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Mythology in the Tides

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Abstract: *Substantial mythology is associated with the tides. Such mythology is discussed in this paper. Monster sitings in Lake Champlain are attributed to submerged debris brought to the lake surface by tilting of the thermocline referred to as a seich. Early mythological explanations of the tides and discussed together with modern concepts. The tidal bore is discussed and related to mythological and useful means of protection. There is a tremendous amount of inaccurate information on the world wide web (the internet), a lot of which can be categorized as pseudoscience; an example related to Chaucer's Canterbury Tales is given. Related examples of pseudoscience are discussed, including effects of tides on sleeping, oysters, and other effects on the human body or bodies of other animals on emotions and actions.*

Keywords: *Estuaries, Monsters, Mythology, Ocean Waters, Pseudoscience, Tidal bore, Tides*

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I. Introduction

The author's interest in the tides goes back to his youth, living near Biscayne Bay in South Florida when there were still undeveloped areas and where the author spent many hours exploring, fishing, boating, and marveling at the nuances of the tides and tidal currents. There is substantial mythology associated with the tides. They are discussed below under the headings of Monster Sitings, Explanations of the Tides, Tidal Bore, Time and Tide, and Related Examples of Pseudoscience.

II. Monster Sitings

A seiche is a tilting of the thermocline that can occur due to wind stress on the lake surface [1]. Lake Champlain between Vermont and New York State has a large north-south length (125 miles, 201 kilometers) and relatively narrow east-west width (averaging 14.3 miles, 23.0 kilometers).Wind along its long direction often produces a seiche [2,3]. The seiche can tilt the thermocline sufficiently that it intersects the bottom, bringing up submerged debris such as waterlogged tree trunks. That is the likely cause of sightings of "Champ", the Lake Champlain monster [4,5], Vermont's version of the Loch Ness monster.

The time period between the "high" and "low" of a seiche can be as much as four to seven hours. This is very similar to the time period between a high and low tide in the oceans, so the seiche is often mistaken for a tide (hence its inclusion here). Lake Champlain has a small tidal variation, on the order of two feet. The internal seiche on Lake Champlain can displace the thermocline (the divide between the upper and lower layers of water) as much as 145 feet. Over 25 percent of the water in Lake Champlain shifts with the passage of an internal seiche wave [2]. It can create currents in excess of one mile per hour – one hundred times faster than the average north-south current.

III. Explanations of the Tides

Early explanations of the tides were quite creative. In Norse mythology, the tide was said to be caused by the breathing of the Earth-serpent Iormungander, an enormous monster that encircled the globe and held its tail in its mouth [6]. There are beautiful Native American [7] and Japanese [8] myths regarding the cause of the tides. One early notion had the moonlight, i.e., the sunlight reflected off the Moon, heating the ocean causing it to expand; which failed, of course, to explain the high tide on the side of the Earth opposite the Moon, or the high tide during the new Moon, or during eclipses of the Moon. Early Chinese writers suggested that the water is the blood of the earth and that the tides are the beating of its pulse, and secondly that the tides are caused by the Earth breathing. Seafaring people in many parts of the world had made the connection between tides and the Moon and its phases. But the reasons for that connection had to await the scientific advances that started earnestly in the 16th century. The role of gravity in establishing the orbits of the planets around the Sun, the orbit of the Moon around the Earth, and the gravitational attraction of the Sun and Moon on the Earth's oceans wasn't discovered until the 17th century.

Scientific knowledge of the tides is based on a long, multicultural quest for understanding. One of the earliest attempts to explain the tides scientifically appeared in a 9th century work by Abu Ma'shar (or

Albumasar), an Arab scholar who was born in Afghanistan and lived in Baghdad [9]. Through the centuries, scientists of various countries added to the understanding, leading up to 17th century England where we come to the huge contributions to science of Isaac Newton [10], which Newton may have never published if not for being convinced to do so by his friend Edmond Halley of Halley's comet fame.]. Newton provided the first complete proof of the revolution of the Earth and planets around the Sun and correct explanation of the causes of the tides.

In the 19th and early 20th centuries, George Darwin, who was the British Royal Astronomer and second son of Charles Darwin of theory-of-evolution fame, added substantially to understanding of the tides [11]. We now have the ability to make accurate tide predictions entirely from theoretical modeling that considers the astronomical positions of the Earth, Moon, and Sun together with the geographic variations of the Earth's oceans and shorelines [9]. Further detailed discussion of the tides is provided by Graber [1].

Nevertheless, at least one well-known encyclopedia [12], a college astronomy textbook [13], and a respected magazine ("Ask the Experts," Scientific American, November 2006, p. 108.) have given incorrect explanations of the tides, specifically what causes the high tide on the side of the Earth facing away from the Moon. In much of the world there are two high tides and two low tides every day, referred to as a semi-diurnal type of tide. The interested reader can find the full explanation for the two daily tides in Graber [1].

IV. Tidal Bores – General, Europe, and North America

In most of the world's estuaries the tide rises gradually. However, in some places, a remarkable phenomenon known as a tidal bore occurs. Then the tide comes into the estuary abruptly as a fast-moving wall of water, in some places up to ten or more feet high. Estuarine tidal bores have been the subject or cause of legend, poetry, recreation, tourism, shipping disasters, and scientific interest for centuries. Graber [14,15,16] discusses and tabulates legends and related information. Those references also discuss the mechanism of the formation of the tidal bore and other interesting features, including its present and historic locations, requirements for its formation, its maximum height, sound, special adaptations by fish, dissipation, and an instability that prevents it from reversing and heading back out to sea, The tidal bore is known by other names including mascaret in France, pororóca in Brazil, silver dragon (báiyín lóng) in China, and aegir or eager in England.

Present-day or historic (extinct) tidal bores occur on China's Qiantang River, the Shubenacadie and other rivers flowing into Canada's Bay of Fundy, England's Humber Estuary, Alaska's Knik Arm and Turnagain Arm, Brazil's Amazon River, the Colorado River in the Southwestern United States and northern Mexico, France's Seine River and Mont-Saint-Michel Bay, England's Severn and Trent Rivers, Scotland's Solway Firth, the Bamu River in New Guinea, the Indus River in Pakistan, and India's Hugli River. The bore has the fascinating appearance of current from upstream and downstream conspicuously coming into each other along a line approximately perpendicular to the shore. On the upriver side of the bore the tidal current goes out and on the downriver side the tidal current comes in (or goes out at a lower speed, depending on the freshwater flow), with an abrupt change in the tidal velocity across the bore.

In Sir Walter Scott's *Redgaunlet* [17], there are historically accurate descriptions of the tidal bore and salmon fishing in a tidal bore estuary, the Solway Firth in Scotland. Historically accurate discussion of the bore on the Seine River in France is given by Jean Jacques Malandain [18]. There are some inaccurate literary references to tidal bores. Tricker [19], in writing about the tidal bore on the Trent River in England, claimed that the heroine of Mary Ann Evan's (aka George Eliot) fictional *Mill on the Floss* [20] was drowned by a tidal bore said to have been based on the real tidal bore, known locally as the aegir (or eager), that occurs on the Trent River in England. However, in reading the *Mill on the Floss* one finds reference to a strong flow but no tidal bore. Wylie [21], writing about tidal bores about 15 years after the earlier statement, corrected the claim about the tidal bore. Several authors attributed the drowning of Victor Hugo's daughter, Leopoldine, and son-in-law, reflected in Hugo poem *A Villequier*, to the tidal bore on the Seine, known as the mascaret. Malandain [22], based on historic tide data, demonstrated that the drowning could not have been due to the mascaret.

The mythological creation of the River Seine was recounted by French author Jacques-Henri Bernardin de Saint Pierre (1737-1814) in L'Arcadie [23].The legend starts with Seine being a beautiful young nymphette, the daughter of Bacchus, god of wine. She served as a servant to Ceres, goddess of wheat, who figures large in French tradition. Those who collect stamps may recall that Ceres served as a representation of the Republic of France on their first postage stamps issued in 1849. When Ceres discharged Seine from her services, she granted Seine's wish to have certain valleys extending from the French coast. Ceres also assigned Seine a guardian nymphette named Heva because she was concerned that a sea god would carry Seine off. Sure enough one day when Seine was at the beach, Neptune saw her and was smitten. He mounted up on his marine horsemen and galloped after her. Just as he was about to grab Seine, she beamed a message to Bacchus and Heva. They turned Seine to water so she could slip through Neptune's fingers, and she now waters the valleys of the Seine. Neptune was undaunted, and twice a day since he thrusts himself up the Seine River with great commotion after

his lost love object. Each time, the Seine recoils reversing the natural flow of the river, to keep her gentler green waters separate from his salty waters of blue. Figure 1 depicts the peacefully sleeping nymph transforming into the River Seine, her body encircled by the skyline of Paris. It resides presently in the musée Denys-Puech in the French city of Rodez. This was the legendary explanation of the tidal bore on the Seine, which no longer occurs because of dredging at the mouth of the river.

Figure 1. White marble late 19th century carving of "La Seine" by Denys Pierre Puech (1854-1942).

Mythology associated with the Petitcodiac River in Canada is reflected in the following legend told by the Micmac artist Michael Francis [24]:

"In the beginning was the Great Spirit, who created everything in the sky, in the ocean and on the earth. He created the first man, whose name was Glooscap. And he created Pet-Kout-Koy-ek, the River That Bends Like a Bow.

Today the water of Pet-Kout-Koy-ek is brown like chocolate. But in ancient times it was clear and fresh. One day a monster Eel swam down the river, pushing all the fish and fresh water into the salty bay.

Turtle told Glooscap about the wicked Eel's misdeeds and the harm he had inflicted upon the river and its creatures. So Glooscap gave great powers to Lobster, who grew gigantic and strong enough to fight the Eel.

Their battle stirred up the mud of Pet-Kout-Koy-ek, turning the water brown, and sent waves far up the river. They fought long and hard, until Lobster prevailed and Eel was killed.

Even today, however, the battle takes place twice a day on the river now called the Petitcodiac. The wave, which forms as Lobster pushes Eel back inland, is known to most at the tidal bore."

V. Tidal Bore - China

None of the records of tidal bores and related cultural interactions approach those for China's Qiantang River, which has been famous for its tidal bore, and related legends, poetry, science, engineering, and history for more than a thousand years (see the author's photograph on Figure 2) . In the 1700s (Qian Long period of Qing Dynasty), the so-called "fish-scale" stone embankment was constructed, although construction on a Qiantang River embankment is thought to date back to around 100 CE (construction started as far back as the Han Dynasty and lasted until the Qing Dynasty). The embankment of the Qiantang River is considered one of the three great ancient engineering feats in China, alongside the Great Wall and the Grand Canal that connects Beijing and Hangzhou.

Eight iron oxen were placed on the Qiantang River bank near the village of Haining to provide mythical protection against the assaults of the bore. However, they weren't able to protect themselves. The power of the Qiantang tidal bore is evidenced by the fact that the eight iron oxen, 1.5 tons each, were washed away in 1953 [25]. Figure 3 shows a photograph of one of the two replica replacements. After the bore has passed, local shipping travelling upstream benefits from the strong current. But the ships must avoid being damaged by the

bore. One means of dealing with the oncoming bore is for ships to ground themselves on platforms provided for that purpose. Figure 4 shows such a platform.

The legend of the origin of the Qiantang bore starts with a General Wu Tzu-hsu, who having displeased the Prince Fu Ch'a of Wu numerous times, was condemned to death. The General told his son to fling him in the Qiantang River after his death and that he would then come on the tide twice a day . From that time on he came hurtling up, several hundred feet high, over-leaping the seawall. The General could be seen at the midst of the tide-head sitting in a funeral car drawn by white horses. Whereupon a temple was built to appease him around the year 475 B.C.E. A more recent temple, The Temple of the Sea God, was constructed near the village of Haining (between Hangzhou and Shanhai) in the year 1730 C.E. by decree of Emperor Yongzhen during the Qing Dynasty. It was destroyed during Mao's reign as were so many other cultural sites. But it was subsequently reconstructed, and was included in the author's visit to the Qiantang River. Figure 5 is the main temple inside of which there is a statue of Emperor Yongzhen (Figure 6), and statues of General Wu Tzu-hsu (Figure 7) and Prince Fu Ch'a (Figure 8). A smaller temple building (Figure 9) contains stone tablets, on one of which the Emperor entreats the people to pray for protection from the tidal bore and the other on which the Emperor's son does likewise (Figures 10 and 11 respectively). The author has collected a substantial number of references on the Qiantang bore, and cites about 20 of them in [14] and [15]. Those most pertinent to the mythology of the Qiantang bore are those of Doré [26] and Moule [27,28,29,30] who describe how the iron oxen provide mythical protection from assaults of the bore, and Fitch [31] and Needham [32,33] who discuss legends related to the bore, and Gaunt [34] who presents a Chinese legend in poetical form in which the bore plays a role.

VI. Time and Tide

There is a tremendous amount of inaccurate information on the world wide web (the internet), a lot of which can be categorized as pseudoscience. The author's Father-In-Law, who was descended from Cape Cod sea captains and named Ebenezer after such a sea captain, was fond of saying "Time and tide wait for no man." the author looked on the web to see if he could find the source of that expression, and found a site which claimed [35] that the expression was modified from a specifically-quoted portion in a specifically-named one of Chaucer's Canterbury Tales, namely the Prologue to "The Clerk's Tale". Geoffrey Chaucer was the fourteenth-century author whose writings in Old English many of us were compelled to learn in high school or college and which are actually enjoyable in modern English [36,37]. So this author read Chaucer's "Clerk's Tale"; a "clerk" incidentally in this context is a cleric or religious leader. And this author did not find the quoted passage nor any other passage related to "Time and tide wait for no man" in that, or in any other of Chaucer's tales for that matter. Another example of the need for skepticism, particularly where the web is concerned, and checking sources.

Figure 2. Tidal bore of about 1 meter (3 ft) on the Qiantang River, Haining, China, October 20, 2010 (photograph by author)

Figure 3. Replica Replacement of Protective Iron Oxen along the Qiantang River, Haining, China, October 20, 2010 (photograph by author)

Figure 4. Ship Grounding Platform and Tidal Bore on the Qiantang River, Haining, China, October 20, 2010 (photograph by author)

VII. Related Examples of Pseudoscience

Nazé [38] debunks claims of effects of tides on when people went to sleep and when they awoke, and tidal effects on tides and timing of menstruation. Another article in *Skeptical Inquirer* was entitled "Why We Are Unmoved As Oceans Ebb and Flow" [39] Those articles explain why, although the Moon can exert a force on the Earth's oceans sufficient to produce tides, the force of the Moon cannot exert a significant physical influence on our bodies compared to the gravitational forces exerted on us by other things around us such as buildings and so forth.

The first article, with 101 reference citations, reports on many careful research studies which have shown that there is no relationship between the time of the full Moon and such things as crime, 911 calls, automobile accidents, birthrates, sleep walking, or madness.

Quincey [40] discusses the strange case of the New Haven Oysters, effectively questioning a persistent claim that oysters can sense where the moon is even when they are transported to another location and moved indoors.

An interesting discussion of the nature of science was provided in a magazine article in *Skeptical Inquirer*. The article, entitled "The Philosophy Behind Pseudoscience" [41] stated that scientific theories must match reality. Thus, observation is a key aspect of science. A law must stand up to a wide range of observational tests or experiments. One example is that the explanation of the tides that the author gave matches qualitatively the observation of the tides. And we have also the ability that the author mentioned to accurately, quantitatively predict astronomical tides from the causative phenomena.

One of the things that has been most satisfying to the author in his career is that he has turned over and replaced numerous widely-accepted concepts through his technical publications, as detailed in [1].

The full Moon associations mentioned previously are part superstition, but there is more to some of it. Dishonest or incompetent science is a form of pseudoscience. The article "The Moon Was Full and Nothing Happened" [42] uncovered related examples of erroneous uses of statistical methods.

Abell [43] does an interesting job of debunking claims in a book about the effects of biological tides, meaning "tides" in the human body or bodies of other animals, on emotions and actions.

As an engineer and scientist, the author distinguishes between problems to be solved and mysteries to be enjoyed unsolved, and, to borrow a quote, "that we can be happier if we regard the universe and existence itself as mysteries". (Quoting from Hecht [44] which notion she attributes to the French philosopher Gabriel Marcel and the student of Buddhism Alan Watts.) In the words of the contemporary Buddhist teacher and writer Stephen Batchelor: "The acknowledgement 'I don't know' comes finally not as failure or disgrace but as release." (Quoting from Hecht, [44]). (The philosopher Moses Mendelssohn (1729-1786) "praised anyone who had Socrates' ability to say 'I do not know'" [44].)

Figure 5. Qing Dynasty Main Temple

Figure 6. Statue of Emperor Yongzhen

Figure 7. Statue of General Wu Tzu-hsu

Figure 8. Statue of Prince Fu Ch'a

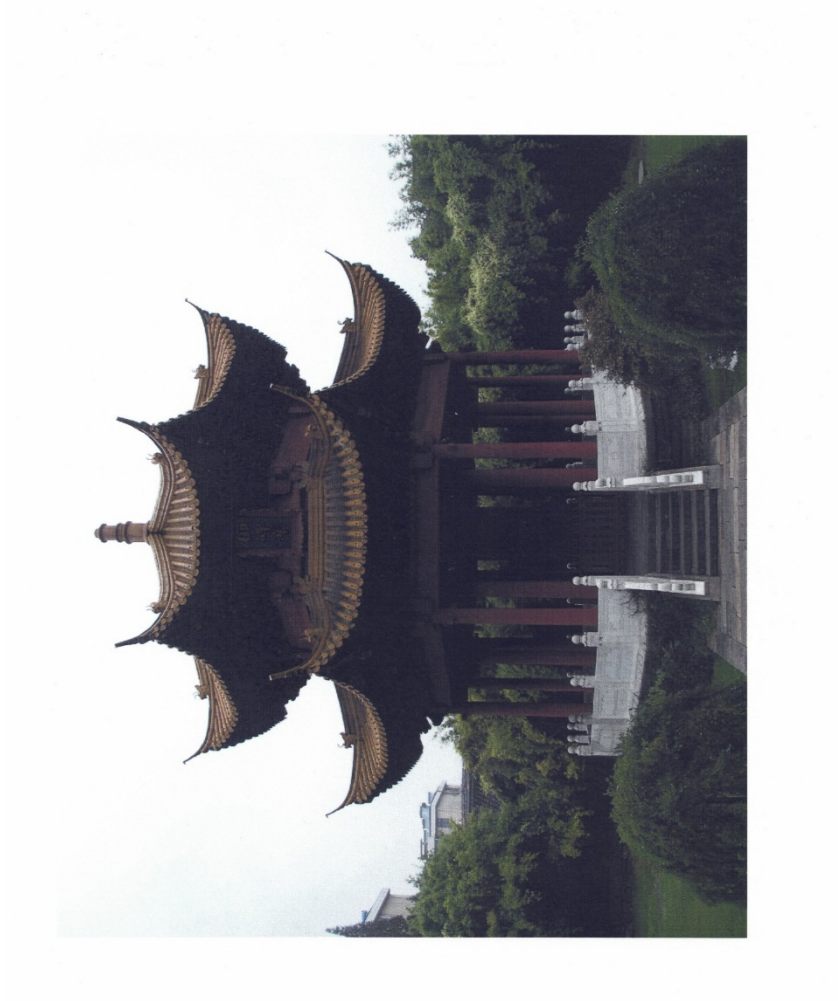

Figure 9. Smaller Temple Building

Figure 10. Emperor Yongzhen's Entreaty for the People to Pray for Protection from the Tidal Bore

Figure 11. Entreaty by Emperor Yongzhen's Son for the People to Pray for Protection from the Tidal Bore

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