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PEARL WORLD
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CLASPS: YESTERDAY AND TODAY

by Norbert Ratzlaff
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The following report describes in chronological order the development of clasps for pearl necklaces. This account essentially proceeds parallel to the corporate history of the Köhle company from Pforzheim in Germany. The development equally concerns the segments design, clasping technique and manufacturing process. The firm's corporate chronicle reports that production of clasps has existed since 1926, while the manufacture of jewelry in the Köhle family enterprise has its origin in 1872.

Until the beginning of the 1930s there were only imitation pearls in all sizes, for which simple silver or metal clasps were normally in demand. Genuine pearls were usually only available in sizes from 2 to 4 mm. The subsequently resulting necklaces were always "graduated necklaces" in which the clasps were on the smallest pearls– behind the neck.

It came about that clasps were made of gold or platinum, and tiny, delicate filigree was often utilized. The trimmings partially consisted of diamonds and/or genuine colored jewels.

The Japanese cultured pearl boom began in the 1930s. At that time there were already cultured pearls with diameters of 6 to 7 mm. But the necklaces were still threaded in graduations: the thickest pearls were situated in the middle, while the smallest were in the rear. The size of the clasps ensued from the size of the necklace. The clasps had a flat vase, while the tongue was adorned with an additional pilot pin as a second safeguard against unintentional opening. Pearls, diamonds and other precious stones served as trimmings.

In the 1950s the availability of cultured pearls continued to increase– even larger cultured pearls were offered at reasonable prices. White gold dominated with clasps, whereas the base often still had to be yellow gold. Thus a distinction to silver clasps was able to be made.

In the 1960s the centrifugal casting technique revolutionized the production of jewelry while at the same time it presented entirely new design possibilities. The progress of Japanese pearl breeders in the production of large cultured pearls enabled the availability of pearls of the same size ("choker" necklaces).

Spherical and barrel shapes conquered the clasp market in the 1970s. With choker necklaces the clasps no longer had to be worn

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MEXICO'S PEARLING HISTORY

We are indebted to Sergio Farell, along with Enrique Arizmendi, Manuel Nava and Douglas McLaurin of *Perlas del Mar de Cortés,* for their continuing input of data on the rich history of pearling in Mexico (see *Pearl World* August/September 1997 and October/November 1999).

When visiting with them in Guaymas, Mexico, in June of 1999, we were introduced to Don Manuel Loranzo Gallo who turned over documentation dating back to the early 1900s on the establishment of a commercial pearl farm on the island of Espíritu Santo in Baja California Sur.

The material (in Spanish) was, essentially, a prospectus for potential investors and it revealed the steps being taken which could well have put Mexico in the position that Tahiti today occupies in cultured pearl production.

We have had this documentation translated, and are preparing a booklet which will be sent to our subscribers. The history of Dr. Gaston Vivés and Senor Gallo's experiments in the cultivation of black pearls and the prospects for success makes for fascinating reading.

Even more fascinating is what

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happened next to these pioneers.

But for now, let us provide you with the following recently-received abstract on the history of Mexican pearling supplied by our friends in Guaymas.

FIVE CENTURIES OF MEXICAN PEARLS

by Douglas McLaurin Moreno and Enrique Arizmendi Castillo, Perlas del Mar de Cortés S.A. de C.V., Guaymas, Sonora, México.

This review is dedicated to the memory of two great men, Don Gastón Vivés and C. Denis George.

This review details the history of the Mexican pearling industry in the Gulf of California, and includes details of the development of the pearl culturing industry responsible for creating the Sea of Cortez bead nucleated cultured pearl. The history of the worldwide cultured pearl industry is given, and the pervading influence of the Japanese pearl culturing industry explained. Innovative Mexican methods used to produce loose (whole) cultured pearls from the indigenous rainbow-lipped pearl oyster (*Pteria sterna*) are described, together with the unique features of the pearls cultured in this bivalve.

INTRODUCTION

The Gulf of California, or "Sea of Cortez" as it is also known, which is located on Mexico's Pacific coast, is a unique subtropical ecosystem. Its waters are characterized by exceptionally high rates of productivity, and are capable of sustaining some of the most important high-volume fisheries in Mexico.

As well, it is able to sustain a high biodiversity of plant and animal species, almost comparable to that of tropical seas. These productivity levels, which are comparable to those of the Bay of Bengal, India, are partially due to the influence of a high upwelling of nutriments that is two to three times greater than that of the Atlantic or Pacific oceans at similar latitudes.

Four Mexican States surround the Gulf of California: Baja California and Baja California Sur (which form the Lower California Peninsula), Sonora and Sinaloa.

The overall climate of the area is dry and arid. Nevertheless, rivers do flow down from the mountains inland, but their freshwater rarely seeps into the Gulf since it is first utilized for agricultural purposes.

In the past, the main sources of freshwater for the Gulf of California were the Colorado River, followed by the Yaqui and Mayo Rivers.

It is in this harsh but unique environment that one of the most important pearl fisheries in the world took place. Pearls from the Gulf of California were recognized for their beauty, large size, unique dark gray color, and rich overtones. Since pre-Columbian times, these pearls were fished from two native bivalve species: the Panamic black-lipped pearl oyster (*Pinctada mazatlanica*) and the rainbow-lipped pearl oyster (*Pteria sterna*). Both bivalves were found in large numbers within the Sea of Cortez. For a period of only four centuries, Mexican pearls reigned supreme throughout the world, and were the most important source of 'new' pearls, since at that time most of the pearls in European markets were being recycled from jewelry collections owned for several generations by wealthy merchants or by royalty.

PEARL FISHERIES IN MEXICO'S GULF OF CALIFORNIA

Before the arrival of European colonizers, the native civilization's pearl fisheries took place throughout Mexico's Pacific coastline, but especially off the coastline of Oaxaca, the usual supply zone for the Mexico (Aztec) and Zapotec-Mixtec Empires.

The Mayan Empire was supplied with smaller pearls sourced from the smaller *Pinctada imbricata* oyster from Mexican-Central American Caribbean waters. Larger pearls were fished from Panamian waters.

In northern Mexico, large civilizations were unable to develop due to the lack of freshwater, along with the harshness of the desert climate. Most cultures in the area surrounding the Gulf of California were semi-nomadic, war-like, and lived off both marine and land resources. It is logical, then, to consider that the first Mexican pearl fisheries took place because of the need of food... with mother-of-pearl shell and pearls being a fortunate by-product.

The natives who were most openly involved in the ancient pearl fisheries of 1500- 500 B.C. were those of the modern day States of Sonora (the Yaqui and the Kom Kaac or 'Seri', as they are also known), and Baja California Sur (Pericú, Cochimí and Guaycura who were banded together under the term 'Californians'). These cultures employed both the shell and pearl of these molluscs as a display of social status, and for the production of figurines, ornaments, and tools for daily use.

All this was to change in 1533, when the first expeditions sent by Hernán Cortez arrived in the Bay of Santa Cruz (modern day La Paz, Baja California Sur). These adventurers proclaimed all the lands, people and resources to belong to the Spanish Crown.

CONQUEST BY SPAIN, AND THE EUROPEAN SETTLEMENTS

When the Spaniards arrived in this region, they already had some idea of the bounties they expected. Stories and legends of European and American origin intertwined, to become the mesmerizing call of the 'mermaids' responsible for luring those in search or wealth.

What the Europeans saw were scantily clad natives, many of

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whom were adorned with large dark gray pearls, living in a vast and deserted land.

In reality, these new lands offered very little in the way of ready-to-use resources. There was no agriculture, and the natives were nomadic (unlike those in Central Mexico). Also fresh water was scarce. In all, the only real reason to colonize these lands was the lure of pearls. And this was a fact, for in the first 50 years after the conquest of Mexico, the most valuable export product was the pearl.

The yearly value of pearls exported to Spain more than doubled that of all other exports including gold, silver, spices etc.

The local population was put to work, either by force or under payment, as divers in the pearling armadas of the Spanish.

After some time, introduced diseases decimated the populations of native Californians, so Yaqui Indians from Sonora were begun to be introduced into Lower California. These immigrants proved to be hardier and better suited to the perils of pearl fishery. Yaqui pearl divers were capable of diving to depths of 20 to 25 fathoms, with only a loincloth, a knife, and a catch-bag as their exclusive diving gear. Diver mortality was high due to both exhaustion and shark attacks.

Pearling armadas consisted of a sailboat (the "flagship") that was capable of pulling a number of smaller boats or canoes. Each canoe had two or three occupants, consisting of a sailor and the divers. The activities of the divers started early in the morning, when they would plunge repeatedly into the waters until noontime. They would then rest for three hours and start diving again for another three or four hours.

Hoisted bags of oysters were transported to the "flagship" for harvest of the shell, their inspection for pearls, and the cleaning of pearl shell. This activity continued unchanged for several centuries.

An average estimate used throughout the world affirms that that "only one oyster out of every 10,000 will produce a pearl". But the Gulf of California seemed to defy this estimate, since many localities were able to produce anywhere between four to fourteen pearls out of every one hundred opened oysters.

The Gulf of California seemed to defy the estimate that "only one oyster out of 10,000 will produce a pearl," since many localities were able to produce anywhere between 4 to 14 pearls out of every 100 oysters harvested.

Mother-of-Pearl (MOP) shell was another valuable commodity at that time, as MOP was used throughout the world for the decoration of jewelry, inlays, and other ornaments. From 1827 to 1874 some 500 metric tons of pearl shell was exported from Mexico to Europe every two years.

In 1874 a major breakthrough in pearl fishing was introduced. This was the diving helmet and the diving suit. This improvement in diving technology allowed the diver to fish for longer periods and at depths of up to 20 meters. Thus the richer pearl beds - ones barely touched by the previous diving efforts - started suffering the same fate as their shallower depth counterparts did due to overfishing.

Unfortunately this over fishing of the pearl beds lead to disaster, for reproductive success in the sea is directly proportional to the density of the pearl oyster beds. Yet another consideration is important: the number of breeding females.

Pearl oysters are protandric hermaphrodites. This means that they can change sex every year, or every breeding season. Usually the pearl oyster starts as a mature male when of 1-2 years old for a simple bio-economical reason: sperm cells are cheaper (in energy terms) to produce than ova.

However, pearl oysters usually mature as females when they attain 4-10 years of age. But, with age also comes an increase in shell size, so these larger (female) oysters were both easier to detect by the fisherman and held greater promise of having a larger pearl within.

As a result, breeding stocks of mature pearl oysters were severely affected by this new pearl fishing technology.

Unfortunately these pearl fisheries were not regulated, in spite of many attempts to get them under control. These attempts at control - initially by the Spanish Crown and later by the new independent Mexican State - were defeated by the impossibility of maintaining reliable inspectors on site. Under such a lawless regime the Mexican pearl fishery gradually came to a standstill by the end of the 19th century.

EARLY PEARL OYSTER CULTURE

So the beautiful black pearls of the Sea of Cortez were about to become a dream of old, with memories of these pearls slowly washing away with time.

This would have been the expected outcome, had it not been for one man's unique vision. He was Don Gastón Vivès, a medical doctor of French origin, who saw a unique opportunity and seized it. He unraveled ancient mysteries,

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and had success where others had only met failure by establishing the world's first commercial pearl oyster farm in Mexico during 1903.

This farm held some eight million Mexican black-lipped oysters (*Pinctada mazatlanica*), under culture conditions, inside special installations located mainly in the inlet of San Gabriel on the Island of Espíritu Santo.

Espiritu Santo is located near the Bay of La Paz in southern lower California. The total culture area of the farm was of 120 hectares, and the farm had over one thousand employees.

But unlike the modern day product - the cultured pearl - Dr Vivès produced natural pearls. As the Gulf of California was once abundant with so-called placers, or sites where pearl oysters and their pearls are known to be abundant, Gaston Vivés was smart enough to employ a former placer as his farm site.

Some reports suggest that he was able to obtain anywhere between 9% and 11% of pearls from of his "cultured" pearl oysters. If one considers that for many decades the official yield of commercial value pearls from a cultured pearl harvest was of the order of 10%t, you can begin to appreciate significant accomplishment of Don Gastón Vivés.

Because of this unprecedented accomplishment, the Mexican black pearl once more circled the planet, and fast became the favored gem amongst all others.

But there was also another positive aspect of this venture: the pearl farm itself acted as a gigantic breeding station for pearl oysters, thus helping nature in the repopulation of other pearl beds in the vicinity.

So Vivés' large and healthy population of cultured pearl oysters gave rise to a revival of many other pearl beds, and so also helped improve the local fisheries.

But changes were approaching rapidly, for on July 18, 1914, the Mexican Revolutionary Army marched into the City of La Paz. By the time they left, Mexico was no longer one of the world's most important supplier of pearls. The Mexican black pearl was all but lost to the world

At around the same time, but on the opposite side of the world, another man of vision, Kokichi Mikimoto, took the lead and introduced humanity to the modern day cultured pearl. After this event, the world was no longer the same, for pearl oysters could be 'seeded' in order to produce great numbers of lustrous round pearls. A series of related events then made it possible to produce cultured pearls in many different species of pearl oyster from around the world; but as the Mexican pearl never featured in these schemes it would remain elusive for most of the 20th Century.

MORTALITY CAME FROM THE NORTH.

By the third decade of the 20th century, once more pearls could be fished from the waters of the Sonoran coastline. Three major pearl fisheries were established: around Puerto Peñasco (Rocky Point) to the north, Kino Bay in the center, and Guaymas to the south.

The most important of these fisheries revolved around Kino Bay. Specifically, this endeavor was conducted by the Kom Kaac (or Seri Indian Nation), and took place in the vicinity of Mexico's largest island, Isla Tiburón.

The place where the Seri gathered the pearls shells is known, even to this day, as Punta Perla (Pearly Point). This fishing effort, unlike most of the previous ones, concentrated in the exploitation of the rich beds of the rainbow-lipped oyster, *Pteria sterna*.

These pearls, which were smaller than those of the black-lipped oyster (*Pinctada mazatlantica*), and which had unusual colors, were usually sold to residents and merchants of the city of Hermosillo (the capitol of Sonora), or to American tourists who passed by. Many of these pearls eventually made their way into the United States, where they were highly regarded because of their unusual colors and overtones.

This time, the fishery was not out of control since it remained solely in the hands of the local people. This fishery could have been an interesting event to examine, for the indigenous natives controlled the self-regulation of this fishery.

Unfortunately, this was not to happen, thanks to what was termed "the mortality". By 1936, and without a warning sign, an unknown malady started flowing down from the northern part of the Gulf and rapidly moved southwards. According to local fishermen, all pearl oysters started to die.

Dead pearl oyster shells were found all over the bottom of the Sea of Cortez. By 1940, the Mexican Federal Government finally issued a Pearl Fishing Ban in order to protect the few remaining pearl beds. But this action was simply not enough against the devastating effect of this invisible enemy. At that time, with certainty, the Mexican pearl finally become extinct.

Without a warning sign, an unknown malady started flowing down from the northern part of the Gulf and rapidly moved southwards. All pearl oysters started to die at that point.

Among the many explanations offered to explain this phenome-

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non, two found support amongst the coastal inhabitants. These were, firstly, that the Japanese had poisoned the Sea of Cortez in order for them to retain their unquestionable leadership in cultured pearl production; and, secondly, that an unknown virus had attacked the pearl oysters.

The first conspiracy theory involved the Japanese; since they had been very conspicuous throughout the Sea of Cortez, acting as fishermen, but some say they had been charting the waters of the Gulf of California in order to make a surprise attack on the Americans that ultimately did take place elsewhere during the Second World War.

The second conspiracy theory involved an unknown virus or microorganism. This was very unlikely, especially considering the rapidity with which the pearl oysters had died.

Only after many years passed, and after marine ecology had become better understood, has a better explanation been found. The most probable cause for the destruction of the pearl beds in the Gulf of California was the Hoover Dam in the United States that began operating in 1935.

Finally, after millions of years of discharging its waters into the basin of the Gulf of California, the Colorado River's water was being withheld. Obviously, this caused a catastrophic environmental effect that echoed throughout the expanse of the Gulf. Levels of oxygen in the water decreased, and the salinity of its waters went up. The rich nutrients previously found in the discharge of the Colorado River were no longer available as nourishment to the phytoplankton (microscopic algae), the basis of any marine food chain. As a consequence, death was sure to follow for many of the marine inhabitants of the Gulf of California.

Some thought the Japanese had poisoned the Sea of Cortez. The most probable cause for the destruction of these pearl beds was the Hoover Dam in the United States that began operating in 1935.

Other species of marine life also suffered a similar fate, for example: the giant totoaba fish (*Totoaba macdonaldii*), and the Cortez oyster (*Crassostrea corteziensis*) also were severely affected by this event.

But since pearl oysters played an important role in the economy of most coastal communities, they are still remembered as being the ones that suffered the most consequences as a result of the damming of the Colorado River.

THE JAPANESE CULTURED PEARL INDUSTRY

The Japanese cultured pearl "ruled" over all other pearls throughout most of the 20th century. The decades of the sixties and seventies saw an unprecedented growth in the production and marketing of cultured pearls.

At that time, Japan alone was responsible for over 90% of the total worldwide production of both marine and freshwater pearls. Japan also was the number one buyer of pearls produced by others.

The Japanese akoya pearl, which is cultured in the *akoya-gai* oyster or *Pinctada imbricata*, dominated the world market for pearls, with just an occasional appearance made by larger size pearls produced in Australia and Burma by utilizing the larger white- and gold-lipped mother-of-pearl oyster, *Pinctada maxima*.

Most people, today, seem to regard the late Kokichi Mikimoto as being responsible for the technology necessary to produce cultured pearls. But such is not the case. Mikimoto started growing cultured half-pearls, or mabés, in Japan during 1896, using a technique adapted from that employed by Chinese Buddhist monks in the 13th century.

The true success of Mikimoto's venture became possible only after his purchase of a 1907 patent for producing round pearls owned jointly by Tatsuhei Mise and Tokichi Nishikawa.

It is also believed by some that this patent was the result of plagiarism of the work on cultured pearls undertaken by an Australian based researcher William Saville Kent during the late 19th century.

Nevertheless, Mikimoto employed his legendary marketing skills to promote his cultured pearls worldwide, thus forever changing the fate of the pearl.

As this industry grew larger and became an important source of national income for the post-war economy of Japan, it was apparent that steps had to be taken in order to ensure maximum profit from the Japanese pearling industry. It was in response to this challenge that the following steps were taken by Japanese authorities:

1 The pearl was declared Japan's national gemstone.

2 Absolute secrecy surrounded every aspect of pearl culture. The dissemination of any information about Japanese pearl culturing was strictly regulated, and pearl culture technology was not allowed to be disclosed to non-Japanese.

3 Japanese technicians would travel abroad to take care of Japanese farms and joint ventures throughout the South Pacific.

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All harvested pearls were returned to Japan for processing and grading, with up to 90% of production used to fuel Japan's vast local and export markets.

Another way that the Japanese avoided competition in the field of pearl cultivation involved the creation and promotion of certain "pearling paradigms" such as: (a) Cultured pearls can only be produced by Japanese specialist technicians; and, (b) A Japanese seeding technician must operate on at least ten thousand pearl oysters before he becomes proficient.

In this manner, the Japanese effectively developed a monopoly for cultured pearls, or, in other words, a pearl cartel, with most of the income staying in the hands of Japanese companies... not those of the foreign producers of the pearls. Still, these actions allowed full control over production, quality, and value, so the cultured pearl commanded very stable, very high prices for many decades.

Two pearling paradigms:
(a) Cultured pearls can only be produced by Japanese technicians;
(b) A Japanese technician must operate on at least 10,000 oysters before he becomes proficient.

But what may have been applied overseas was not applied inside Japan. As a consequence, by the late sixties and the first years of the seventies, overproduction and the lowering of quality of Japanese akoya pearls caused an unprecedented drop in their prices.

This caused considerable turmoil in the Japanese economy. So the Japanese government decided to take control of the situation by establishing production quotas, storing part of the production, and then slowly releasing quantities of the production onto world markets to maintain price.

Still, this was just "the tip of the iceberg" of a larger problem that would ultimately re-emerge during the late eighties.

CULTURED PEARL PRODUCTION IN OTHER PARTS OF THE PACIFIC OCEAN

The first non-Japanese site chosen for pearl culture was Zamboanga in the Philippines. Culturing began in 1916, and was followed closely by the commencement of pearl farm off the island of Buton in Indonesia.

By 1940, and during World War II, pearl culture in the Indo-Pacific region came to an understandable standstill. Pearl culture began again only after most countries had "healed" their war wounds.

As part of the arrangement for the payment of war costs inflicted on the Australians, Japan signed an agreement under which they would help establish the Australian pearl culture industry. So it was in 1956 that the first joint operated pearl farm commenced operations in Kuri Bay, to the north of Broome.

By the 1960s the Australian pearling industry had established the foundations of what was to be its future, and sailed off into a prosperous future. Yet, for some years the technology needed to implant and grow cultured pearls was to remain fully under the control of the Japanese.

Pearl culturing in many other parts of the Indo-Pacific region was quite feasible, especially when the unique attributes of a pearl were considered against the likely yield of other local products, such as fish and other edible products of the sea.

Pearls were non-perishable, small and lightweight, and had high value; but pearl culturing just did not happen. Very few people, other than the Japanese, had the knowledge and courage to attempt pearl culturing.

One exception individual was the late C. Denis George. In retrospect, it is indeed unfortunate that not too many governments were happy with the idea of having several thousands of uncontrolled family-owned pearl farms scattered throughout the Pacific Ocean. As a consequence, their respective governments promptly closed all of these nascent ventures.

Continued suspicion of Japanese influence being involved in the decisions of these governments remains strong.

By the mid sixties, an interest in the culture of naturally colored black pearls was starting. The French Polynesian government called upon Japanese expertise in order to evaluate their possibilities in pearl culture. As the Japanese had previous experience growing black pearls in the waters surrounding the island of Okinawa, their response was to set up a small experimental pearl culturing facility in the atoll of Hikeru during 1961. By 1965, the first 1,000 cultured black pearls grown in French Polynesian waters had been produced.

MODERN MEXICAN PEARL CULTURE

About the same time as the Tahitians (1966), and within the confines of the first country that had a successful commercial pearl oyster farm, in Mexico City a local engineer turned jeweller, Don Manuel Lozano Gallo, dreamed of the possibilities of growing Mexican cultured pearls... but without Japanese intervention.

His idea was to use some of the techniques developed by Don

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Gastón Vivès, and combine these with modern day aquaculture techniques. Since Mr. Gallo had little knowledge of pearl oyster culture and pearl oyster biology, he called upon the expertise of the Australian pearl culture specialist, the late C. Denis George.

With the advice and help of Mr. George, Don Manuel Lozano Gallo quickly set up a small experimental farm within Bahía Falsa, which is located inside the Bay of La Paz. Thousands of spat collectors were put into the sea (including Vivés' "incubators") to collect juvenile pearl oysters, and, on November 29th, 1969, the first experimental seeding operation for the production of cultured pearls in the Western Hemisphere finally took place.

Unfortunately, neither Don Manuel Lozano Gallo nor Denis C. George had the chance of actually looking at the pearls they had taken so much care to grow, for the Mexican Federal Government seized and nationalized the pearl farm in 1971.

According to Don Manuel Lozano, he had had a very serious discussion with a former Mexican President, and was informed that this action was considered to be an act of "political vengeance."

In a new move, new fishery policies were enacted in the December of 1970. These new laws and regulations made it virtually impossible for a private entrepreneur to use most aquatic species for any commercial purpose, for these were to be used solely under a social cooperative regime. This, factually, acted as an overall deterrent to Mexico's nascent aquaculture industry.

THE JAPANESE ARRIVAL

Don Manuel Lozano Gallo's pearl farm was placed under the authority of the State of Baja California Sur's Fisheries Department. Any pearls obtained from the original harvest were never seen by the public, and the results of the project never saw the light of day.

As later pearl culture trials undertaken by a few Mexican researchers were unsuccessful, the Mexican Government believed that it was finally time to call in the Japanese. An official delegation of Japanese pearl specialists arrived on Mexican soil on the April 4th, 1979, for the purpose of conducting an evaluation of the pearling resources of the Bay of La Paz.

The Japanese delegation included Dr. Shohei Shirai (highly regarded as a pearl oyster specialist), Mr. Yoshiyashu Sano, and Mr. Ryu Kuronuma. During their stay, the Japanese evaluated the pearling potential of the Gulf of California and came up with the following observations:

1 Pearl culture in the Gulf of California was a technically feasible venture

2 *Pinctada mazatlanica* was very similar to *Pinctada margaritifera*, and therefore was suitable for the production of South Sea quality black pearls

3 *Pteria sterna* had a shell that displayed beautiful violet and purple colors, making it possible to be used to "create one of the world's rarest culture beds for purple pearls"

4 The local populations of pearls oysters were depleted and could not sustain a sustainable pearl culture operation.

5 Because of the low population of pearl oysters, in order to establish a pearl industry in the region there was the need to produce hatchery-reared pearl oysters

A little time later, the experimental pearl farm in La Paz closed down and the Mexican Government showed no further interest in pearl culture. Over the years that followed, only an occasional short study on indigenous pearl oysters, or mention of the once famous Mexican pearls was made from time to time.

In retrospect, it could be hypothesized that the oysters were biding their time and gaining in strength and numbers so that they could make comeback sometime in the future.

THE DECLINE OF THE JAPANESE STRANGLEHOLD

The nineties marked a singular event in the long story of the Japanese pearling cartel, the decline of the Japanese economy, and the loosening of their control over the pearl culturing industry. After more than four decades of tight control, the Japanese were facing new problems and obstacles: their economy was starting to weaken, their internal market (once the world's biggest pearl market) was facing diminishing income; and Japanese overproduction of low-quality akoya pearls was further damaging both the industry and its markets.

The troubled Japanese economy, and its poorly producing pearling industry, helped many pearl producing countries gain some independence from Japanese influence. Since the Japanese could no longer channel the world's pearl production through its internal market, they decided to leave producers to their own devices.

Some of them felt this newfound freedom was a blessing; others saw it as a curse.

At the last stage of this debacle a new pearling world emerged out of the old one. Non-Japanese pearl producers were thriving in free markets; the United States emerged as the main market of cultured pearls; and even the technological stronghold of the Japanese was waning.

Pearl culture technicians of every race and nationality made their appearance.

In the near future, Chinese pearl technicians will dominate the scene, given their low wages.

In 1994, an unprecedented gathering of the pearl world took place in Honolulu, Hawaii. *Pearls*

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'94 was a tremendous success, even though the Japanese did not send an official delegation to the event. For the first time ever researchers, producers, wholesalers, and jewelers from all over the world had the opportunity to unite their voices and discuss the future of the most ancient of gems, the pearl.

From that time, the pearl world was to be forever reshaped... with the consequences of this reshaping remaining uncertain for some years.

NEW PEARLS FOR A NEW CENTURY: THE RETURN OF THE MEXICAN PEARL

During the last decade of the 20th century, many scientific and technical advances, coupled with sociopolitical changes in Mexico, made it possible for the resurrection of the Mexican pearl.

In February, 1994, within the research facilities of the Guaymas Campus of the Tec de Monterrey, the first experimental harvest of cultured mabé pearls in the Americas took place.

This success was followed closely by the successful production of experimental loose (whole) cultured pearls in April, 1995.

These important events lead to the establishment, in 1996, of the first modern (marine) pearl farm on the American continent that is now known as *Perlas del Mar de Cortez* (formerly *Perlas de Guaymas*).

This pearl farm operates independently of any Japanese influence, and utilizes technologies developed locally in Mexico.

The important breakthroughs on which the modern Mexican pearl industry is based can be summarized as:

1 The first commercial production of marine cultured pearls (mabés and rounds) in the Western Hemisphere

2 Use of Mexican technology, researched locally, as opposed to the use of Japanese technicians; thus allowing full independence for the Mexican industry

3 For the first time, a species of winged pearl oyster was used for the commercial production of loose cultured pearls

The significance of this decision is the fact that virtually all marine (salt-water) cultured pearls are cultured in mother-of-pearl type oysters that belong to the genus *Pinctada*. Winged pearl oysters are never employed, except to produced mabé or half-pearls, for the following reasons: (a) the greater availability of Pinctada-type oysters; (b) the ingrained Japanese belief that it is not technically feasible to produce loose cultured pearls using *Pteria*-type oysters; and (c) the basic fact that most pearl technicians were either Japanese or Chinese.

In order to break new ground, the Guaymas based pearl culture team of the Tec de Monterrey - at that time comprised of Sergio Farell, Manuel Nava and the authors - had to overcome a series of initial problems, and so "lay the pillars" of this nascent industry.

INITIAL PROBLEMS: HOW OBTAIN A SUPPLY OF PEARL OYSTERS

In order to grow cultured pearls, you need an adequate supply of healthy pearl oysters. According to most studies of the area, pearl oyster stocks were seriously depleted throughout the Gulf of California. So began a series of studies on basic pearl oyster biology that included the study of breeding cycles and settling of spat (juvenile pearl oysters).

After a short (3 year) period of research, a very successful method for collecting spat was found. The use of standard mesh bag collectors proved most suitable. Unfortunately, while wild spat collection has been used for many decades all over the world, in most localities this process is usually ineffective.

Hundreds of thousands of spat collectors must be used to gather juveniles, due to the low recruitment numbers (on average, anywhere between 1 and 10 oysters) per collector. However in Guaymas, the average production of collected wild spat is between 400 to 780 juveniles per collector bag... with an all time record of around 1,700 oyster spat being found in a single mesh bag that had a surface area of one square metre.

In Guaymas, the average production of collected wild spat is between 400 to 780 juveniles per collector bag... with an all time record of around 1,700 oyster spat found in a single mesh bag one square metre in size.

Consequently, at Guaymas there was no need to the use of hatchery-produced spat.

The problem of spat being solved, the next problem in the long list was the culture of the pearl oysters themselves. It was only a matter of time before the most common aquaculture cages were being used for trial experiments.

Finally the researchers settled on an array of Japanese aquaculture equipment that included: pearl nets for the culture of spat from 1 to 8 mm size over a time span of 6-8 months; lantern nets for the culture of juveniles and young adults of from 8 to 90 mm size over a time span of 12-18 additional months; and finally to the use of pocket nets for pearl culture over period of 18-26 months.

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FURTHER PROBLEMS: HOW TO PRODUCE PEARLS

One of the main problems in pearl culture is the delicate pearl culture operation itself. High mortalities are usually associated with this procedure, even when highly trained technicians are employed.

In most commercial operations, an average mortality rate of around 30-50% is expected, although this number is believed to recently have fallen to around 10%, thanks to the use of new surgical techniques.

The main cause of post-operative mortality is due to forceful opening of the pearl oyster's bivalve shell. Pearl oysters, as with all other bivalves, will close their shells in the presence of danger. So, the use of steel pliers is a necessary to open the shell.

When forced open, the animal will try to close up, sometimes breaking its shell or tearing the large adductor muscle that is responsible for its closure.

In Mexico, use of a proprietary anesthetic solves this problem and allows the shells to be safely opened with a mortality rate as high as low as 1%.

Solving this problem led to yet another one: how to safely and effectively perform the delicate pearl culture operation that is commonly referred to as the Mise-Nishikawa method.

According to certain Japanese specialists, such as Tamura, Kafuku, and Ikenoue, the Japanese *akoya-gai* oyster has at least five different locations suitable for locating pearl sacs responsible for the production of cultured pearls: two of these locations being the most popular.

Unfortunately the pearl sac is often confused with the place in the oyster's anatomy where the cultured pearl can be produced. In reality, the pearl sac is a delicate "skin" composed of epithelial cells belonging to a grafted piece of mantle tissue that lines the pearl-producing cavity within the pearl oyster.

The mantle, a skin-like membrane that covers the inside of the oyster's shell, is the only tissue in the oyster's body that is truly capable of secreting nacre.

The procedure commonly used throughout the world to grow pearls has as its scientific basis a tissue grafting operation.

The graft is a small piece of mantle tissue from donor oyster that is surgically inserted into the recipient oyster's gonad or reproductive organ. This grafted tissue will hopefully "take" and grow a pearl sac that will then start secreting nacre around a bead of mother-of-pearl shell that is also inserted with the graft.

Since the oyster's body essentially consists of a compact mass of gonadal tissue– surrounding the mollusc's stomach, composite liver-pancreas, intestines, kidney and heart– the grafting operation poses a serious technical problem.

Japanese specialists, such as Hideyuki Tanaka and Morimitsu Muramatsu, have indicated that the unique (and very muscular) anatomy of a winged pearl oyster will not allow for the successful implantation of a bead nucleus.

Japanese specialists have indicated that the unique anatomy of a winged pearl oyster will not allow for the successful implantation of a bead nucleus.

Many Japanese pearl farmers tried growing loose cultured pearls within *Pteria penguin* during the 1950s and 1960s, only to face continuing problems and go as far as state that "it was a continuous nightmare."

Having had no previous experience with other species of pearl oysters was, perhaps, the most important factor in our successful culture of loose pearls using the *Pteria sterna*.

A good understanding of the unique anatomy of this lowly creature came second, followed by a good understanding of the theory of pearl sac formation.

As a consequence, the pearling paradigms of the Japanese had no adverse effects on our self-devised homografting technique. As a matter of fact, a recent study by Nava et al. (2000) has shown that an untrained person can achieve satisfactory pearl culture results based on the experience of operating on a mere 7,000 rainbow-lipped pearl oysters.

After the operation, and the oyster's convalescence for a period that may last for up to 3 weeks, the trouble is not over.

The quality, shape and size of the pearl will depend on a myriad of factors, most of which are impossible to control.

However, our success is basically dependent on the care given to the oysters at the farm; the environment in which the implanted oyster has to live and secrete nacre; and the oyster's own physiological condition.

After a period of 3-4 weeks the oysters are returned to land installations for inspection. This inspection involves three main operations: identification and removal of dead oysters, which are discarded; inspection with X-rays to confirm retention of the nucleus; and sampling of oysters to allow an assessment of the success of our grafting operation.

All oysters that show a bead nucleus within the appropriate part of the oyster's anatomy, when examined with X-rays will be returned to the pearl culture grounds. Those that do not meet this condition will be returned to the farm for a period of 4-9 months, after which time they will be used for the production of cultured mabé half-pearls.

At present time, the average

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mortality rate of oysters after at least 18 months in culture is about 40 per cent. The productive yield of marketable pearls is 10 per cent.

These percentage yields are improving every year, but are very similar to those published by many Japanese authors as being the standard for akoya bead nucleated oysters cultured in Japan during the 1950s.

POSITIVE ENVIRONMENTAL IMPACT ON THE GULF OF CALIFORNIA

As previously described in this review, over past years the Sea of Cortez sustained one of the most intensive pearl fisheries in the world. This lead to the slow exhaustion of its pearl beds, and had a very negative impact on both the viability of these pearl beds, and the reproductive effectiveness of the adult oysters they held.

Fortunately, a pearl farm based on ecologically sound principles is a unique tool for allowing the recovery of exhausted pearl beds. Sexually mature pearl oysters can have a very high rate of fertilization rate in a farm, thus aiding in the slow recovery of the species.

Since the beginning of the pearl culture operations in Guaymas, a steep increase in the production of pearl oyster spat has been recorded, with the average number of juvenile pearl oyster per collector bag increasing from only 30 individuals per bag in 1993 to 900 individuals per bag in the year 2000.

Another positive impact on the ecology of the Gulf stems from the use of culture structures and cages which act as a temporary artificial reef.

When the experimental pearl farm was constructed in 1991, the number and variety of reef fishes was equal to the region's average. Since that time there has been a large increase in both the number and variety of marine life found in the area.

These new habitats reduce the competition for space between species by several mechanisms. First, they increase the biomass of sedentary species such as the giant sea cucumber (*Isostichopus fuscus*) that was on the brink of extinction.

Second, they redistribute the existing biomass so that various species can move back and forth from natural to new habitats. Bottom-dwelling species and some pelagic fishes are in this category, as they will exploit a new source of food from the biomass being held in the artificial reef.

Third, they work as a giant nursery for both rocky reef and sand dwelling species of fish, as most juveniles are small enough to pass through the mesh of the cages and reach a safe haven from predators.

After gaining some maturity species such as the Cortez angelfish (*Pomacanthus zonipectus*) will migrate back to the natural habitat in which they will grow to maturity.

These facts, alone, are highly suggestive of a viable, long-term future for pearl farming in the Sea of Cortez.

THE SEA OF CORTEZ CULTURED PEARL

In Mexico, the most successful pearl culturing results – both at the experimental and commercial level - have been obtained by utilizing the rainbow-lipped pearl oyster, *Pteria sterna*. As a consequence, at the present time the Guaymas pearl farm has some 250,000 pearl oysters in culture, and of these only 1% of the cultured population belongs to the local black-lipped pearl oyster, *Pinctada mazatlanica*. For this reason, most of the cultured pearls from the Sea of Cortez will be of the rainbow or multicolored type.

The Sea of Cortez Pearl is grown in sizes of 6-12 mm, but have the average diameter of 8.0 mm. The largest pearl produced to date has been a pearl with a diameter of 14.0 mm.

> The Sea of Cortez pearl is grown in 6-12mm sizes, but has an average diameter of 8.0mm. The largest pearl produced to date has been 14.0mm.

Many shapes are available and include round, semi-round, semi-baroque, circled and baroque pearls. Rounder pearls are relatively uncommon (only 5%), with baroques comprising up to 50% of a harvest because of the long cultured cycle (from 18 to 26 months) that the rainbow-lipped pearl oyster must undergo.

As with all other bead-nucleated cultured pearls, the thickness of the coating of nacre on Sea of Cortez Pearls must be on the order of 1.5 to 2 mm in order to produce a high quality product.

It must be emphasized that quality control is very important in the farming of these cultured pearls, for it is quite clear that the Mexican pearl must compete economically with the high over- production schemes of pearl producing countries such as China (1,100 metric tons of freshwater pearls and 20 tons of akoya), Japan (20 tons of akoya) and French Polynesia (10 tons of black South Sea pearls).

But we, who were responsible for producing the Sea of Cortez Pearl, believe that we have a viable option to compete with a unique, high quality cultured pearl.

The colors displayed by Sea of Cortez Pearls are an entirely different matter, for words oftentimes cannot be used to accurately describe them. The variations in color range from a very light

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opalescent grey to golden-bronze, greens and blues, violets and purples, and even jet-black (but with ever-present overtones of rosé-violet and blue-green).

Some of the unique colors seen on the pearls are golden olive-green, deep purple, abalone-cyan, and burgundy.

Other beautiful colors – similar to those seen on commercial quality South Sea black pearls - also can be found. These include aubergine, dark-green, dark-gray and black.

The Sea of Cortez pearl displays a unique orange-red fluorescence under long-wave ultraviolet light, something that does not occur with Tahitian black pearls.

A paper on the unique color attributes of the Sea of Cortez pearl which is being prepared by Dr. Lore Kiefert, of the Swiss Gemological Institute (SSEF), should help to further the overall knowledge of their natural colors.

The Mexican Sea of Cortez pearl has yet another unique attribute: it is not processed in any way.

After harvesting, pearls are routinely washed under tap water and a cloth is used to dry and remove organic matter off their surfaces. Then, they are either sold or set into jewelry.

Absolutely no bleaching, dyeing or polishing is allowed.

This very desirable lack of processing allows this unique pearl to display a strong metallic luster that is caused by the presence of fine suture lines in the nacre that are responsible this pearl's optical effects of orient and overtone.

Thus, Sea of Cortez pearls will possess a long lasting natural beauty that is more akin to a natural pearl than most other cultured pearls.

CONCLUDING REMARKS

The 21st Century will mark a special point in the long lasting romance between humanity and the pearl.

This can either be a time for the rebirth of the industry – based on its maturity and set on the principles that guarantee a high-quality product and the dissemination of knowledge - or it can mark the beginning of an era of "clone pearls" that will be based on the principles of the mass production of identical-looking, disposable pearl-like products.

The only ethical way to improve a pearl is through continuing education at all levels: the consumer, the retailer, the jeweler, the wholesaler and even the pearl farmer.

To everyone's level of understanding it must be explained that a pearl is an organic gem that has been created by a unique creature that lives in a unique environment subject to the laws of nature.

Thus the resulting pearl is as unique as life itself. If people all over the world are trying so hard to distinguish themselves from others, why should we force the pearl to become a clone?

The nascent Mexican Pearl industry is stubborn enough to cast aside old beliefs and ideologies, to set its sights on a high-quality product, and to employ an environmentally sustainable approach towards pearl farming. This will ensure a lustrous future for the industry.

Intensive use of the rainbow-lipped pearl oyster (*Pteria sterna*) enables production of naturally lustrous and colorful pearls, unlike others found anywhere in the world today.

The Sea of Cortez Pearl represents an additional option to those who favor beauty, uniqueness and rarity.

Whatever the final outcome may be, the answer is clear: beautiful, high quality pearls will remain in use and will be cherished for as long as humans walk this precious earth.

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