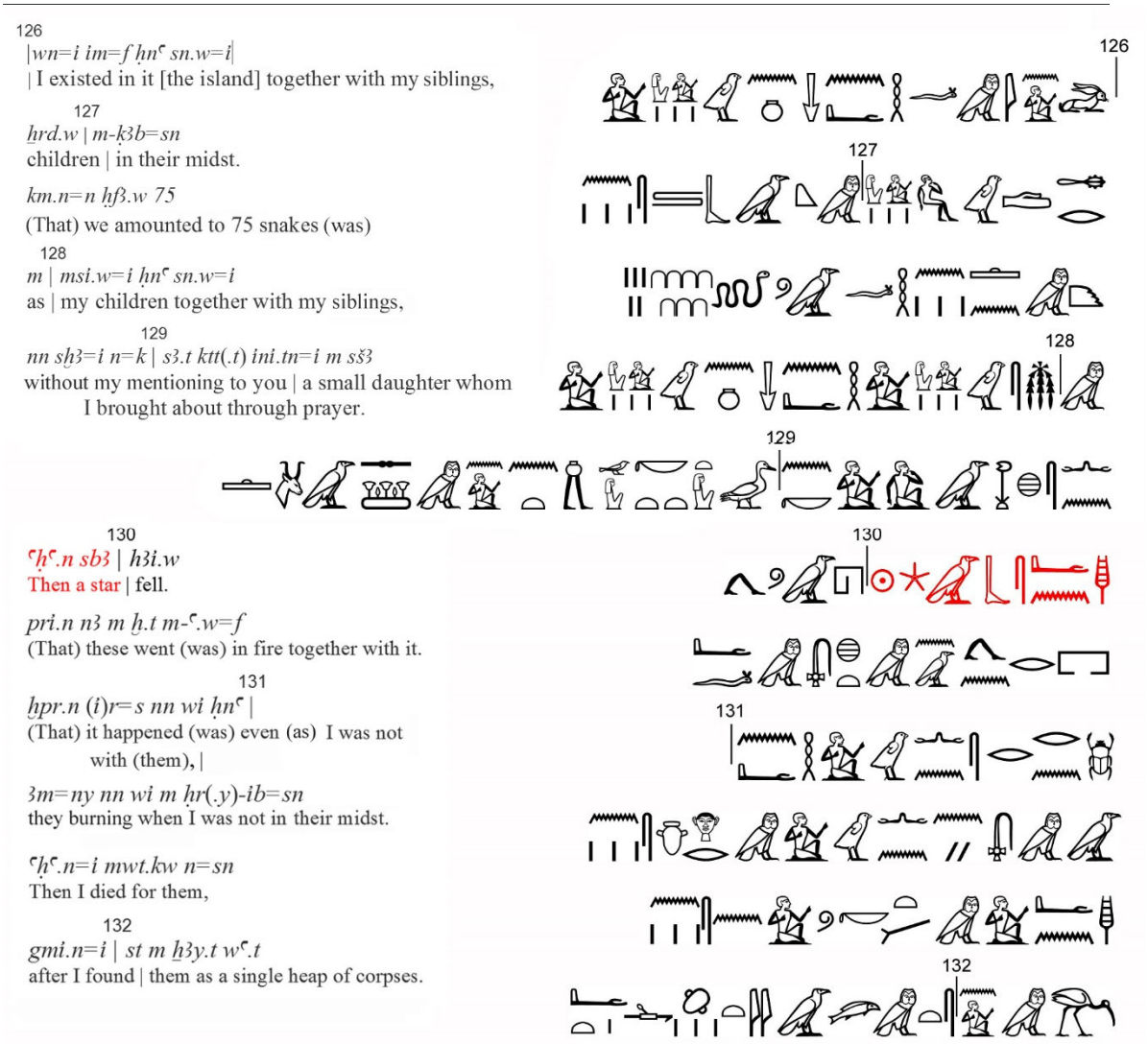

Fig. 1 The serpent's story in the *Tale of the Shipwrecked Sailor*. Lines 126-132 (numbering of Allen, 2015). It is standard academic practice to transcribe hieratic text into its hieroglyphic counterpart for the purpose of publication. Hieroglyphs (read right-to-left) are at the right-hand side of the figure, transliteration and author's literal translation at the left, following the conventions of Ockinga (2012). For a polished translation, see Section 2.1, *Structure and Narrative*. Line-breaks are indicated by vertical lines, which are numbered in the hieroglyphic text and its transliteration.

The story then returns to the plight of the sailor (ShS 132-186), whom the serpent continued to encourage and assist. The serpent predicted that the sailor would be rescued and would return safely to Egypt, and this is indeed what transpires. The papyrus concludes with a colophon that identifies the scribe (ShS 187-189).

2.2 Interpretation

The standard interpretation of the "Great Green" or ocean in the main narrative is the Red Sea, and "the mining region of the Sovereign" is taken to be a location in Sinai (Wainwright, 1946: 31) (Fig. 2). In truth, however, the sailor's voyage appears to be a type of Otherworld Journey – a dangerous crossing-over to a divine or magical realm beyond the edge of the known world.

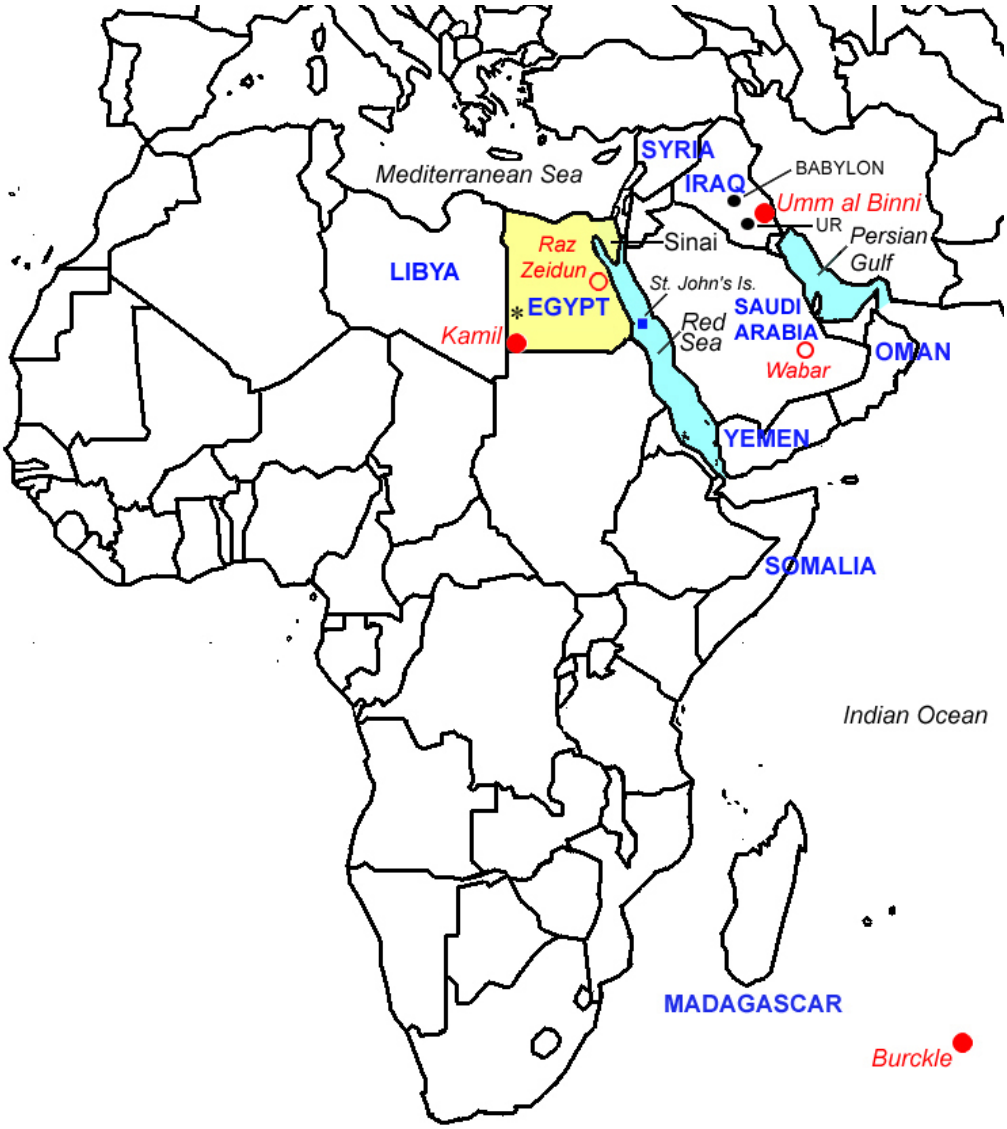

Fig. 2 Sites of confirmed/proposed impacts mentioned in the text. Map of Africa and Near East, showing modern political boundaries. Country names are in blue bold capitals, ancient city names in black capitals. Filled red discs indicate confirmed and putative impact sites discussed in detail in the text; open red circles show confirmed and putative impact sites mentioned in Section 3.5, *Other Sites*. Being on the east coast of Mexico, the Chicxulub site lies far beyond the western boundary of the map. Asterisk: strewn field of Libyan Desert Glass.

Another early example is contained in the *Epic of Gilgamesh*, whose oral roots date back to 2200 BCE (George, 1999: lx-lxi). In this story, the eponymous Mesopotamian hero braves the scorpion-men guarding the mountains of Mashu and crosses over to the Garden of the Gods in quest of immortality (Standard Version, Tablet IX; George, 1999: 70-75). The genre is more likely to be familiar to Western readers from the later examples in Celtic legend. For example, there are many tales in which an Arthurian knight makes a perilous crossing to a wonderful land in the Otherworld (Besamusca, 2007: 8-9). The Egyptian sailor's adventure seems to have particular parallels in the pre-Christian Irish tales of voyages to magical islands, such as the *Voyage of Mael Dúin* and the *Voyage of Bran*, which were first committed to writing in the 8th century CE (Ellis, 1991: 45-46, 160-161).

William K. Simpson observes (Simpson 2003: 45-46) that the *Tale of the Shipwrecked Sailor* is

> ...one of the most interesting, straightforward, and yet puzzling compositions of ancient Egyptian literature. [...] A curious emphasis is placed on numbers, the height of the wave, the dimensions of the ship, the number of sailors, the length of the serpent's hood, the number of months of the sailor's stay, and so on. It is almost as if the tale is an allegory involving the movement of stars.

Prior scholarship on the *Tale* has established that the serpent is probably to be identified with the Heliopolitan creator god Re-Atum (Derchain-Urtel, 1974). Moreover, it seems that the serpent's strange story about the extinction of his 74 kin as a result of a falling star is likely to be a reference to the 74 forms of the sun-god Re listed in the later *Litany of Re*, a New Kingdom funerary text first inscribed in the tomb of Thutmose III (Dynasty 18) (Baines, 1990: 62). The version in the tomb of Seti I (Dynasty 19) specifies 75 such forms (Derchain-Urtel, 1974: 84; Hornung, 1999: 138). The destruction of all but one of the serpent's species situates the island in an eschatological zone at the end of time. Such a time is predicted in Spell 175 of the *Book of the Dead*, where Re-Atum says "I will despatch the Elders and destroy all that I have made; the earth shall return to the Abyss, to the surging flood, as in its original state. But [...] I will transform myself into something else, namely a serpent, without men knowing or the gods seeing" (Faulkner, 1972: 175). Accordingly, the serpent that the sailor meets in the middle of the ocean may represent this final form of Re-Atum.

The *Tale of the Shipwrecked Sailor* is considered to contain esoteric knowledge, much of it related to the serpent's story (Baines, 1990: 58, 67). Whatever its meaning, this tragedy is enshrined as the central motif of the narrative: it is element X in a structure A-B-C-X-C'-B'-A' (Baines, 1990: 67). Unlike all of the other motifs, its form is mythic rather than folkloric; it seems to be a religious allegory. As a mythic island (X) set in the dead centre of a sea of folk-tale elements (A-C and A'-C'; Baines, 1990: 65), it may even be the "payload" of the whole story. As if to highlight the passage, the layout of the writing on p.Hermitage 1115 switches from vertical columns (ShS 1-123) to horizontal lines at precisely the point where the serpent begins the preface to his personal tragedy (ShS 124). In his translation and commentary, Allen (2015: 34) is mystified by the switch, commenting that "[t]he reason for the change is unknown." Moreover, the phrase "Then a star" in the sentence "Then a star fell" is written in red (Fig. 1); rubrics in Egyptian texts usually indicate headings and/or mark the beginning of a new theme. The layout of the hieratic writing later reverts to vertical columns, with the text concluding in same format as that in which it began (ShS 177-189) (Allen, 2015: 9, fn 2).

Allegorical references to Egyptian religious concepts can be identified in many features of the serpent's story; for example, the "little daughter brought to me through wisdom" may be equated with the Egyptian personification of order/justice/truth as the goddess Maat (Derchain-Urtel, 1974: 99), and the destruction of all but one of the island's 75 snakes can be identified with the anticipated death all but one of the 75 forms of Re at the end of time (Baines, 1990: 62). In contrast, the falling star and its destructive fireball has no obvious referent in Egyptian religion. On the contrary, its direct and matter-of-fact presentation suggest that may be derived from a real-world event.

3 CANDIDATE METEORITE/COMET IMPACTS IN THE THIRD MILLENNIUM BCE

3.1 References in Cuneiform Texts

Shooting stars, comets, meteors, meteorites and fireballs are relatively common phenomena in the astromantic literature of the Ancient Near East (Bjorkman, 1973; Chadwick, 1993; Fincke, 2013). References also occur in mythological accounts. For example, the Pennsylvania Tablet ("Surpassing all other kings," Tablet II), which was written in southern Babylonia (i.e., in the south of modern Iraq) in the late 18th century BCE, has the hero-king Gilgamesh relate a dream to his mother (Gilgamesh P, 4-14; George, 1999: 101-102) in the following words:

"O mother, during the course of my night
I walked hale and hearty among the young men.
"Then the stars of the night hid from me,
a piece of the sky fell down to me.
I picked it up, but it was too heavy for me,
I pushed at it but I could not dislodge it.

"The land of Uruk was gathered about it,
the young men were kissing its feet.
I braced my forehead and they helped me push,
I picked it up and carried it off to you."

3.2 Umm al Binni

The unusual morphology of the Umm al Binni structure in the al Amarah marshlands of southern Iraq, near the confluence of the Tigris and Euphrates rivers, suggests that it may be a relatively young meteorite crater (Master, 2001 and 2002), probably <5000 years old (Master and Woldai, 2007: 94). With a radius of *ca*. 3.4 km, the structure has a polygonal outline with what appears to be a raised rim and surrounding annulus (Master and Woldai, 2007: 89); it is consistent with a spherical iron impactor of *ca*. 4.1 x 10^9 kg (calculated from parameters in Master and Woldai, 2007: 95). The absence of ejecta-like material around the northern portion of the structure may potentially be explained by erosion caused by a north-to-south water flow in the marshes (Master and Woldai, 2007: 100). Until recently filled with water, the lake was emptied in the 1990s in the course of Saddam Hussein's marshland drainage project (Master and Woldai, 2007: 89).

An "ash layer" found at Tell Leilan and Tel Brak in Syria (Weiss *et al*., 1993; Courty, 2001) and in sea-sediment core off the coast of Oman (Kerr, 1998), which was dated to *ca*. 2350 BCE, has been interpreted as an impact fallout layer (Courty, 1997, 1998 and 2001; Master and Woldai, 2007: 95; Masse, 2007: 35). It has been pointed out that a bolide impact in the al Amarah marshlands around 2350 BCE could account for both the Umm al Binni structure and

the regional ash layer (Master, 2002; Master and Woldai, 2007: 95). For an impact on dry land, the energy yield of the resulting explosion has been estimated at 7.9×10^{17} J (Fig. 3), equivalent to 188 megatons (Mt) of TNT (Master and Woldai, 2007: 95). By way of comparison, the largest nuclear bomb ever detonated – the Soviet "Tsar Bomba" H-bomb – had a yield of 50 Mt (Atomic Heritage Foundation, 2014).

It is possible that the site was under water at the time of the impact (Master and Woldai, 2007: 94-95). However, the famously thick (up to 3.7 m) water-laid clay/silt layer discovered by Sir Leonard Woolley at the nearby Sumerian city of Ur (Fig. 2) – which he attributed to a Near Eastern "Great Flood" that inspired the later story of Noah's Ark – is much too early to be associated with a tsunami event *ca*. 2350 BCE; it lies at the top of the Ubaid strata (Woolley, 2006: 30-31; Ur Online, n.d.; Leick, 2001: 111-112), and must therefore be dated to *ca*. 4000 BCE (van de Mieroop, 2016: 15). The fall of the pan-Babylonian kingdom of Akkad *ca*. 2150, which was allegedly predicted by a prodigy in which "many stars were falling from the sky" (Bjorkman 1973: 106), was followed by a period of confusion (van de Mieroop, 2016: 348). There is general agreement that the Ancient Near East, including Egypt, entered a Dark Age *ca*. 2200 BCE (Monson and Lancaster, 2014: 41), and it is entirely possible that one or more extraterrestrial impact events were responsible for some of the disorder associated with that time (Masse, 2007: 34-35).

Oral reports of the catastrophic loss of life wrought by such an impact in Mesopotamia would soon have reached Egypt via long-established communication networks. Connections between the two regions date back to prehistoric times and include economic migration, trade

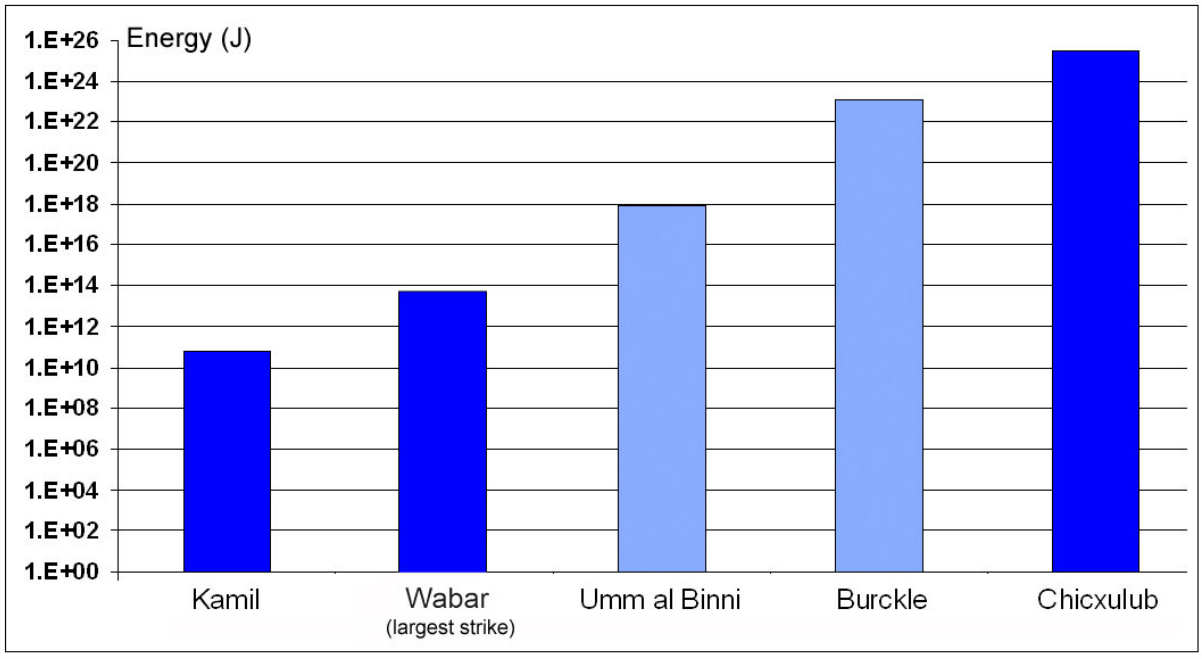

Fig. 3 Log-scale plot of energy estimates (Joules) for confirmed/proposed impacts discussed in the text. Bars for confirmed impacts are dark blue, those for proposed impacts are light blue. Kamil value calculated from parameters in Folco *et al*., 2010 using the algorithm of Schmidt (2004). Wabar value converted from kT TNT equivalent for largest impact, as cited by Wynn and Shoemaker (1998: 66 and 70). Umm al Binni value from Master and Woldai (2007: 95). Burckle value from Abbott *et al*. (2007: 4). Chicxulub column shows the mean value for the range cited by Durand-Manterola and Cordero-Tercero (2014).

by land and sea, diplomatic exchanges and forced relocations arising from war (Mumford, 2013). As David Wengrow writes, "[i]n the second millennium BC, as from the time of their inception, the principal dynastic powers of South-West Asia and North-East Africa were related through material interests and exchanges, even as they remained culturally and politically divided" (Wengrow, 2006: 13). More specifically, J.C. Fincke comments: " Since news of exceptional occurrences could be expected to have spread quickly among the population, the incidences of meteorite falls would have soon become common knowledge in ancient Near Eastern civilizations" (Fincke, 2013: 175-176).

As mentioned above, the serpent's mysterious island is generally presumed to lie in the Red Sea, whereas of course Umm al Binni lies further to the east, atop the Persian Gulf (Fig. 2). It is perhaps worth noting that ancient authors often equated the two gulfs, identifying one with the other. Explaining Herodotus' usage in *Histories* 1.1, A.R. Burn's footnote (de Sélincourt, 1972: 41 fn 1) reads "Red Sea: the Greeks used this expression for all parts of the southern (or Indian) Ocean. Here the Persian Gulf is meant, and the reference is to (real) ancient influences from Mesopotamia." Likewise, in his *Natural History* (6.115), Pliny the Elder writes "The Persians have always lived on the shore of the Red Sea, which is the reason why it is called the Persian Gulf" (Rackham, 1942: 425). Pliny, Statius, Livy, Strabo and Plutarch all use "Red Sea" as an umbrella term that includes the Persian Gulf and Indian Ocean.

3.3 Burckle

There is one other proposed impact event east of Africa in the third millennium BCE that could have served as an inspiration for the Egyptian "falling star." This relates to the so-called Burckle crater, an undersea structure in the Indian Ocean south-east of Madagascar (Fig. 2) that is reportedly *ca*. 29 km in diameter (Abbott *et al*., 2006a,b; Abbott et al., 2007: 2). With an age estimate of <6000 years, it has tentatively been ascribed to a comet strike around 2807 BCE (Carney 2007; Abbott *et al*., 2007; Masse, 2007: 56-63). The collision energy is calculated to have been 1.3 x 10^{23} J (Fig. 3) (Abbott et al., 2007: 4). The site's greater distance from Egypt, and the fact that the date proposed for this incident is 457 years earlier than that proposed for the Umm al Binni strike, combine to make the putative Burckle strike the less attractive of the two candidates for the impact described in the Egyptian tale. Moreover, an analysis of sediment layers near the Burckle structure by proponents of the impact hypothesis has yielded ambiguous results (Abbott *et al*., 2009). The Burckle impact hypothesis is controversial (Carney 2007). While doubt has been cast on some of the key evidence (Pinter and Ishman, 2008; Bourgeois and Weiss, 2009), its proponents have responded vigorously to the challenge (Abbott *et al*., 2008; Gusiakov *et al*., 2010).

The immediate loss of terrestrial life from a mid-oceanic impact would have been by water (in the form of mega-tsunamis) rather than by fire, the agent recorded in the *Tale of the Shipwrecked Sailor*. Still, the maritime setting of the *Tale*'s island east of Egypt and its linkage with Punt (Somalia/Yemen; Fig. 2) to Egypt's south is consistent with the location of the Burckle structure in the Indian Ocean, far to the south-east of Egypt. In addition, the driver of the *Tale*'s plot is a fierce storm at sea which contained a wave 8 cubits (4.2 m) in height and which culminated in the sailor being cast ashore by another huge wave (ShS 34-37). In the narrative, the tsunami-like storm is presented as causally and temporally unrelated to the falling star, but the two events do occur in the correct natural sequence; although we are told about the former before the latter, the celestial impact that killed all the serpent's kin occurred prior to the storm that caused the sailor's shipwreck.

3.4 Kamil

Inspection of the Earth Impact Database (PASSC, 2017) revealed only one confirmed impact event of an appropriate age proximal to Egypt and the Near East: the Gebel Kamil meteorite strike in the eastern Sahara, in the south-western corner of modern Egypt (Fig. 2). The crater, which was first identified in 2010 (Folco et al., 2010), is the result of an iron meteorite impact <5000 years ago (D'Orazio *et al*., 2011: 1180). The crater is 45 m in diameter (D'Orazio *et al*., 2011: 1180) and the impactor is estimated to have weighed 9.1 x 10^3 kg (Folco et al., 2010), although with an oblique trajectory it could have been three times heavier (D'Orazio *et al*., 2011: 1193). For the former option, the energy yield of the explosion may be estimated at 5.6 x 10^{10} J (Fig. 3) (Folco et al., 2010; Schmidt, 2004), which is more than 10 million times smaller than the estimate for the putative strike at Umm al Binni. Such an explosion would have been equivalent to just 13.4 tons of TNT.

By coincidence, the heat from a powerful impact or airburst in the same region of Egypt some 28.5 million years ago is believed to have created the strewn field of "Libyan Desert Glass" north of Gilf Kebir (Koeberl et al., 2003; Aboud, 2009) (Fig. 2, asterisk). The typically yellow glass was worked to form cutting edges in prehistoric times (Olsen and Underwood, 1979). A piece also features as the central gemstone in the pectoral of Tutankhamun, where it is carved into a large scarab (BBC News, 2006).

The location and setting of the Kamil impact diverges from the eastern and maritime location of the island in the *Tale of the Shipwrecked Sailor*. However, recollections of independent but similar events are likely to become fused in ancient narratives. For example, the biblical Exodus story may combine a Canaanite collective memory of the expulsion of the Hyksos from Egypt in the mid-16th century BCE with the migration stories of much smaller Semitic groups who left Egypt in the 13th century BCE, and the written account was probably modernised for its immediate audience by the addition of contemporary details from the 7th century BCE (Finkelstein and Silberman, 2001: 48-71). In the same vein, Tacitus probably uses details of the more recent Syrian earthquake of 115 CE when composing *Annals* 2.47, his account of the earthquake of 17 CE in Roman Asia (Graham, 2017). It is easy to imagine that recollections of the smaller but more immediate "falling star" at Gebel Kamil might have served to embellish and enliven Egyptian accounts of a larger but more distant impact in Mesopotamia or elsewhere to the east/south-east of Egypt.

3.5 Other sites

Another desert impact site, this time between Egypt and Mesopotamia, was discovered in the Empty Quarter of Saudi Arabia in the 1930s. The Wabar site (Fig. 2) contains at least three craters, the largest being 116 m in diameter (Wynn and Shoemaker, 1998: 68). An original meteoroid of *ca*. 3.2 x 10^6 kg underwent several fragmentations during descent, with the largest impactor at Wabar (of 8.0-9.5 m diameter) causing an explosion equivalent to *ca*. 12 kT TNT (Wynn and Shoemaker, 1998: 66 and 70) (Fig. 3). However, the Wabar event is too recent to be a candidate for the "falling star" in the *Tale of the Shipwrecked Sailor*; the site is less than 450 years old, and is perhaps ground-zero to a celestial fireball that passed over Riyadh in 1863 or 1891 (Wynn and Shoemaker, 1998: 71). The recency of the impact, coupled with the remoteness and homogeneity of the desert location, mean that Wabar "is perhaps the best-preserved and geologically simplest meteorite site in the world," as well as one of just 17 sites worldwide that contain remnants of the impactor (Wynn and Shoemaker, 1998: 71).

Other potential impact sites in or near Egypt have been nominated since 2000. For the most part, these are either now considered unlikely to have a genuine extraterrestrial origin or else are too old to have served as an inspiration for the "falling star" in the *Tale of the Shipwrecked Sailor* (Reimold, 2010). An Egyptian site proposed in 2011 at Raz Zeidun, between the Nile and the Red Sea east of Thebes/Luxor (Fig. 2), has a location highly relevant to the present study (Baratoux *et al*., 2012), but the status of the site remains unclear and the age of the putative impact unknown.

4 GEOMYTHOLOGY

4.1 Inspiration from the Fossil Record?

Folk explanations of notable geological features, including the fossil remains of extinct megafauna, are found around the world (Mayor, 2007). Indeed, many palaeontologists believe that there are connections between the dragons of myth and legend and the discovery of dinosaur fossils by ancient peoples (Humanities at Stanford, 2008). For example, a number of the fantastic creatures of classical mythology, such as the griffin, may have been inspired by real-life encounters with the fossilized bones of prehistoric creatures (Mayor, 2011).

With regard to the giant serpent in the *Tale of the Shipwrecked Sailor*, we might note the existence of *Gigantophis*, a genus of prehistoric giant snake which lived in the northern Sahara. In Egypt, vertebral remains were collected in 1901 from the Upper Eocene Qasr el-Sagha formation in the Fayum (Rio and Mannion, 2017: 1). Adult specimens of *G. garstini* are estimated to have been *ca*. 6.9 m in length (Rio and Mannion, 2017: 13), slightly less than half the size of the serpent in the story. In addition, only a small number of fossils are known today (Rio and Mannion, 2017: 2). On balance, then, the remains of *Gigantophis* seem unlikely to have served as an inspiration for the giant serpent of the Egyptian tale.

However, other paleontological discoveries in ancient Egypt may well have contributed in a general sense to the concept of the "giant serpent." The Greek historian Herodotus (5th century BCE) heard Egyptian tales of winged serpents and – in the desert near Buto, in the Nile Delta – was shown "proof" of their former existence (Mayor, 2011: 135-136). His account (Hdt. *Hist*. II 75-76; de Selincourt, trans. (1972: 157-158) reads:

> On my arrival I saw their skeletons in incalculable numbers; they were piled in heaps, some of which were big, others smaller, [...] The place where these bones lie is a narrow mountain pass leading to a broad plain which joins on to the plain of Egypt [...] The winged snakes resemble watersnakes; their wings are not feathered, but like a bat's.

Phlegon, a later Greek historian (2nd century BCE), described giant articulated skeletons eroding out on the surface of the desert at the Wadi Natrun in Lower Egypt. Modern science has discovered Egypt's most significant Pliocene exposures at this site, leading Adrienne Mayor to claim that "by Phlegon's day, travellers went out of their way [to Wadi Natrun] to view the spectacle of massive, articulated skeletons of mastodons, such as *Gomphotherium angustidens* [...] or the huge giraffids *Sivatherium maurusium* and *Libytherium*" (Mayor, 2011: 150). Since Wadi Natrun has always been the main source of the natron required for artificial mummification, its marvels would have been known to ancient Egyptians of the 2nd millennium BCE and earlier (Mayor, 2011: 150).

In Upper Egypt, Egyptian worshippers of Seth "collected nearly *three tons* of black, river-polished fossil bones" between 1300 and 1200 BCE. They deposited these finds as relics at two

shrines devoted to the god Seth at Qau and Matmar, near Asyut (Mayor, 2011: 177). Other fossilized bones (including those of extinct crocodile and gigantic buffalo) found at Qau had been carefully wrapped in linen and placed within tombs. The heavy, mineralized black bones, which had been highly polished by river sand, were probably revered as the remains of Seth, the god of disorder and darkness (Mayor, 2011: 177-178). As Mayor notes in another context (Mayor, 2011: 198):

> The discovery of gigantic, blackened, burnt-looking petrified bones [...] might well evoke scenarios of huge creatures incinerated by bolts of lightning in the deep past. [...] The notion that fossil-monsters were killed by lightning is not unique to classical antiquity. [...] The lightning motif [...] reflects the attempt to imagine a force powerful enough to destroy monsters of such size and strength. Today, many believe that a giant asteroid impact was the great cataclysm that destroyed the dinosaurs.

Mayor's last sentence leads us effortlessly into the final topic for discussion in this paper.

4.2 Extinction of the Terrestrial Dinosaurs

The fact that some meteors move through the sky with a spiralling motion has led certain cultures – such as the ancient Chinese – to associate them with snakes (Guang-jie and Zhou-sheng, 2010: 440-441). However, there is no reason to believe that such a correlation informs the association between the falling star and the terrestrial serpents in the Egyptian story.

Having identified the sailor's enchanted island with St. John's Island (Zeberged/Zabarjad) off the Rās Benās promontory in the Red Sea (Fig. 2), at whose base lies the southern Egyptian port of Berenice Troglodytica, G.A. Wainwright was prompted by the modern-day absence of snakes on the island to wonder in 1946 whether "[i]n view of this accuracy, it may be asked whether of the destruction of the serpents may not be the romanticized record of an actual event" (Wainwright, 1946: 38). Post-1980 – and especially post-2010 – readers are more likely to recognize in the giant serpent's story of the destruction of his kin an astounding similarity to the modern scientific understanding that a large meteorite, comet or asteroid hit the Earth and caused global environmental damage, leading to Cretaceous–Paleogene (K-Pg) [= Cretaceous-Tertiary (K-T)] boundary and the extinction of the earth-bound giant reptiles.

This mass extinction event is now securely attributed to a large asteroid impact at Chicxulub, Mexico, *ca*. 65.5 million years ago (Bottke *et al*., 2007; Schulte *et al*., 2010; Kring, 2010). The energy yield of the impactor has been estimated at 1.3-58 x 10^{24} J (Fig. 3) (Durand-Manterola and Cordero-Tercero, 2014). J. Bradley Schaefer predicts that "[t]he immediate shock and heat from the impact would have annihilated all life within perhaps a 1,000-mile radius from ground zero" (Schaefer, 2005). The possibility of a human folk-memory of this event is, of course, precluded by the absence of any humans at the time; the Hominina (humans and their bipedal ancestors) separated from the Panina (chimpanzee family) only some 5-8 million years ago (Conroy, 2005: 123; Haviland *et al*., 2008: 121). We should note that the terrain inhabited by the giant serpents of the Egyptian *Tale* was similarly devoid of human life; the sparing of a single snake is a literary device necessary for the sailor (and, by extension, the reader) to learn how the reptilian megafauna met its end prior to his arrival on the scene.

In science, however, no such device exists; the geographic and temporal remoteness of the Chicxulub impact from Middle Kingdom Egypt constitute insuperable obstacles. Thus, while we must acknowledge the remarkable accuracy of the Egyptian *Tale of the Shipwrecked Sailor* in attributing the rapid demise of a large population of flightless giant reptiles to a fireball

resulting from a collision between the earth and a celestial body, it is not possible to propose a rational explanation for it. However, this uncanny convergence of ancient literature and modern science deserves to be more widely appreciated.

Unexpected agreements between traditional wisdom and modern science occur in other contexts. For example, Adrienne Mayor has noticed that a recent theory, which attributes a mass extinction of marine and terrestrial life at the Permian-Triassic boundary (*ca*. 251 million years ago) to a huge underwater explosion of flammable gas (Ryskin, 2003), has a remarkable parallel in the cosmogony of Zuni Native Americans (Mayor, 2005: 116). The Zuni creation myth also has humans evolve from lower life-forms, thereby anticipating the concept of Darwinian evolution (Mayor, 2005: 116).

5 CONCLUSION

The central motif in the Egyptian Middle Kingdom *Tale of the Shipwrecked Sailor* (*ca*. 2000-1900 BCE) concerns a star that fell to earth and caused the extinction of a population of giant serpents on an island to the east or south-east of Egypt. All but one of the serpents were "burned utterly" in the fireball that followed the impact. "Falling stars" are relatively common phenomena in the astromantic records of the Ancient Near East. If the recently postulated Late Holocene meteorite impact at Umm al Binni in the al-Amarah marshland of southern Iraq (Fig. 2) is indeed the cause of a regional impact fallout layer dating to *ca*. 2350 BCE, then a folk-memory of this event, and the loss of life that it caused, could be preserved in the Egyptian story. Another candidate is a putative comet strike of *ca*. 2807 BCE that has been proposed to account for the undersea "Burckle crater" south-east of Madagascar, and thus south-east of Egypt (Fig. 2). Its earlier date and greater distance from Egypt make it a less attractive option, but its location accords with the mid-ocean setting of the Egyptian story and one could interpret the *Tale*'s fierce storm, with its huge waves, as a folk-memory of the tsunami that an oceanic impact would generate. A similar connection – albeit on a much smaller scale – could be made for the less energetic and land-proximal Umm al Binni strike if the site was under water at the time of proposed impact.

It is, of course, important to remember that both the Umm al Binni and Burckle impact events are at this stage proposals which await testing and confirmation. As outlined above, an impact origin for the Burckle structure remains unproven and highly contested, so – together with its greater temporal and geographic remoteness from Egypt of *ca*. 2000 BCE – it must be regarded less favourably than the Umm al Binni option. Unfortunately, the security situation in Iraq has for many years prevented scientists from accessing the al-Amarah marshland, so the most recent analyses have relied upon satellite imagery, and fall short in several respects (French and Koeberl, 2010). If the putative fallout layer dated to *ca*. 2350 BCE that has been detected in Syria and off the coast of Oman (Fig. 2) proves to have its origin in a Near Eastern impact other than the one proposed for Umm al Binni, then this might serve equally well as a candidate for the serpent's "falling star." Artefacts fashioned from meteoric iron have been found in Iraq, Turkey and Egypt in contexts dating to 2500, 2400-2200 and 2050-2025 BCE, respectively (Bjorkman, 1973: 124-125). A confirmed terrestrial impact crater in the eastern Sahara, within the borders of modern Egypt near Gebel Kamil, is dated to 3000 BCE or later; while its location is at odds with the setting of the island in the *Tale of the Shipwrecked Sailor*, it may still have contributed to the narrative's description of the impact-derived fireball and its catastrophic effects on life.

In light of the modern belief that an asteroid impact caused the Cretaceous–Paleogene extinction event in which the non-avian dinosaurs were eliminated some 66 million years ago, it is uncanny to find the destruction of a population of flightless yet dragon-like giant reptiles attributed to just such a collision in an Egyptian narrative dating to *ca*. 2000 BCE. Clearly the Egyptian sages fully appreciated the potential consequences for earthly life of celestial impact events some two millennia before John of Patmos described how, in his eschatological vision (Rev 8: 8-11),

> ... something like a great mountain, burning with fire, was thrown into the sea. A third of the sea became blood, a third of the living creatures in the sea died, and a third of the ships were destroyed. The third angel blew his trumpet, and a great star fell from heaven , blazing like a torch, and it fell on a third of the rivers and on the springs of water. The name of the star is Wormwood. A third of the waters became wormwood, and many died from the water, because it was made bitter. [NRSV]

Papyrus Chester Beatty IV (Dynasty 19, i.e., 13-12th century BCE) describes the Egyptian sages as "those learned scribes from the time of the successors of the gods, those who foretold the future" and it promises of "those sages who foretold the future, that which came forth from their mouths took place" (Simpson 2003: 1). It would seem that this was no idle boast. Whether their apparent prescience in respect of the extinction of reptilian megafauna by a celestial impact event was arrived at by divine revelation about deep prehistory, clairvoyance of what modern science would reveal, keen observation of the world around them, lucky guesswork or sheer coincidence is a matter for individual readers to decide for themselves.

Cite as: Lloyd D. Graham (2017-19) "Then a Star Fell:" Folk-Memory of a Celestial Impact Event in the Ancient Egyptian *Tale of the Shipwrecked Sailor*?, online at https://www.academia.edu/35137388/_Then_a_Star_Fell_Folk-Memory_of_a_Celestial_Impact_Event_in_the_Ancient_Egyptian_Tale_of_the_Shipwrecked_Sailor.

---

6 REFERENCES

Abbott, D.H., Bryant, E.F., Gusiakov, V., Masse, W., Breger, D., 2008. Comment on "Impacts, mega-tsunami, and other extraordinary claims." *GSA Today*, 18(6), e12. DOI: 10.1130/GSATG9C.1. Online at https://www.geosociety.org/gsatoday/comment-reply/pdf/i1052-5173-18-6-e12.pdf, accessed 1 September 2017.

Abbott, D.H., Gerard-Little, P., Costa, S. and Breger, D., 2009. Odd $CaCO_3$ from the Southwest Indian Ocean near Burckle Crater candidate: Impact ejecta or hydrothermal precipitate? 40th Lunar and Planetary Science Conference, The Woodlands, Texas, 23-27 March. Abstract online at http://www.lpi.usra.edu/meetings/lpsc2009/pdf/2243.pdf, accessed 1 September 2017.

Abbott, D.H., Martos, S., Elkington, H., Bryant, E.F., Gusiakov, V., and Breger, D., 2006a. Impact craters as sources of megatsunami generated chevron dunes. Geological Society of America, Philadelphia Annual Meeting, 22-25 October. Abstract online at https://gsa.confex.com/gsa/2006AM/finalprogram/abstract_114274.htm, accessed 1 September 2017.

Abbott, D.H., Masse, W.B., Burckle, L.D., Breger, D. and Gerard-Little, P., 2006b. Burckle abyssal impact crater: Did this impact produce a global deluge? In Papmarinopoulous, S.P. (ed.) *The Atlantis Hypothesis: Searching for a Lost Land*. [Proceedings of international conference, 11-13 July 2005, Milos Island, Greece]. Greece, Heliotopos Publications. Pp. 179-190.

Abbott, D.H., Masse, W.B., Burckle, L.D., Breger, D. and Gerard-Little, P., 2007. Burckle abyssal impact crater: Did this impact produce a global deluge? [Updated version of Abbott *et al*., 2006b]. Columbia University Academic Commons, DOI:10.7916/D89P31F3. Online at https://academiccommons.columbia.edu/catalog/ac:193126, accessed 1 September 2017.

Aboud, T., 2009. Libyan Desert Glass: Has the enigma of its origin been resolved? *Physics Procedia* 2, 1425-1432.

Allen, J.P., 2015. *Middle Egyptian Literature – Eight Literary Works of the Middle Kingdom*, Cambridge, Cambridge University Press. Pp.9-53.

Atomic Heritage Foundation, 2014. Tsar Bomba. Online at http://www.atomicheritage.org/history/tsar-bomba, accessed 1 September 2017.

Baines, J., 1990. Interpreting the Story of the Shipwrecked Sailor. *Journal of Egyptian Archaeology*, 76, 55-72.

Baratoux, D., Reimold, W.U., and Chennaoui-Aoudjehane, H., 2012. The Second Arab Impact Cratering and Astrogeology Conference, Casablanca, 14-20 November 2011 – A bridge between geoscientists and astronomers. *Meteoritics and Planetary Science*, 47(6), 1098-1103.

BBC News, 2006. Tut's gem hints at space impact. Science and Environment archive, online at http://news.bbc.co.uk/2/hi/science/nature/5196362.stm, accessed 2 December 2018.

Besamusca, B., 2007. The human condition, friendship and love: The *Epic of Gilgamesh* and medieval Arthurian romance. In Summerfield, T. and Busby, K. (eds.) *People and Texts – Relationships in Medieval Literature. Studies Presented to Erik Kooper*. Amsterdam and New York, Rodopi. Pp.1-15.

Bjorkman, J.K., 1973. Meteors and meteorites in the Ancient Near East. *Meteoritics*, 8(2), 91-130.

Blackman, A.M., 1932. *Middle Egyptian Stories*. [Bibliotheca Aegyptiaca 2]. Brussels, Édition de la Fondation Égyptologique Reine Élisabeth.

Bottke, W.F., Vokrouhlický, D., and Nesvorný, D., 2007. An asteroid breakup 160 Myr ago as the probable source of the K/T impactor. *Nature* 449(7158), 48-53.

Bourgeois, J. and Weiss, R., 2009. "Chevrons" are not mega-tsunami deposits – A sedimentologic assessment. *Geology* 37, 403-406.

Carney, S., 2007. Did a comet cause the Great Flood? *Discover*, 15 November. Online at http://discovermagazine.com/2007/nov/did-a-comet-cause-the-great-flood, accessed 1 September 2017.

Chadwick, R., 1993. Identifying comets and meteors in celestial observation literature. In Galter, H.D. (ed.) *Die Rolle der Astronomie in den Kulturen Mesopotamiens*. [Grazer Morgenländische Studien 3]. Graz, Graz Kultur. Pp.161-184.

Conroy, G.C., 2005. *Reconstructing Human Origins*. New York and London, W.W. Norton.

Courty M-A., 1997. Causes and effects of the 2350 BC Middle East anomaly evidenced by micro-debris fallout, surface combustion and soil explosion. Presentation to the 2nd SIS conference, Natural Catastrophes during Bronze Age Civilisations, 11-13 July 1997, Fitzwilliam College, Cambridge. Abstract online at http://www.sis-group.org.uk/abstract/courty.htm, accessed 1 September 2017.

Courty, M-A., 1998. The soil record of an exceptional event at 4000 B.P. in the Middle East. In Peiser, B.J., Palmer, T. and Bailey, M.E. (eds.) *Natural Catastrophes During Bronze Age Civilisations:*

Archaeological, Geological, Astronomical and Cultural Perspectives. [British Archaeological Reports, S728]. Oxford, Archaeopress. Pp.93-108.

Courty M-A., 2001. Evidence at Tell Brak for the Late EDIII/Early Akkadian Air Blast Event (4 kyr BP). In Oates, D., Oates, J. and McDonald, H. (eds.) *Excavations at Tell Brak*. 2. *Nagar in the Third Millennium BC*. London/Cambridge, British School of Archaeology in Iraq/McDonald Institute for Archaeological Research. Pp.367-372.

De Buck, A., 1948. *Egyptian Readingbook*. I. *Exercises and Middle Egyptian Texts*. Leiden, Nederlandsch Archaeologisch-Philologisch Institut voor het Nabije Oosten.

De Sélincourt, A. (trans.), 1972. *Herodotus: The Histories*. London, Penguin.

Derchain-Urtel, M.T., 1974. Die Schlange des "Schiffbrüchigen." *Studien zur Altägyptischen Kultur*, 1, 83-104.

D'Orazio, M., Folco, L., Zeoli, A., and Cordier, C., 2011. Gebel Kamil: The iron meteorite that formed the Kamil crater (Egypt). *Meteoritics and Planetary Science*, 46(8), 1179-1196.

Durand-Manterola, H.J. and Cordero-Tercero, G., 2014. Assessments of the energy, mass and size of the Chicxulub Impactor. ArXiv (Cornell University Library), online at https://arxiv.org/abs/1403.6391, accessed 1 September 2017.

Ellis, P.B., 1991. *A Dictionary of Irish Mythology*. Oxford, Oxford University Press.

Faulkner, R.O. (trans.), 1972. *The Ancient Egyptian Book of the Dead*. London, Guild Publishing.

Fincke, J.C., 2013. "If a star changes into ashes…" A sequence of unusual celestial omens. *Iraq*, 75, 171-196.

Finkelstein, I. and Silberman, N.A., 2001. *The Bible Unearthed – Archaeology's New Vision of Ancient Israel and the Origin of its Sacred Texts*. New York and London, Touchstone/Simon and Schuster.

Folco, L., Di Martino, M., El Barkooky, A., D'Orazio, M., Lethy, A., Urbini, S., Nicolosi, I., Hafez, M., Cordier, C., van Ginneken, M., Zeoli, A., Radwan, A.M., El Khrepy, S., El Gabry, M., Gomaa, M., Barakat, A.A., Serra, R., El Sharkawi, M., 2010. The Kamil Crater in Egypt. *Science*, 329(5993), 804.

French, B.M. and Koeberl, C., 2010. The convincing identification of terrestrial meteorite impact structures: What works, what doesn't, and why. *Earth Science Reviews*, 98, 123-170.

George, A. (trans.), 1999. *The Epic of Gilgamesh*. London, Penguin.

Guang-jie, W. and Zhou-sheng, Z., 2010. Special meteoric phenomena recorded in ancient Chinese documents and their modern confirmation. *Chinese Astronomy and Astrophysics*, 27(4), 435-446.

Graham, D., 2017. Dating the composition of Annals 2.47 in light of Tacitus' description of the AD17 earthquake. Seminar, Department of Ancient History, Macquarie University, 1 September 2017. Abstract online at http://www.maha.ancienthistory.com.au/event/ancient-history-seminar-series-5/, accessed 3 September 2017.

Gusiakov, V., Abbott, D., Bryant, E., Masse, W. and Breger, D., 2010. Mega tsunami of the world oceans: Chevron dune formation, micro-ejecta, and rapid climate change as the evidence of recent oceanic bolide impacts. In Beer, T. (ed.) *Geophysical Hazards: Minimising Risk, Maximizing Awareness*. Dordrecht, Springer Science – Business Media V.B. Pp.197-227.

Hamacher, D.W. and Goldsmith, J., 2013. Aboriginal oral traditions of Australian impact craters. *Journal of Astronomical History and Heritage*, 16(3), 295-311.

Haviland, W.A., Walrath, D., Prins, H.E.L., McBride, B., 2008. *Evolution and Prehistory: The Human Challenge*. Belmont CA, Thomson Wadsworth.

Hoffmeier, J.K., n.d. The Gebel Barkal Stela of Thutmose III. COS 2.2B in Hallo, W. (ed.) *Context of Scripture* Online. Online at http://dx.doi.org/10.1163/2211-436X_cos_aCOSB_2_2B, accessed 1 September 2017.

Hornung, E., 1999. *The Ancient Egyptian Books of the Afterlife* (trans. Lorton, D.). Ithaca and London, Cornell University Press.

Humanities at Stanford, 2008. Dinosaurs and dragons, oh my! Stanford fossil historian links dinosaur bones to mythological creatures. Online at http://shc.stanford.edu/news/research/dinosaurs-and-dragons-oh-my > Research News > 2 October 2008, accessed 1 September 2017.

Koeberl, C., Rampino, M.R., Jalufka, D.A., Winiarski, D.H., 2003. A 2003 expedition into the Libyan Desert Glass strewn field, Great Sand Sea, Western Egypt. Third International Conference on Large Meteorite Impacts, 5-7 August, 2003, Nördlingen, Germany. Abstract online at https://www.lpi.usra.edu/meetings/largeimpacts2003/pdf/4079.pdf, accessed 2 December 2018.

Kring, D.A., 2010. International consensus – Link between asteroid impact and mass extinction is rock solid. Lunar and Planetary Institute, 4 March. Online at http://www.lpi.usra.edu/features/chicxulub/, accessed 1 September 2017.

Leick, G., 2001. *Mesopotamia: The Invention of the City*. London, Penguin.

Masse, W.B., 2007. The archaeology and anthropology of Quaternary Period cosmic impact. In Bobrowsky, P. and Rickman, H. (eds.) *Comet/Asteroid Impacts and Human Society: An Interdisciplinary Approach*. Berlin and Heidelberg, Springer. Pp. 25-70.

Master, S., 2001. A possible Holocene impact structure in the Al 'Amarah marshes, near the Tigris-Euphrates confluence, southern Iraq. *Meteoritics and Planetary Science*, 36(9), Supplement, A124.

Master, S., 2002. Umm al Binni lake, a possible Holocene impact structure in the marshes of southern Iraq: Geological evidence for its age, and implications for Bronze-age Mesopotamia. In Leroy, S. and Stewart, I.S. (eds.), 2002. *Environmental Catastrophes and Recovery in the Holocene*. Abstracts fromconference, 29 August–2 September 2002. London, Brunel University. Pp 56-57.

Master, S. and Woldai, T., 2007. Umm al Binni structure, southern Iraq, as a postulated Late Holocene meteorite impact crater. In Bobrowsky, P.T. and Rickman, H. (eds.) *Comet/Asteroid Impacts and Human Society – An Interdisciplinary Approach*. Berlin and Heidelberg, Springer.

Mayor, A., 2005. *Fossil Legends of the First Americans*. Princeton and Oxford, Princeton University Press.

Mayor, A., 2007. Place names describing fossils in oral traditions. In Piccardi, L. and Masse, W.B. (eds.) *Myth and Geology*. London, Geological Society. [Special Publications 273]. Pp.245-261.

Mayor, A, 2011. *The First Fossil Hunters. Dinosaurs, Mammoths, and Myth in Greek and Roman Times*. Princeton, NJ, Princeton University Press

Monson, J.M. and Lancaster, S.P., 2014. *Regions On the Run: Introductory Map Studies in the Land of the Bible*. Rockford IL, Biblical Backgrounds.

Mumford, G.D., 2013. Egypt and the Levant. In Killebrew, A.E. and Steiner, M. (eds.) *The Oxford Handbook of the Archaeology of the Levant: c. 8000-332 BCE*. Oxford, Oxford University Press. Pp. 69–89.

NRSV, 1989. *Holy Bible – New Revised Standard Version*. Peabody MA, Hendrickson.

Ockinga, B.O., 2012. *A Concise Grammar of Middle Egyptian*. Darmstadt/Mainz, Philipp von Zabern.

Olsen, J.W. and Underwood, J.R., 1979. Desert glass – An enigma. *Saudi-Aramco World*, Sep/Oct, 2-5; online at http://archive.aramcoworld.com/issue/197905/desert.glass-an.enigma.htm, accessed 2 December 2018.

PASSC, 2017. Earth Impact Database, Planetary and Space Science Centre, University of New Brunswick, Canada. Online at http://www.passc.net/EarthImpactDatabase/, accessed 1 September 2017.

Pinter, N., and Ishman, S.E., 2008. Impacts, mega-tsunami, and other extraordinary claims. *GSA Today*, 18(1), 37-38. DOI: 10.1130/GSAT01801GW.1. Online at http://www.tcfawcett.com/ipsh/geology/GSAToday_chevrons.pdf, accessed 1 September 2017.

Rackham, H. (trans.), 1942. Pliny: *Natural History, Volume II: Books 3-7*. [Loeb Classical Library 352]. Cambridge MA, Harvard University Press.

Reimold, W.U., 2010. The First Arab Impact Cratering and Astrogeology Conference, Amman, Jordan, 9-11 November 2009 – An appreciation. *Meteoritics and Planetary Science*, 45(2), 157-160.

Rio, J.P. and Mannion, P.D., 2017. The osteology of the giant snake *Gigantophis garstini* from the upper Eocene of North Africa and its bearing on the phylogenetic relationships and biogeography of Madtsoiidae. *Journal of Vertebrate Paleontology*, e1347179. DOI: 10.1080/02724634.2017.1347179.

Ritner, R.K. and Moeller, N., 2014. The Ahmose "Tempest Stela", Thera and comparative chronology. *Journal of Near Eastern Studies*, 73, 1-19.

Ryskin, G., 2003. Methane-driven oceanic eruptions and mass extinctions. Geology, 31(9), 741-744.

Schaefer, B.E., 2005. Meteors That Changed the World. *Sky And Telescope*, 1 February. Online at http://www.skyandtelescope.com/observing/celestial-objects-to-watch/meteors-that-changed-the-world/, accessed 1 September 2017.

Schmitt, S.R., 2004. Asteroid Impact Crater Calculator. Online at http://www.convertalot.com/asteroid_impact_calculator.html, accessed 1 September 2017.

Schulte, P., Alegret, L., Arenillas, I., Arz, J.A., Barton, P.J., Bown, P.R., Bralower, T.J., Christeson, G.L., Claeys, P., Cockell, C.S., Collins, G.S., Deutsch, A., Goldin, T.J., Goto, K., Grajales-Nishimura, J.M., Grieve, R.A., Gulick, S.P., Johnson, K.R., Kiessling, W., Koeberl, C., Kring, D.A., MacLeod, K.G., Matsui, T., Melosh, J., Montanari, A., Morgan, J.V., Neal, C.R., Nichols, D.J., Norris, R.D., Pierazzo, E., Ravizza, G., Rebolledo-Vieyra, M., Reimold, W.U., Robin, E., Salge, T., Speijer, R.P., Sweet, A.R., Urrutia-Fucugauchi, J., Vajda, V., Whalen, M.T., and Willumsen, P.S., 2010. The Chicxulub asteroid impact and mass extinction at the Cretaceous-Paleogene boundary. *Science*, 327(5970), 1214-1218.

Shaw, I. and Nicholson, P., 2008. *The British Museum Dictionary of Ancient Egypt*. London, British Museum Press.

Simpson, W.K. (ed.), 2003. *The Literature of Ancient Egypt*. New Haven and London, Yale University Press.

Ur Online, n.d. Woolley's excavations. Online at http://www.ur-online.org/about/6/, accessed 1 September 2017.

Van de Mieroop, M., 2016. *A History of the Ancient Near East, ca. 3000–323 BC*. Chichester, Wiley Blackwell.

Wainwright, G.A., 1946. Zeberged: The shipwrecked sailor's island. *Journal of Egyptian Archaeology*, 32, 31-38, with a correction (1948) in *Journal of Egyptian Archaeology*, 34, 119-120.

Weiss, H., Courty, M-A., Wetterstrom, W., Guichard, F., Senior, L., Meadow, R., Curnow, A., 1993. The genesis and collapse of Third Millenium North Mesopotamian civilization. *Science*, 261(5124), 995-1004.

Wengrow, D., 2006. *The Archaeology of Early Egypt: Social Transformations in North-East Africa, 10,000 to 2650 BC*. Cambridge, Cambridge University Press.

Wilkinson, T. (trans.), 2016. *Writings from Ancient Egypt*. London, Penguin.

Wooley, L., 2006. *Excavations at Ur – A Record of Twelve Years' Work*. London, Keegan Paul.

Wynn, J.C. and Shoemaker, E.M., 1998. The day the sands caught fire. *Scientific American*, 279(5), 64-71.
