THE VALUE OF PEARLS:
A HISTORICAL REVIEW AND CURRENT TRENDS

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Pearls are often reported as the oldest valuable gem known to humankind, and have been collected for at least 8,500 years (Ainis, et al., 2019). This article offers a brief review covering historical references of pearls and provides context on their value in history. We discuss the sources of natural pearls, some of the old documented pearl trade routes, and how demand and supply fluctuated through time. As natural pearls have achieved world record prices at auction in recent years, we also reflect on current market and testing trends that are shaping the saltwater cultured and natural pearl industries.

Pearls have long been appreciated for their orient and lustre that requires no cutting or polishing. Natural pearls are accidental formations in wild oysters or mussels, and have been considered to be one of the most precious gems in many cultures (Kunz & Stevenson, 1908). For centuries, scientists had debated the origins and formation mechanisms of pearls. Early myths ranged from pearls forming due to the entry of the tears of God or an angel, the dew of heaven, or lightning that had passed into an oyster's body (Dakin, 1913). Later, scientists developed various theories of pearl formation caused by sand grains, shellfish eggs, diseases or parasites (Strack, 2006).

In the 19th century, the pearl sac theory was proposed and it enabled the production of loose round cultured pearls in the 20th century (Nagai, 2013). Production began in Japan with the saltwater Akoya pearl oyster, and this same technique was later expanded to the South Sea pearl oyster (1956 in Australia) and the Tahitian pearl oyster (1961). Freshwater cultured production first began in Japan in 1935, but today takes place nearly exclusively in China where production began in the 1960s.

At present, cultured pearls vastly dominate the global pearl industry. Natural pearls remain a valuable niche and have experienced a considerable revival amongst collectors since the turn the early 2000s. In this article, we would like to briefly review the history of pearls and discuss how their value has fluctuated throughout history.

SOURCES OF NATURAL PEARLS

In ancient times, major saltwater pearl harvest sites were limited to the Persian Gulf and the Gulf of Mannar, between India and Sri Lanka, and the yield was poor. Today, the Persian Gulf is one of the last regions worldwide where pearl oyster fishing takes place, though largely as a hobby (Figure 1). The vast majority of natural pearls found in the trade are repurposed or come from old stocks.

FIGURE 1. *Pearls come in all sizes and shapes. Here an example of natural pearls from Qatar. Photo: Laurent Cartier.*

The freshwater pearl mussel fisheries were active in China, Scotland, Central Europe and USA. Minor pearl fishing took place in the Middle Ages and later in Europe, mostly in the streams of Central Europe and Scotland/UK (Strack, 2006). Julius Caesar—emperor of the Roman Empire from 49BC to 44BC—was said to be fond of pearls, and rumour has it (Deutsch, 1924) that one motive for invading Great Britain was to get access to freshwater pearls from Scottish rivers. Caesar also decreed that pearls were only to be worn by women above a certain rank (Kunz & Stevenson, 1908). Pliny the Elder (AD 23/24 -79), a Roman naturalist, stated that, "the first rank then, and the very highest position among all valuables, belongs to the pearl."

Throughout the Middle Ages and especially with the onset of the Renaissance in Europe, pearls remained objects of high

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value. The discovery of pearl oyster beds in the Americas in the early 16th century, radically changed supply and contributed to pearls being widely worn by European royalty. Centuries followed in which pearls were considered objects of power, wealth, and fashion. Although books and reports often speak of pearls and European royals, it is important to note that pearls were treasured objects in many different cultures. This includes Mexico (at least 8,500 years), the Persian Gulf (since at least 8,000 years) and Aboriginal Australia (since at least 2,000 years) amongst others.

The trade in natural pearls began to collapse during the Interwar period (1918-1939) and was lastingly hit by news of cultured pearls reaching the market in large quantities in the 1920s. Furthermore, the Great Depression of 1929, subsequent worldwide economic hardship and the Second World War (1939-1945) had a huge impact on luxury goods and natural pearls. Maurice Shire was quoted in a 1985 National Geographic article on pearls (by Fred Ward) as saying that, "In the 1920s, there were over 300 U.S. natural-pearl dealers. By the 1950s we were down to six, and now none."

Natural pearls remained a very niche trade up until the beginning of the 21st century, when they re-emerged as star jewels at auctions and in private sales. They have fetched spectacular prices in recent years due to increased demand, rarity and extremely limited supply (Shannon, 2017).

THE VALUE OF PEARLS: ANCIENT TO MEDIEVAL TIMES

The earliest archaeological find of pearl jewelry was discovered in Susa, the ancient capital of Elam, in the Khuzistan region of Iran. The particular necklace with 216 pearls is dated not later than the 4th century BC (Dirlam, et al., 1985).

The records of values/prices for pearls in ancient to medieval times are limited to some especially large or famous pieces. For example, it is said that Cleopatra used two pearls to amaze Anthony, which were worth 10,000,000 sesterces (Ullman, 1957) ($7.6 million in 2021 value). Another example is a pearl called al-Yatima belonging to the Abbasid caliph Hārun al-Rašid (786-809) in medieval Islam. The weight was claimed to be 14 mithqals (ca. 60 grams) (Shalem, 1997) and it was reportedly valued at 70,000 dirhams (Michaël Jan, 1967) ($4.7 million in 2021 value). These are the very top end examples, but they tell us how pearls were evaluated in ancient times. Considering the limited supply of pearls, the value of pearls did not drastically change across the ancient period until the discovery of the New World (Ball, 1935). Given the high value of pearls, there was also an interest in producing imitation pearls at the time. In 1480, Leonardo da Vinci came up with a recipe for imitation pearls: make a paste using very small pearls, dissolve it with lemon juice, dry the mix into powder form, bind it using egg white and finally polish the finished product for improved lustre (Mottana, 2019).

SUPPLY FROM THE NEW WORLD (RENAISSANCE TO MODERN)

The pearl world radically changed when Christopher Columbus made his 3rd voyage to South America in 1498. He found that the local populations on the Venezuelan coast had large amounts of valuable pearls. This triggered the 'Pearl Age,' a great pearl rush that was financed by Spain and harshly exploited indigenous populations. During 1513-1540, 11,877 kg of pearls were traded (400 kg/year on average) (Parsons, 1980), peaking at 1,380 kg in 1527 (MacKenzie, et al., 2003). This amount sourced from the New World is enormous considering the yield in Bahrain, the centre of the Persian Gulf pearl trade, was 1 million pearls per year at a later time (the early 18th century) (Carter, 2005). If the average size is assumed as 5 mm, 1 million pearls corresponds to 175 kg.

FIGURE 2. *Queen Elizabeth I on "Armada Portrait with a lot of pearls" (Wikimedia Commons, ca. 1588)*

The surge in supply from the New World affected pearl prices. In 1502, Amerigo Vespucci stated that he traded 157 pearls worth 375,000 maravedí (Yamada, 2013) (ca. $1,250/pearl in 2021 value). In 1596 Jan Huygen van Linschoten stated that a 1 ct pearl from Asia is worth 375 maravedí (Yamada, 2013) (ca. $196/pearl in 2021 value). The supply from the New World supported the abundant use of pearls by Queen Elizabeth I (1558- 1603) (Figure 2) and the typical Renaissance figurine pendants using baroque pearls (Dirlam, et al., 1985).

Discoveries of further pearl oyster beds in Panama and Mexico (Figure 3) contributed to huge supplies of pearls in the New World. A merchant of that period, Jean-Baptiste Tavernier, depicted the great gemstones he encountered in his voyages. In his book "Travels in India," he showed a pearl that the King of Persia bought from an Arab in 1633, which cost 32,000 tomans (Tavernier, 1889) ($2 million in 2021 value) and is estimated to have been around 500 grains (125 carats).

FIGURE 3. *Historically one of the most important sources of natural pearls, the Sea of Cortez in Mexico, today houses the only pearl farm in the Americas. Photo: Laurent Cartier*

With the discovery of diamond mines in Brazil in the 1700s, diamonds became increasingly popular in Europe. However, pearls remained important signs of power and wealth with royals such as Marie-Antoinette, Queen of France (1755-1793). Men such as Mughal Emperor Jahangir (1569-1629) or Charles I (1600-1649) were also known to wear pearl jewelry showing the reach pearls had over the ages and over different cultures.

Freshwater natural pearls have also been collected throughout history and there are many interesting reports of the pearl fever that went through the United States of America in the late 19th century (Kunz, 1898). However, international demand for freshwater natural pearls has generally been less than for saltwater natural pearls. One exception was the record sale of an 18th century Qing dynasty imperial (freshwater) natural pearl court necklace that sold at a Sotheby's Hong Kong auction in April 2010 for ca. US$ 8.7 million.

BOOM AND BUST IN MODERNISM (LATE MODERN PERIOD)

In the 19th century, the rise of a wealthy bourgeoisie with more disposable income pushed the demand for jewelry and pearls beyond royalty and social elites. Evening dresses had a low neckline and strings of pearls were popular for adorning ladies' décolletés. Empress Eugenie, the wife of Napoleon III and the fashion leader of that period, loved pearls so much that she wore several strings of pearls on her wedding day, although it was considered unlucky to wear them at the wedding (Dirlam, et al., 1985). Advances in diving equipment in the late 19th century meant that pearl fishing could be carried out more intensively, sharply accelerating the exhaustion of wild stocks of pearl oysters in many regions (Cariño & Monteforte, 2009). Accordingly, the pearl price increased and a report in 1877 says the price had increased 1.5-2 times in the previous 25 years (Yamada, 2013).

The demand for pearls continued and the price soared at the beginning of the 20th century. For example, a pearl necklace was bought for $22,000 in 1894, and it sold for $85,000 in an auction in 1911 (Yamada, 2013). The almost four times price increase is significant as the purchasing power of USD decreased only 10% during this period (Webster, 2022). As Yamada listed in her book, three reasons can be assumed for the pearl price soaring during this period (Yamada, 2013). Firstly, new diamond mines were found in South Africa lowering the value of diamonds and instead, pearls increased in value. Secondly, the nouveau riche in the USA rapidly became wealthy and sought pearl jewelry as an apparent symbol of wealth. Thirdly, Leonard Rosenthal tried to control the pearl market through buying almost all of the pearls in the major production sites, such as Bahrain and Venezuela. He would have been the De Beers of the pearl industry had it not been for the Great Depression and the invention of cultured pearls.

As if responding to the unprecedented pearl rush and depleting supplies, English marine biologist William Saville-Kent was the first to successfully achieve culturing loose pearls at the end of the 19th century (Saville-Kent, 1897). In Japan, Mikimoto Kōkichi would apply the Mise-Nishikawa method in 1916 (Taylor & Strack, 2008) and successfully create a new industry, as well as founding the Japanese flagship jeweler Mikimoto. The round cultured pearls were sold by Mikimoto in London from 1919 onwards for 75% of the price of natural pearls (Yamada, 2013). In 1922, The New York Times reported that cultured pearls sold for 30% less than natural ones. In 1928, in a case of alleged fraud, it was stated that cultured pearls had about one tenth the value of the natural material (Ogden, 2012). Whilst it was first thought that UV-light could distinguish natural and cultured pearls in 1921, this turned out to be wrong. The challenges the trade experienced with distinguishing natural and cultured pearls planted the seeds of gemological research. By 1927, X-rays and endoscopes were being used to identify cultured pearls (Ogden, 2012). This background information offers interesting parallels to the introduction and pricing of synthetic diamonds in the jewelry industry nearly a hundred years later.

The natural pearl industry strongly opposed the appearance of cultured pearls and an accusation of "Faked Pearl" and "Oriental Deception" was reported in a newspaper in London in 1921. The anti-cultured pearl movement spread to France and the USA and resulted in several lawsuits. However, it did not lead to the collapse of the natural pearl price immediately. Reputable biologists testified that the surface structure and formation process of cultured pearls were the same as the natural ones, and there was no method for distinguishing natural and cultured pearls without damaging them. Natural pearls still retained a high value. For example, there is a record that pearl necklaces were sold for $230,000 ($3.6 million in 2021 value) to $360,000 ($5.6 million in 2021 value) to businessman Rodman Wanamaker by Tiffany & Co. in 1923 and 1925 (Yamada, 2013).

The actual natural pearl price crash was triggered by the Great Depression. In 1929, the U.S. stock market collapsed, and the effect spread across the world, including the pearl industry. In 1930, the Bank of France announced it would stop according the

usual credit to pearl dealers or discounting their drafts, and the value of pearls diminished by 85% that very same day, according to Leonard Rosenthal in his biography (Rosenthal, 1952). This also significantly affected the cultured pearl price. The price of one momme (3.75 grams) of 6.3 mm cultured pearls cost 5,000 JPY ($68,000 in 2021 value) in 1919, and the same quantity of pearls cost only 5 JPY ($66 in 2021 value) in 1939 (Yamada, 2013). The most famous story of the pearl price crash is the Cartier natural pearl necklace. The necklace was valued at $1 million ($21 million in 2021 value) and exchanged for New York's Fifth Avenue mansion owned by Morton Plant in 1917. The value of the mansion in 2022 is estimated to be more than $100 million (Yardi Systems, Inc., 2022). After the pearl price crash, the value of the necklace plummeted and was sold at an auction for $157,000 ($1.5 million in 2021 value) in 1957 (Newman, 2020).

PREVALENCE OF CULTURED PEARLS AND RE-EVALUATION OF NATURAL PEARLS (POSTMODERN)

Pearl cultivation in Japan was suspended during World War II because of the regulation restricting manufacturing and selling of luxury goods (in order to prepare for war), but grew exponentially once it restarted under the careful protection of the Japanese government (National Diet Library Japan, 1952). Production reached a peak of 125 tonnes in 1967, and overproduction later created a set of challenges for the industry (Müller, 1997). Images of world fashion icons of the era, such as Grace Kelly, Marilyn Monroe, Audrey Hepburn, and Jacqueline Kennedy, showed them adorned with pearls. Middle-class women, influenced by the icons, desired affordable pearls, and cultured pearls from Japan were able to fulfil their demands.

In the last a few decades, the huge volume of cultured pearls has highlighted the rarity of natural pearls. David Warren, senior international jewelry director at auction house Christie's, commented in the Financial Times that natural pearls have again assumed their primacy since 2000 and a necklace priced at £10,000 in the 1990s would now sell for £100,000 (Shannon, 2017). In fact, the Rockefeller Pearl Necklace sold for $470,000 in November 1998 and was resold in May 2018 for $2 million (Christies, 2018). It may be noted that the resale value of cultured pearls is very low, therefore, their purchases are an emotional purchase. On the other hand, the rarity of natural pearls made them collector items and supports their resale value if they are of sufficient quality. In 1992, an Australian South Sea cultured pearl necklace (16-20mm) sold at Sotheby's New York for $2.3 million, a world auction record for cultured pearls. It is hard to estimate what such a necklace would sell for today, but it is generally agreed that the price for cultured pearls is past the boom period of the 1980s and 1990s when supply was much lower. In addition, some natural pearl jewelry has fetched record prices in recent auctions (Table 1).

FIGURE 4. *The historic pearl pendant of Queen Marie Antoinette (1755-1793) was sold in November 2018 for a world-record 36 million Swiss Francs (ca. US$ 36.19 million) at Sotheby's Geneva as part of the sale of the Bourbon Parma family jewel collection. Photo: SSEF. Painting: ca. 1767, Wikimedia commons.*

Table 1: *Recently auctioned exclusive jewelry items with natural pearls*

Jewelry name	Pearl description	Price (USD)	Date of auction	Auction site
Cowdray Natural Black Pearl Necklace	42 pearls sized 6.65 - 12.90 mm	$5.3 million	Oct 2015	Christies, Hong Kong (Christies, 2017)
Pearl necklace of the Maharaja of Baroda	68 pearls sized 9.47 - 16.04 mm	$7.1 million	25 Apr 2007	Christies, Geneva (Christies, 2007)
Seven-strand natural pearl and diamond necklace	614 pearls sized 5.1 - 17.5 mm	$9.1 million	12 Nov 2013	Christies, Geneva (Christies, 2013)
"La Peregrina" pearl necklace	La Peregrina (50.56 ct) and 56 cultured pearls	$12 million	13 Dec 2011	Christies, New York (Christies, 2011)
Marie Antoinette's pearl and diamond pendant	15.90 x 18.35 x 25.85 mm	$36 million	15 Nov 2018	Sotheby's, Geneva (Sotheby's, 2018)

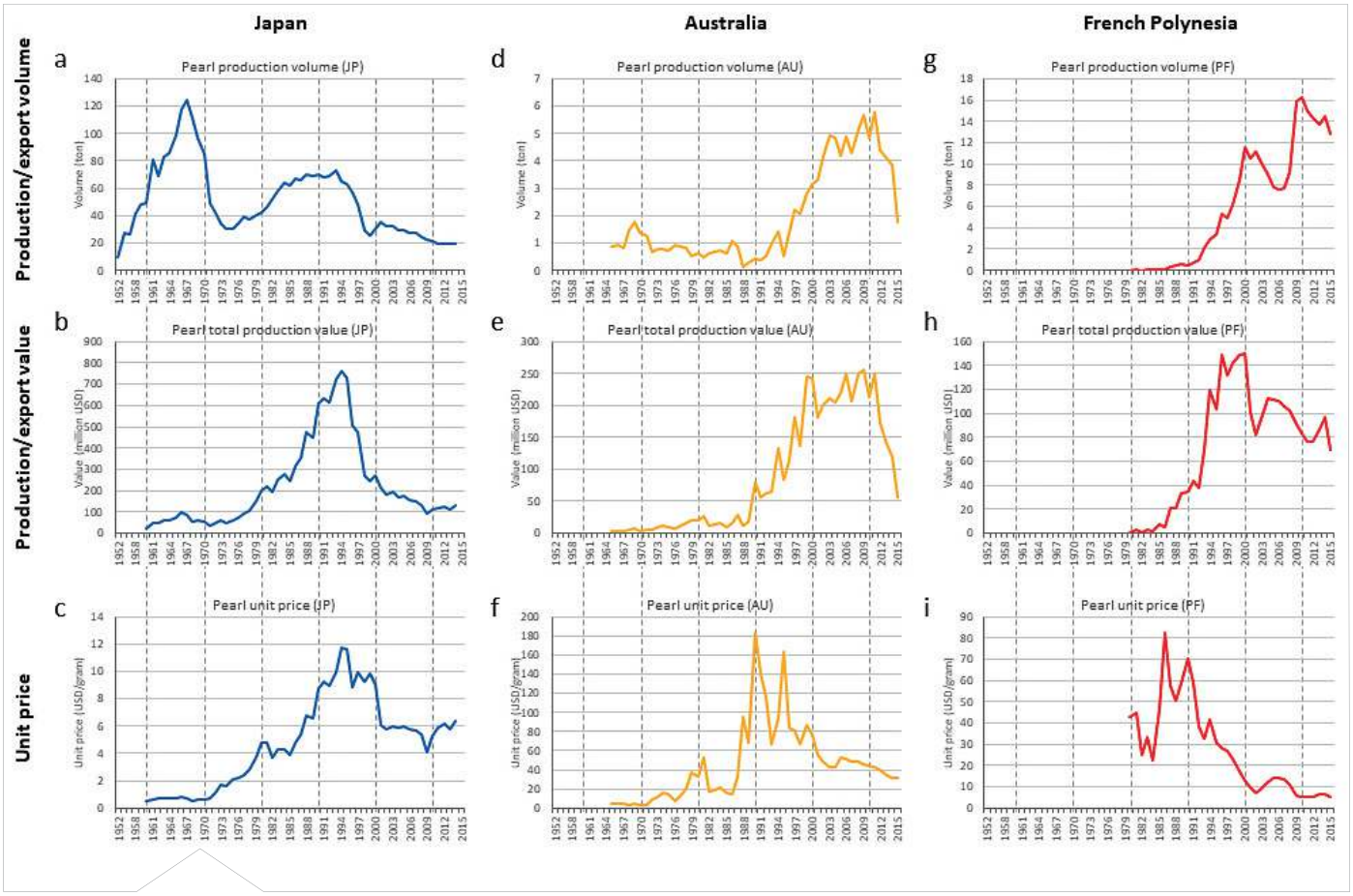

FIGURE 5. *Cultured pearl production/export quantity, value and unit price in Japan, Australia, and French Polynesia. a) Production quantity in Japan; b) Total production value in Japan; c) US$ unit price in Japan (Yano Research Institute, 2016); d) Production quantity in Australia; e) Total production value in Australia; f) US$ unit price in Australia (Yano Research Institute, 2016) (Southgate, et al., 2008); g) Production quantity in French Polynesia; h) Total production value in French Polynesia; i) US$ unit price in French Polynesia (Yano Research Institute, 2016) (Tisdell & Poirine, 2008).*

With the re-emergence of natural pearls at the beginning of the 21st century, and the increasing values associated with them, the work of gemologists able to conclusively identify whether a pearl is natural or cultured has become very important. At the same time, given increasing values, there have been numerous attempts to pass off cultured pearls as natural pearls in recent years. This includes the introduction of deceptive beadless cultured pearls and cultured pearls with natural pearl beads into the market (SSEF, 2021). In this context, the non-destructive identification of natural vs. cultured is as important as ever. Although the classical internal observation with X-ray radiography is still the primary technique, other techniques such as 3D microtomography, neutron imaging, age dating and even DNA fingerprinting provide valuable clues in distinguishing natural and cultured pearls.

DRIVERS OF THE MARINE CULTURED PEARL MARKET

This section focuses on marine cultured pearls (Akoya, South Sea, Tahitian) due to the lack of reliable production and valuation data from China regarding freshwater cultured pearls. Freshwater cultured pearls vastly outstrip marine cultured pearl production in terms of volume, and estimates range between 600 tonnes and over 5,000 tonnes per year since 2005, though figures today would be lower (Cartier & Tu, 2017) (Zhu, et al., 2018). However, the $ value of these gigantic quantities is lower than that of marine cultured pearls. Recent innovation and a focus on higher quality freshwater cultured pearl production in China merit a separate study.

The value of individual cultured pearls is defined by their size, shape, color, lustre, surface condition, and thickness of nacre. However, what are the key macro drivers of the cultured pearl market? Historical data of cultured pearl industries in Japan, Australia and French Polynesia indicates five main factors (Figure 5).

1) Supply volume: The first driver that repeatedly played a big role in the history is the supply volume. In Japan, the skewed supply in 1960s-1970s pushed the price. In Australia, the fluctuation of prices in the 1990s was sharply correlated with its supply volume. In French Polynesia, the price in the 1990s kept decreasing because of the oversupply and this trend has continued to this day.

2) Quality: The second driver is the quality. The significant Australian cultured pearl price increase in the 1980s was because of the quality improvement (increase of round/baroque pearls compared with half pearls). The

FIGURE 6. *Water levels at the Jewelmer Terramar Four farm in the Philippines show increasing levels of sea water that pose a long-term threat to pearl farmers. Photo: Laurent Cartier.*

FIGURE 7. *La Peregrina, probably the world's most famous pearl. The pearl is drop-shaped, weighs ca. 202.24 grains or 50.56 ct, and measures ca. 17.35 - 17.90 x 25.50 mm. Discovered in the early 16th century and last seen and sold at a Christie's auction in December 2011. Photo: SSEF.*

above-mentioned low price in French Polynesian in the 1990s are also because of its poor quality.

3) Trends: The third factor is the fashion trends that support the demand. In 1950s-1960s, the growing supply of cultured pearls in Japan was supported by the boom of cultured pearls advertised by the fashion icons of the era.

4) Macro economy: The fourth driver is the macro economy, which impacts both supply and demand sides. In Japan, the asset price burst in early 1990s caused the long-lasting recession and the cultured pearl supply plummeted. Around 2010, the Global Financial Crisis impacted negatively both on supply volume and prices in all three production areas.

5) Environment: The last factor is the environment, which biologically influence the pearl oyster ecosystem. In the late 1990s, a disease struck akoya oysters and 75% of oysters died in Japan. Together with the above mentioned long recession, it caused a significant decrease of the cultured pearl farmers in Japan. Climate change is a growing risk for pearl production worldwide.

In addition to the above five drivers, a couple of additional factors are worth being discussed to foresee the cultured pearl market. The first one becoming increasingly important in recent years is linked to sustainability of pearl production and how pearl farmers are affected by global changes (Cartier & Ali, 2021). Global warming and the associated higher water temperature can cause higher oyster mortality and diseases (Tomaru, et al., 2001), and lower quality nacre (Latchere, et al., 2018). Ocean acidification due to higher levels of carbon dioxide in our atmosphere (and thus in the oceans) causes shell nacre malformation and significant decline in shell strength, and pearl nacre may also be influenced (Welladsen, et al., 2010). Climate change is also leading to an increase in tropical storms and could further threaten pearl farms due to rising sea levels (Figure 6). At the same time, consumer interest in sustainable cultured pearls is rising (Nash, et al., 2016), however, the change in consumer behaviour and conservative wholesalers is still no straightforward trajectory. The establishment of greater traceability in the industry and more awareness of consumers are indispensable. Another factor to be noted in the future of pearl production is the technical advancements in culturing pearls. This includes using new methods to cultivate pearls and experiments including the use of organic nuclei to shorten production times (Cartier, 2013). Although it is yet unrealistic, genetic engineering (Katsuhito, 2002) or even pearls grown *in vitro* could not be excluded in the future (Jayasankar, et al., 2018) (Raghavan, et al., 2019).

CONCLUSION

There have been some fluctuations in the value of pearls throughout history. The value of pearls remained high because of their intrinsic rarity from the beginning of human history, and the abundant supply from the New World lowered the value in the 16th century. The surge in demand and overexploitation of oyster beds in the early 20th century drove the value to the highest level, then the value collapsed due to the Great Depression and the introduction of cultured pearls. The current and future cultured pearl market is dynamically influenced by a combination of multiple global factors as historical data indicates. Pearl farmers will continue to innovate in order to operate successfully, and new ventures, such as for example in Fiji, Micronesia, and UAE in recent years, will continue to appear.

On the other hand, given the rarity of high-quality natural pearls, they are likely to benefit from stable demand even though there is not a huge collector base. It is also positive to note that natural pearls from other species such as conch and melo have been increasingly used by leading jewelry designers in recent years. Although a pearl is no longer considered as having "the very highest position among all valuables" like in ancient times, the position of a natural pearl as a rare and expensive precious material (only surpassed at auction by fancy-colored diamonds) is firmly established, and its value is expected not to go lower, at least for rare and exceptional natural pearls.

The widely travelled 11th century Persian explorer Al-Biruni was quoted as saying, "the desire of pearls is a thing which is found in all nations." This will continue to be the case, regardless of the highs and lows of pearl supply, demand and fashion trends. As one of the world's oldest gems, inseparable from the human desire to collect jewelry and treasures, we think pearls have a bright future. ◆

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