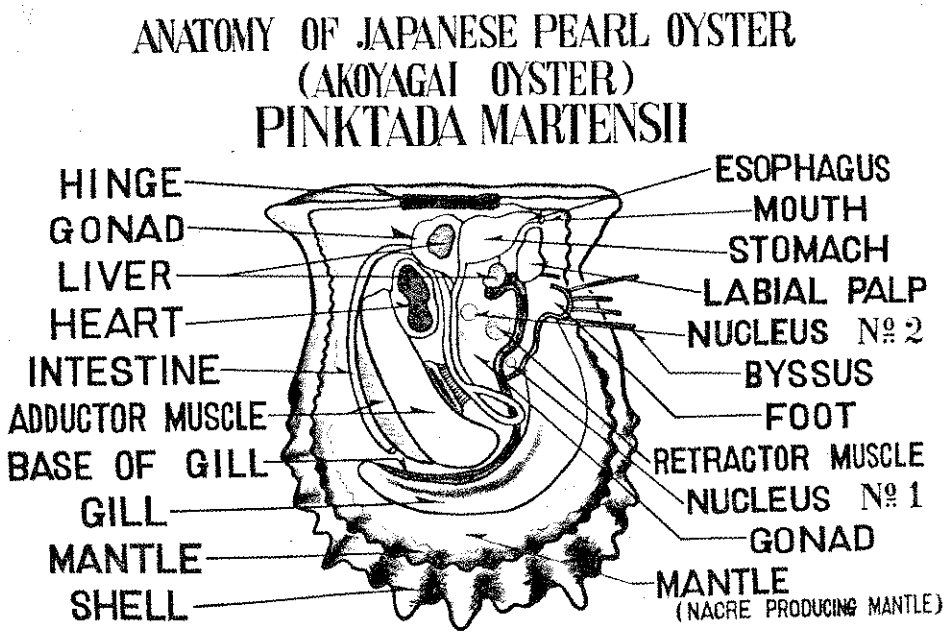


Nuclei for round pearls are inserted in either the gonad or retractor muscle or, frequently, both. The adductor muscle and foot are sometimes eaten as delicacies.

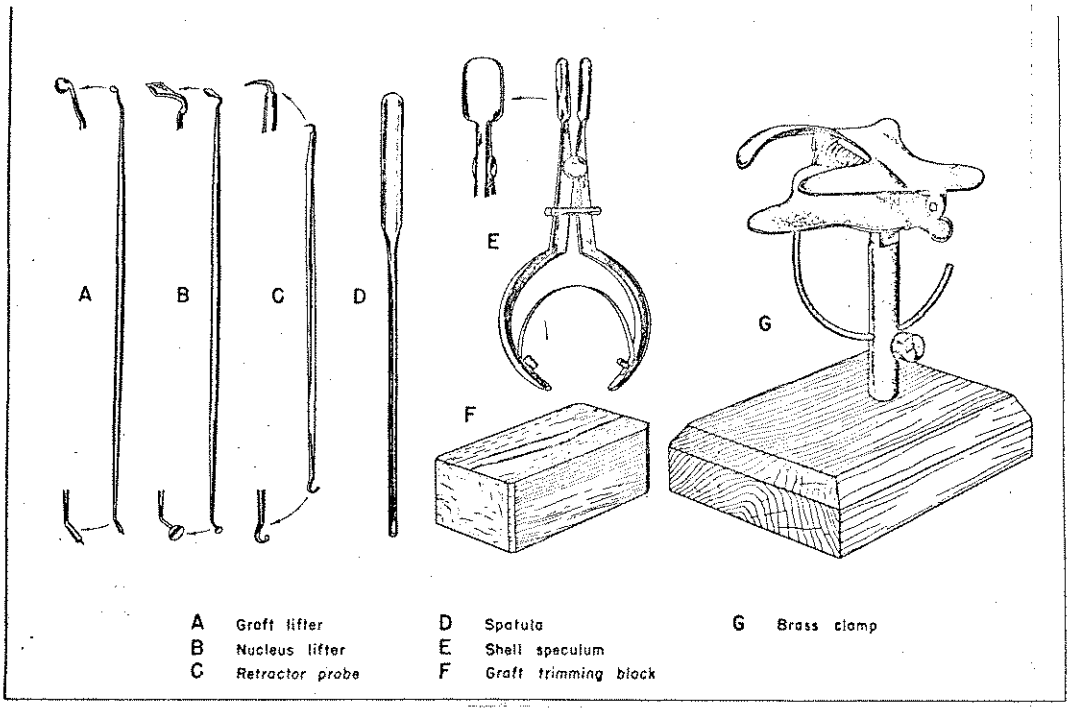
As for pearls, they are now known to be the result of reactions to irritants that lodge themselves on the shell or penetrate the mantle. If they fall (or are placed) upon the shell, the secretions of the oyster or clam glue them firmly and the result is a blister pearl. If they penetrate the tissue of the mantle slightly, they are covered roundly by the secretions from the epithelial cells at the point of penetration, but the other end may get partially glued to the shell and the result is a misshapen pearl, neither round nor button, which is called baroque after the work of the Fontainebleau artists who loved to paint the fantastic shapes of rocky grottoes designed for the delight of the seventeenth-century French court. (In art this nonsymmetrical form is also known as rococo or grotesque.) In short, all pearls are the result of reactions to irritants, but a round pearl develops only when the irritant penetrates the outer skin (epithelium) of the mantle and deeply fractures the secondary skin (parenchyma), carrying with it a few cells

from the epithelium in the process. These cells continue to live, and form within the parenchyma a sort of pocket or sac that embraces the irritant which is then, layer by layer, bathed first in aragonite, then conchiolin, then nacre. It was this process, first investigated by two Japanese experimenters early in the century and later postulated as theory by Oda, the chief researcher for Mikimoto in the 1940's, which formed the great breakthrough in pearl cultivation and permitted the culturing of round pearls. Skill and science have further improved the conditions under which the oysters do their delightful work, but no substitute for the ways of nature and nacre has yet been discovered.

The objective scientific and legal story of the first cultured round pearls has been carefully detailed in a report made by the aquatic biologist Dr. A. R. Cahn to the United States government in October, 1949, during the early years of the American occupation of Japan. It is a fascinating book-length document that for all its technicalities reflects the fierce competition between the pearl cultivators and the scientists to discover nature's secret, and suggests tersely the tremendous difficulties involved in the whole process of pearl cultivation, even after that secret was discovered.

The story begins sometime around 1900, when a teenager named Tatsuhei Mise, who was clever with his hands, acquired a stepfather who was an inspector of oysters. Young Mise had no training in science but was a skilled carpenter, and it is probable—although this is suggested only by the facts—that it was actually the stepfather who first set him off and who guided him on his experiments in seeding oysters to make pearls. In any event, in 1904 Mise brought to the Japanese marine scientists the first round cultured pearls they had ever seen along with a tool he had developed for his procedure. The procedure was new: It consisted of transplanting a bit of mantle from a pearl-bearing living oyster into another oyster at the same time a pearl nucleus was inserted; he called his tool a grafting needle and asked for a testing of both the tool and the procedure so that he might patent them.

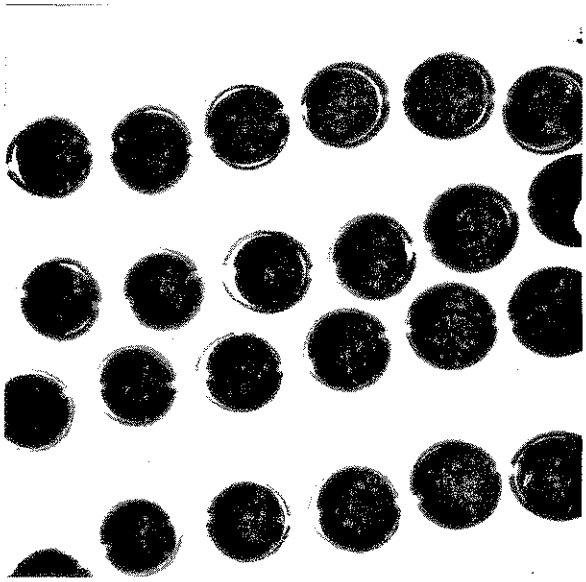
In 1907, he was given a patent on his grafting needle but his request for a patent on his cultivation methods was denied. Why? It is around this question that scores of debates have been held and many accusations flung. There is no question but that he was on the right track. Within five months another man, this time a scientist, had come forward with a similar procedure. He was Tokichi Nishikawa, a graduate of Tokyo University (1897) with a major in zoology, who had been working in the bureau of fisheries and who had produced his round pearls under laboratory conditions. But Nishikawa's request for a patent was also denied.

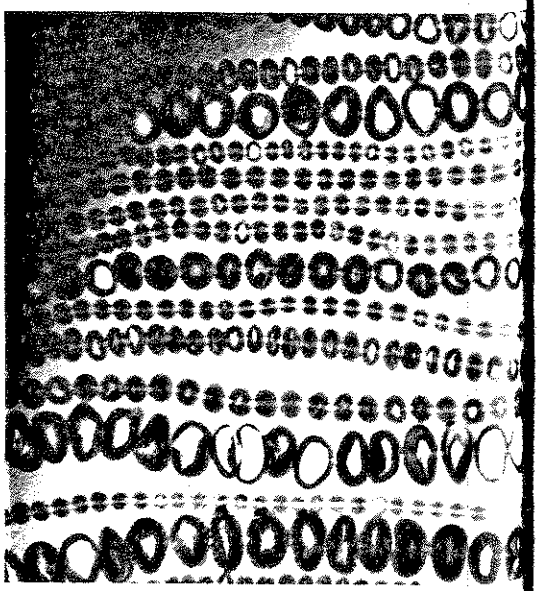


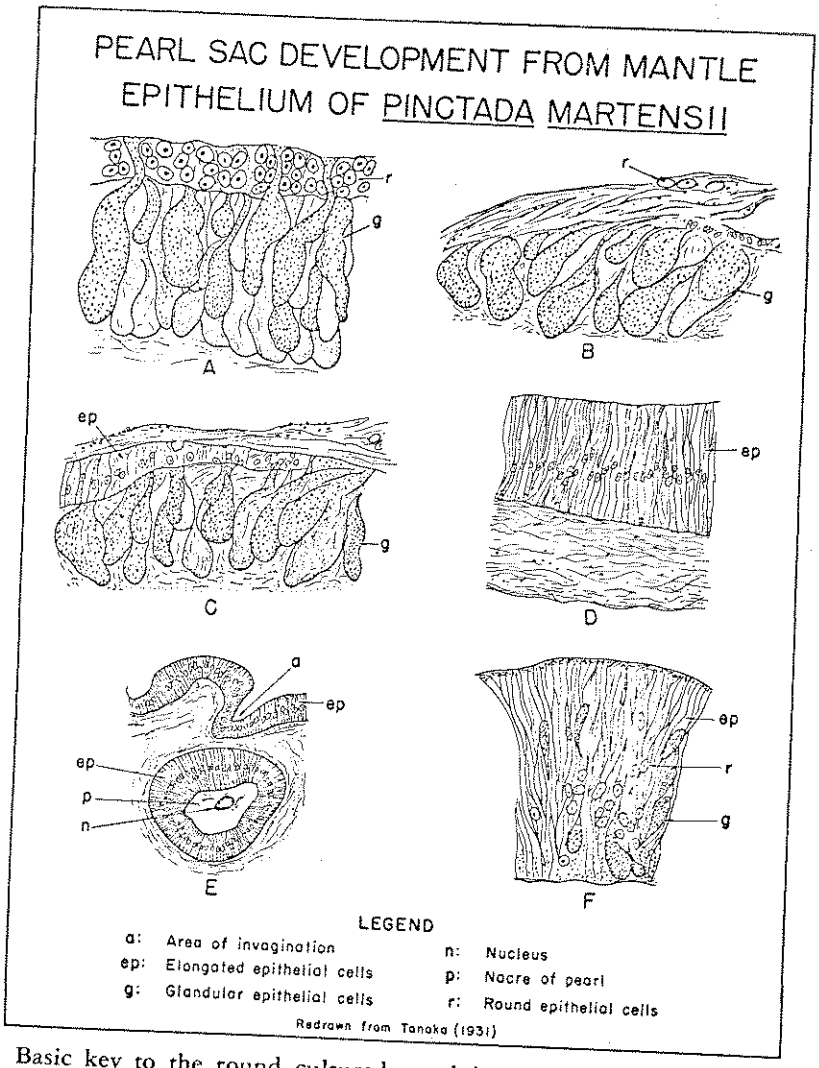
Tools for inserting a nucleus into a pearl oyster have changed little in the fifty-odd years of their existence. The two needles on left are modified from original transplanting needle invented by Mise in 1904. From the Government report distributed by the U.S. Department of Commerce.

Bottom left
Only X rays will reveal with certainty the differences in pearl formation. This reveals the clamshell nuclei in a strand of cultured pearls.

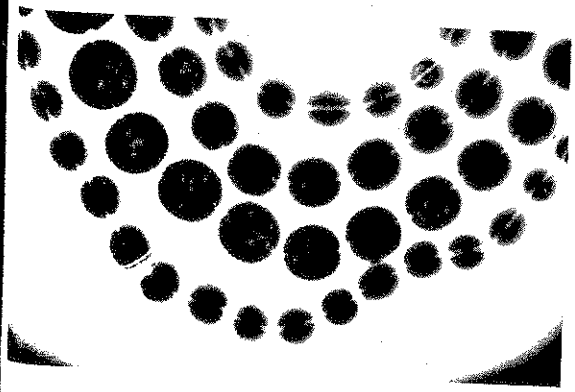
Bottom right
An X-ray picture of a pearl formed solely around a tissue graft—a non-nucleated freshwater pearl. Almost all such pearls are baroques.







Basic key to the round cultured pearl is a transplant of mantle tissue from another oyster along with a nucleus; these sketches show how a pearl sac then grows to protect the growing pearl. Sketch copied from Tanako for the U.S. Government report made by the Natural Resources section of the GHQ Allied Powers in Tokyo, 1947.



Natural pearls. Probably the original irritant—a grain of sand, a parasite—long ago dried up. Almost no natural pearls have been produced in the last ten years. *All radiographs courtesy of the Gemological Institute of America.*

Not until 1916 when Kokichi Mikimoto presented his claims to the title of discovery was anyone granted a patent on cultivating round pearls. It was as if they had been waiting for the "Pearl King" to crown him with glory, ignoring all others.

That was the way, at least, the American scientist Dr. Cahn saw it. When he studied the matter he came out firmly on the side of the first man to apply. He withdrew the title of discoverer from Mikimoto and declared Mise and Nishikawa the true heroes. It is a delicate point still; even today there are arguments among pearl experts about it. Although Mikimoto began using the Mise-Nishikawa techniques *after* he acquired his own patent, and although he publicly admitted that both Mise and Nishikawa retrieved the oyster's secret scientifically *before* he did, as a pearl merchant without peer he also related far and wide how he had by trial and error made round pearls long before anyone else, how he had slaved longer and harder over the task—and suggested that while laboratory procedures were important as technicalities, the real test came in the marketplace, and there his crown was indisputable.

There are further complications. It is sometimes suggested that there was a deliberate conspiracy to discredit young Mise. Personally, I doubt it. Very rarely have men been granted scientific credit for a single show of intuitive brilliance. The Mise grafting needle—which was actually a thin, pointed, metallic tube that could carry both a nucleus and a bit of mantle epithelium—was superior to anything the scientists were already working with and so Mise received recognition for it, but clearly Nishikawa had already been working along the same lines, and under scientific conditions. When Nishikawa applied for his patent five months later than Mise, Mise was charged with infringing on his methods; an obviously unfair move which does suggest conspiracy. Doubtless supporters of Nishikawa pushed through this move. But it is clear that Nishikawa himself had no part in it; after he had received his patent for transplanting tissue (not for making round pearls—that was the special glory saved for Mikimoto), he turned around and signed an agreement with Mise that henceforth the tool and the procedure should be united and the total process shared under the title of the Mise-Nishikawa method.

Other factors may have played a role in this Mise-Nishikawa transaction. Because both were dead before Dr. Cahn made his independent report, no questioning of either of these two men took place, and I can only surmise about them. But in the record of their early experiences there is one curious coincidence that may or may not have some bearing on their sudden emergence in the pearl world. This was that both had knowledge of Austra-

lian oystermen and their work with oysters: Mise through his stepfather, who, as a government inspector of oysters, helped his carpenter son to make pearls just after he returned from a trip to the Australian oyster beds; Nishikawa, in connection with his work as a zoologist, went to Australia to visit the oyster beds just before starting his pearl-making experiments. It seems possible to me that sometime around the turn of the century an unsung Australian oysterman hit accidentally upon the method Mikimoto had sought for so many years and passed his secret along unwittingly to these two brilliant young Japanese.

Another conjecture concerns the bureau of fisheries. Both Mise's stepfather and Nishikawa worked there; Mise's stepfather was a long-term employee; Nishikawa worked there for several years before he joined the marine biological staff at Tokyo. The charge against Mise of infringement suggests that possibly the stepfather carried secrets home to the boy; it is also possible that the experiments were a common task, and that skill and patience in the frustrating task of transplanting the tiny pieces of epithelium were all that separated both Mise and Nishikawa from other workers in the fisheries.

It is also possible that Luther Burbank actually deserves at least some portion of their scientific credit. His experiments with the grafting of fruit and the hybridizing of various species began a half century before. It would seem reasonable that, given the knowledge of how to make a button pearl, men of curiosity would want to experiment with whether a finer pearl could be made through tissue-grafting. Medical experiments with the grafting of human skin began about the turn of the century, after Burbank and after the discovery of that first great pain-killer, chloroform (which, you may recall, was also suggested for oysters)—so why not the grafting of oyster tissue? Experiments might even have begun in California, and been discarded because they did not work on the local pearl oyster, the abalone, then tried in Australian waters with the *Pinctada maxima,* and finally passed to the Japanese where, using *Pinctada martensii,* they succeeded so gloriously. It would appear that the name "grafting needle" used to describe Mise's tool and the word "transplanting" used in Nishikawa's patent might have been used precisely because hybridization was the category of scientific experiment the laboratory was working on—not simply pearl nucleus insertion.

These are my own thoughts. Dr. Cahn in his report clearly felt that Mise and Nishikawa had been wronged because of the mercantile interests of Mikimoto and the value of these interests to the Japanese government, which shared in his profits and leased him his island farm. As a scientist,

Cahn had little use for Mikimoto's well-publicized claims; to him, the fact that Mikimoto was a genius as a businessman meant little beside the scientific laboratory facts and the legal patent records. Cahn was right to enter Mise's and Nishikawa's names in his study.

But he did not give Mikimoto enough credit. For Mikimoto's claim that he had produced round pearls before 1907 when Mise and Nishikawa recorded theirs clearly was true although their roundness was undoubtedly accidental. Just as in nature some irritants penetrated the tissue of the oyster in such a fashion as to produce round pearls, so had some of Mikimoto's inserted bits of salt and clam shell been forced into the mantle and embraced by nacre. Information to support this cannot be found in the legal records of the time, but American newspapers reported it. The most notable account was a story in the old *New York Herald* published on October 9, 1904, which stated flatly that for several years Mikimoto had produced some round pearls of good luster which were very small but beautiful. The article, which was unsigned but written by an American correspondent for the *Herald,* included an interview with Mikimoto about his pearl beds on the shore of Taketu Island, and stressed his secrecy about his methods. (He even walled in his workshop.) It also gave credit not only to the experimental work in the Tokyo University laboratories but suggested there had been a steady exchange of ideas between Mikimoto and the laboratory for some years. It further said—quoting Mikimoto—that the late Prince Komatsu had visited Mikimoto's pearl farms and been so impressed that he had sent Mikimoto a silver cup engraved with the words, "The works of men help nature"—a phrase of sacred blessing, so to speak, for the Prince was thought to be a direct descendant of the Deity.

The fact that there were round pearls coming from the Mikimoto farms was also authenticated by a pearl importer of the time, Maurice Brower. He noted that while the "vast majority of the culture pearls"—as they were then called—were button pearls, there were some fine round ones and, in a masterpiece of understatement, predicted that the new pearls "would be a considerable factor in the market" before too long. Americans had not yet taken to them, he said, charging they were "artificial," but in London and Paris they "were gradually gaining ground."

There is little doubt, however, that the round pearls in Mikimoto's harvest were, in the main, accidents. As Mikimoto later told his biographer Robert Eunson, an American war correspondent, during these years he was terribly discouraged because even though he was growing steadily more successful with his button pearls, he was constantly risking all his profits on secret attempts to perfect a pearl that could compete with a natural

pearl. He knew that he had to get the nucleus into the tissue itself, but slashing pockets in the mantle caused too many of his oysters to die, and greasing the nucleus with glycerine and pressing it into the flesh didn't work. It is probable that he began transplanting experiments about the same time the Tokyo technicians did; in 1905 he claimed to have found five beautiful round pearls in a small oyster bed he had set out a few years before, and then he knew that he was finally on the right track. Shortly thereafter, as Cahn stated in his report, he hired a dentist, one Otokichi Kuwabara, who aided him in his first grafts.

The story of Mikimoto's work deserves more than passing references to this phase. His life was a sort of Japanese Horatio Alger tale, with the Japanese government replacing the rich uncle in the American story by rewarding the hard-working, virtuous hero with a land lease at the very moment he might have been wiped out by failure. There are also humble beginnings and a highly successful ending: Starting as a peasant-artisan, Kokichi Mikimoto died at the age of ninety-six in 1954, leaving behind him fifty-four descendants, countless legends, a thriving multimillion-dollar business, and millions and millions of beautiful round pearls.

He was the son of a line of small merchants in the port village of Toba; his father had invented a flour-milling machine and become a noodle-maker. Because the father worked long hours and died early, young Mikimoto was chiefly influenced by his grandfather, and from him and one of his cronies, he learned how to sell before he was even in his teens. Noodles were his chief stock then, but since noodles were made at night, he also had time to peddle vegetables. He was thus not any ordinary peddler, he was enormously energetic, and, because he was also adventurous and religious, his clientele soon embraced a wide range of people. Near his home was the famous Shinto shrine of Ise, where the Emperor made an annual pilgrimage to report personally to his ancestors on Japanese affairs; here too, young Mikimoto made pilgrimages. (The Shintoists, like the Chinese Buddhists, do not believe in only one God but rather in a group of gods, with the Sun Goddess ruling over all.) When his father became sick, Kokichi went early each morning to a simple wooden shrine near Toba to pray for his health and, combining religion with business, took to massaging the backs of the old people worshipping there. As this developed his hands, he also learned juggling, and, ironically, through this mere pastime, he met his first foreigners and became involved in the larger world.

It was then unusual for a man of his class—the workers, or *shonins*—to meet foreigners. Until four years before Mikimoto's birth, indeed, no Japanese had spoken with men of the West. It was in 1854 that Admiral

Special food and medication for the growing oyster are therefore major aspects of oyster-breeding and pearl culture. More and more experiments are being made in this field; vitamins are varied and the results tested; chlorophyll is scattered on the water in the form of algae; in the laboratories rice and soybean supplements are tested and new antibiotics tried out. It has been found that not only is it important to have healthy oysters in which to grow the pearl itself, but that the health of the oyster which provides the bit of mantle for transplanting is also important.

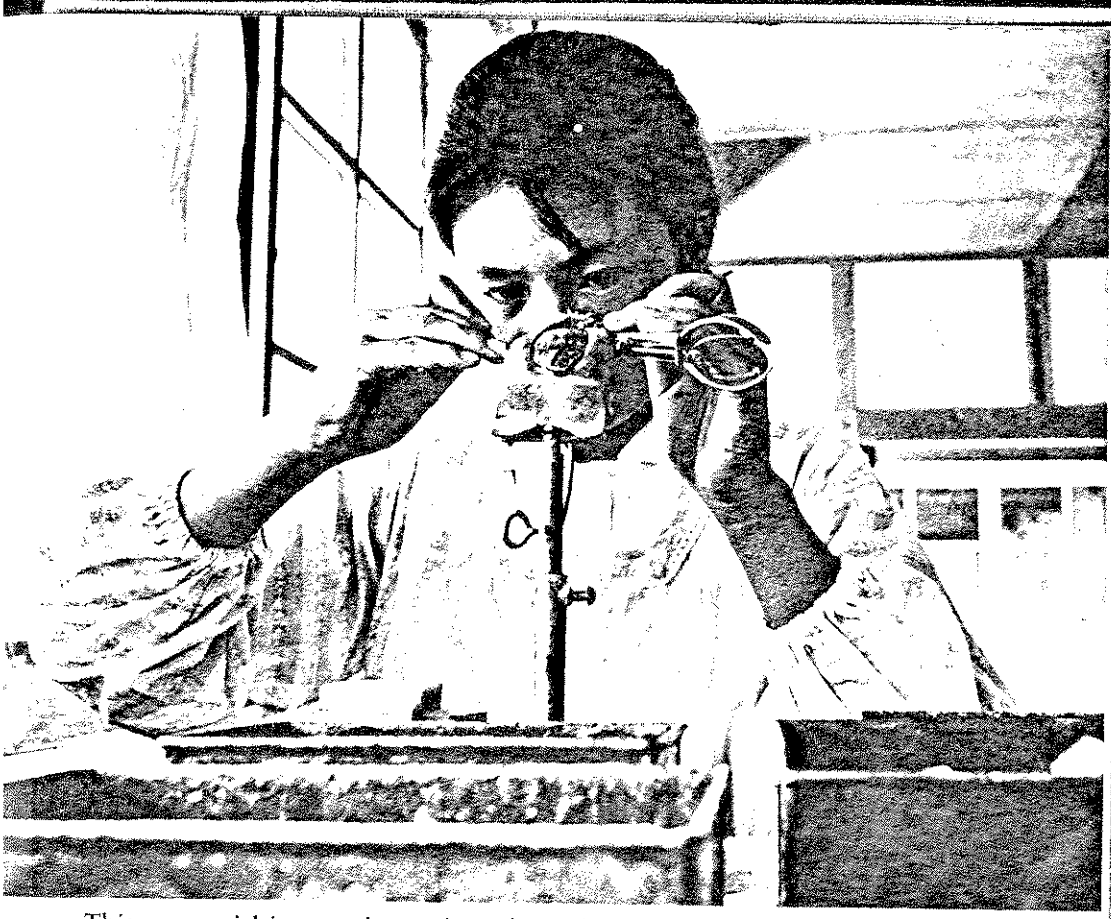
But as yet no perfect all-around formula for feeding and medication has been found. Some years ago a parasite was discovered that no medication —including aureomycin in the water and doses of penicillin directly into the oyster itself—could eradicate. The epidemic ran its course; thousands of young and old oysters died. Overcrowding of the breeding waters was suspected to be the basic problem, so efforts are now being made to reduce the oyster population systematically; the large pearl farmers have agreed together that they will cut back the number of oysters being bred so that each oyster can have a decent living space, and this kind of stress will not be a threat either to the pearl's perfection or the oyster's health.

The cultivation of oysters is a basic task of the pearl farmer, but the cultivation of the pearls themselves is also basic.

Pearl culture begins with the insertion of a nucleus into the gonad of a healthy three-year-old pearl-bearing oyster along with a piece of living mantle tissue from another oyster. This is a delicate operation that must be performed neatly, precisely, and swiftly. If the insertion is made in the wrong spot, the pearl will suffer; if the oyster being operated upon is handled too roughly, the oyster will die.

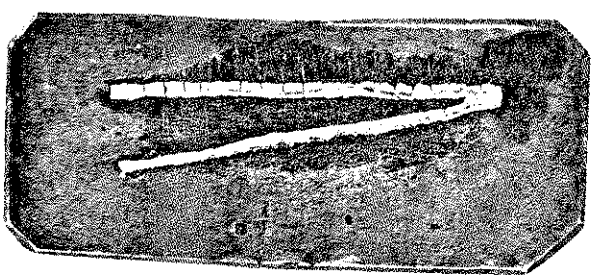
Insertions take place many months of the year, but the chief season is late spring and summer. No oyster under two years can stand the strain of even a small nucleus; only a three-year-old oyster will live through the shock of a large nucleus, or of several nuclei. If the nuclei are small, twenty may be inserted. If 6-millimeter, two are; larger nuclei are inserted singly.

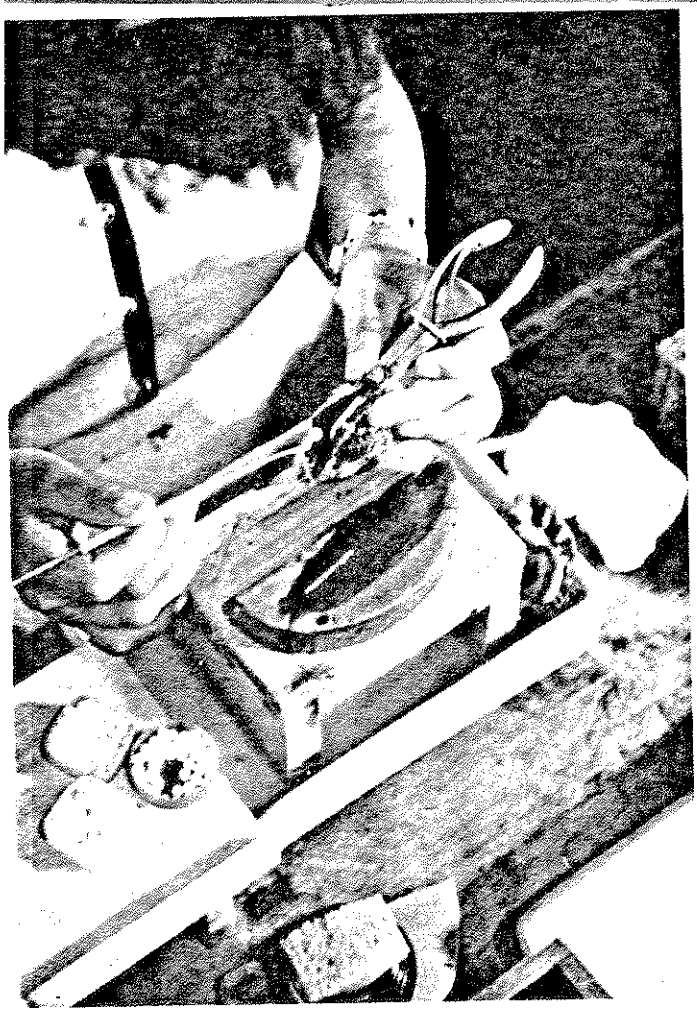
The first problem is getting the nucleus. Many experiments were made in the early years until it was discovered that mussel or oyster shell polished into beads was the most satisfactory. Then the perfect shell was sought—the one with the same hardness and the specific gravity of the pearl itself. Nishikawa himself drew up the specifications in the laboratory, but he died before the present nucleus was found in the pig-toed clamshell of the Mississippi Valley. He worked with the shell from the Yangtze Valley in China, but war with China shut off that source. Today the American supplies are dwindling, and searches have begun again for another shell; hard-



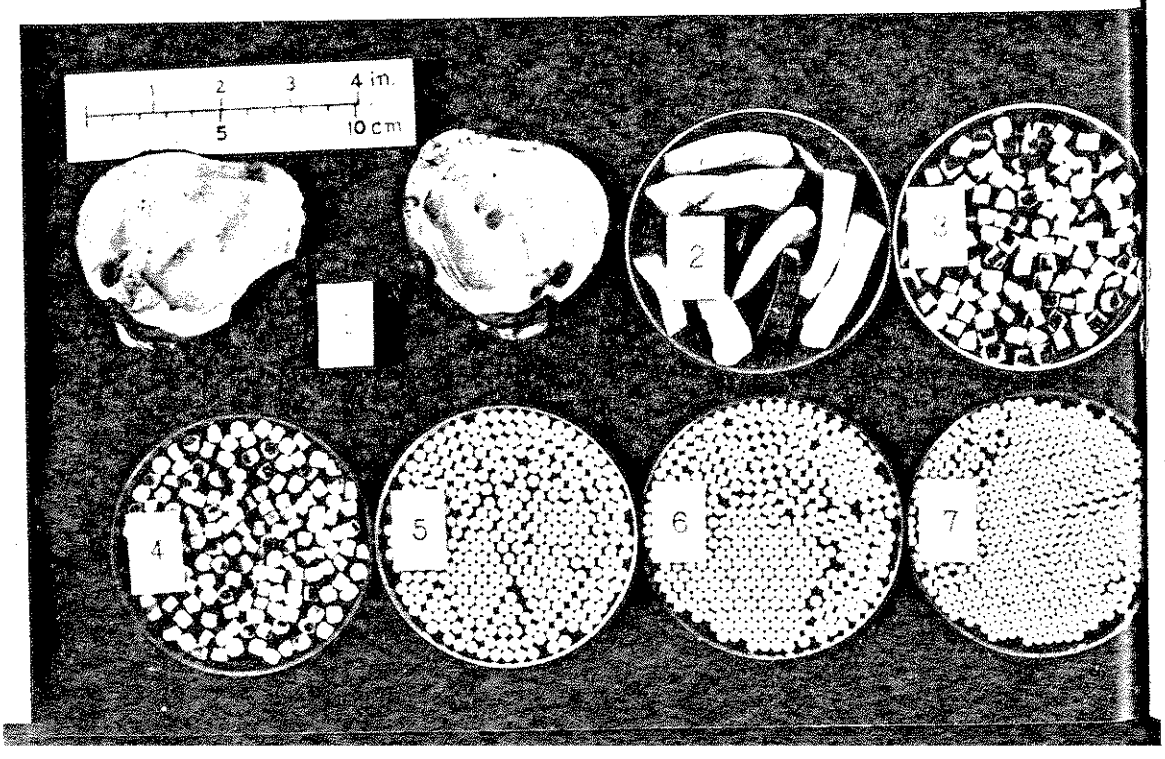
This young girl is removing a piece of mantle tissue from a live oyster for use as a transplant in pearl culturing.

The mantle is segmented and inserted with a nucleus into an oyster to stimulate nacre production for the growing pearl.





To do the insertion operation, the worker first fixes a partly open, live oyster in a desk clamp with the right valve uppermost and then exposes the main body mass. While a retractor hook holds down the foot to prevent it from moving, an incision is made into the main mass of the tissue, and first the mantle tissue, and then the nucleus—a shell pellet—are inserted into this pocket of grafted tissue and live tissue. Only three-year-old oysters are used for the operation, which takes both skill and speed. Note pegged oysters at bottom center, the sponge keeping mantle tissue moist, the cups of clamshell nuclei of varying sizes, and the completed oysters. The operation in action takes half a minute or less.



ness on the Mohr scale must be between 3.5 and 4, the specific gravity must be between 2.65 and 2.69. Like diving for oysters, the importing and making of the nuclei was once simply a part of the pearl industry; today, however, it is a separate business. The shell is collected from the Ohio, Wabash, and Tennessee rivers by dredge, brought into Kobe by boat, freighted up to Osaka, and there, in a huge factory, it is cut first into strips, then into cubes, and then lapped or sand-polished into beads of graduated sizes from 2 millimeters to 8 or 9, which are then sold to the pearl farmers. In the past few years, because the dwindling number of mussels in Mississippi waters and the expanding demand from Japan met head on, the price of shell has almost tripled, but it will doubtless rise even higher if no satisfactory substitute or more protected waters for the mussel now in use are found. As well as the Japanese, the Tennessee Valley Authority is researching future possibilities for shell beds and alternative mussels. Currently about six tons of scrubbed shell is shipped to Japan annually from the United States: Other shell is believed being imported from Red China, South America, and Mexico.

As well as a healthy stock of oysters and a supply of nuclei and transplants, the pearl farmer needs skilled inserters who can handle small tools and small oysters. For a long time this has been women's work—or rather girls'. Today, as more and more young people are seeking a city life and sophisticated education, the number of girls available for training has become fewer, and, as a result, wages have risen and training speeded up. The youngest workers are assigned to cutting transplants. They progress to small nuclei. Only workers who have two or three years' experience in insertion work are permitted to work with really large nuclei—from 6 to 8 millimeters. More and more these top-skill workers are boys or young men, working their way up in the company—perhaps on a part-time basis—to become executives. Where once the farmwork ratio of boys to girls was about 2 to 8, now it has come closer to 4 to 6. Then too, more foremen-teachers are being used, and most of them are young men.

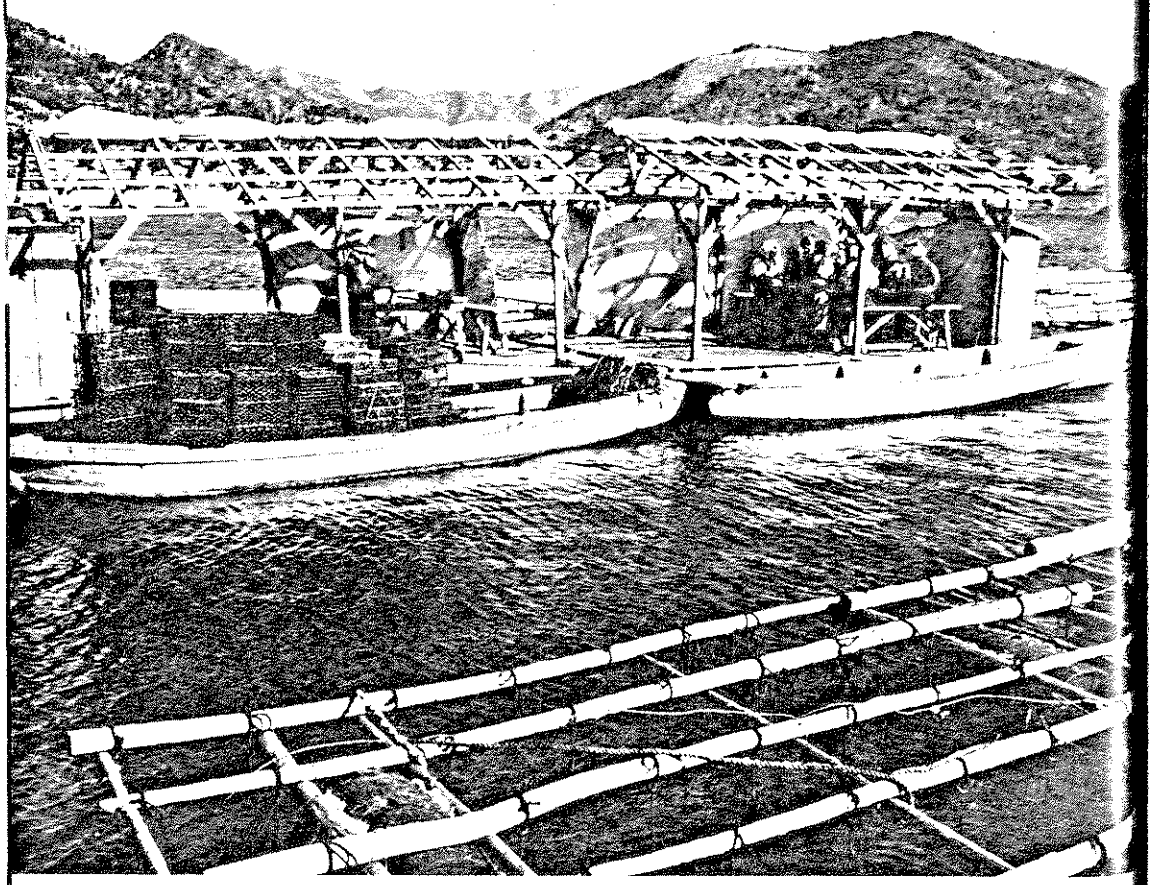
Opposite

A picture description of the nuclei, from pig-toe clam (No. 1) found in the Tennessee rivers of the United States to the polished, round pellet (Nos. 5, 6, 7). The size and shape of the nucleus plus time and health determine the size and shape of a cultured pearl. Trays Nos. 2, 3, and 4 show the clamshell cut first into strips, then into squares; 5, 6, 7 show finished nuclei. Because of industrialization, American rivers are producing less and less clamshell while Japan needs more and more.

The process of insertion is fascinating to watch. The great secret of the Mise-Nishikawa method is the all-but-simultaneous insertion of the nucleus *and* the thin slice of mantle tissue into the living gaping oyster. Timing the workers I found that the best could perform this two-in-one operation in 18 seconds but that none took more than 30, regardless of the size or number of the nuclei. I was prepared for the double action and for the tools but the speed of the workers' hands was startling, reminding me repeatedly of the magician's adage that the hand is quicker then the eye.

All insertions take place close to the oyster beds so that the oysters will not be removed from their native waters for more than a few hours. After being pulled up in their baskets, the oysters are first placed on tables to be cleaned, and partially tranquilized—prepped for their operation. Only

Floating work sheds near rafts; at right, girls are cleaning oysters.



a few are handled at a time, the actual number depending on the number of workers. The oysters are then distributed to each workstand by twos and threes, usually by the foreman, who is responsible for seeing that those with large nuclei get the largest oysters, and that the oysters from which the transplant is cut are the healthiest specimens of all. The worker has his tools handy on his worktable—his special opening knife, his inserting needle, bits of graft, and boxes of nuclei. During the operation the oyster may be pegged open (the traditional way) or his mouth separated by the same vise that holds him in place, a sort of surgical strap and table combination called a retractor.

After the insertion, the oyster is closed, placed in a bucket, and returned to the sea baskets for further growth. There is no visual checking of inserting accuracy; by then it is too late to do it again. In some large firms, however, records are kept of just how Miss X's operations turn out compared to Mr. Y's. The loss in the few hours of opening, inserting, and returning to the water may run as high as 50 percent. Only part of this may be due to a lack of inserting skill and speed, but this is at least one factor that can be checked and changed. Other factors causing death or disease lie, of course, in the oyster's basic health, the accidents during his early years, the care or lack of it after the operation, and such freakish events as sudden typhoons, earthquakes, and parasite epidemics. Overall, of every four oysters nucleated at three years of age, only one will produce pearls; of every four pearls harvested, only one will be of export quality. The success ratio is thus about 1 in 16. Mikimoto and Yamakatsu say their standards demand an even higher ratio—1 in 20.

Harvesting takes place two to three and a half years after the inserting operation, usually in the late winter months when the cool waters cause the flow of nacre to be purer and finer. A few months before harvesting, the rafts are dragged closer inshore where the salinity is not so great; the fresher water aids the luster. Then that year's crop is hauled up and, finally, after three to seven years of skillful handling (plus lovingkindness) the results are ascertained in terms of pearls.

Some cultivators specialize exclusively in small pearls, since only the larger, richer companies can finance the long-term growth and risks of pearls 7 to 10 millimeters in diameter. But others work in the 2 to 6 range; and one company, after years of experimentation, has succeeded in growing really large oysters of the finest luster *(Pinctada martensii)* which will take really large nuclei such as 8 millimeters and nurture them through into 11½- and 12-millimeter pearls. It was a dream worth dreaming but very risky, and production is still limited. The *Pinctada maxima* of South Sea

Bibliography

Chapter 1

Shells as Evidence of the Migration of Early Culture by J. Wilfrid Jackson (University of Manchester Press and Longmans Green & Co., Inc., London and New York, 1917) provides the basic key to the ancient cult of the shells. Jackson is supported by Sir Elliot Smith, the Manchester archaeologist, in the preface, and by the scholar Vincent A. Smith, in his major work *The Oxford History of India* (The Clarendon Press, Oxford, England, 1923). This definitive history of India provided me with the description of Korkai and the poem from Tamil land's classic period. Not much has been written about this area but there are also references to it and to pearls in Will Durant, "The Story of Civilization," Vol. I, *Our Oriental Heritage.*

Another useful work on pearls from Manchester, England, concerning early symbolism of the pearl was that of Maurice A. Canney: "The Life-giving Pearl." It was published in the journal of the Manchester Egyptian and Oriental Society, 1930, No. 13, pp. 43–62. The two great scholars of mythology, Robert Graves and Sir James George Frazer, also support the main thesis that in ancient times the pearl symbolized the moon as earth-mother and was thought born of rain or dew.

As suggested by the text, I have accepted the description and the chronology of King Solomon's meeting with the Queen of Sheba from Immanuel Velikovsky, *Ages in Chaos,* Vol. I, Sidgwick & Jackson, London, 1953. I am quite aware that Velikovsky's works have aroused controversy among scientists but too many of his findings have been proven right for me to disdain them. The references to the Bible and the Odyssey are included in the text. The interpretation of the famous Persian necklace of Susa is my own, as is that of Egyptian cosmetics, but the facts about them (and of many of the other pearl pieces) are thoroughly reported in that great volume on pearls, *The Book of the Pearl,* by George Frederick Kunz and Charles Hugh Stevenson, The Century Company, New York, 1908. As for data on the meaning of various numbers in the early cultures, the most readable source book is *Mathematics for the Millions,* by Lancelot Hogben (W. W. Norton & Co., Inc., New York, 1951). A new translation of Pliny on

gems was edited by Sidney Ball, *A Roman Book on Precious Stones,* Gemological Institute of America, Los Angeles, 1950.

Chapter 2

The social history of the rise and fall of Constantinople and the early beginnings of Western European civilization are colorfully portrayed in many histories as well as in such staples as Gibbon and Durant. E. F. (Lord) Twining's lengthy work, *A History of the Crown Jewels of Europe,* B. T. Botsford, London, 1961, provides precise details of royal display from pre-Christian times to the present. There are several notable researchers into the medieval role of gems: George Frederick Kunz, *The Curious Lore of Precious Stones,* J. B. Lippincott, Philadelphia and London, 1913; Joan Evans, *Magical Jewels,* Oxford, England, 1922; William Jones, *History and Mystery of Precious Stones,* London, 1880. Kunz rambles through various legends and tales; Evans is interested in jewels in magic and medicine; Jones, who dedicated his book to the art critic John Ruskin, concentrates on literary attitudes toward jewels—his book is studded with snippets of verse and quotation marks. Many of the connections made between religious and philosophic attitudes and pearls are my own; the data inspiring them are to be found in biographies and histories of the persons and places involved and in the stories about pearls in *The Book of the Pearl* by George Frederick Kunz and Charles Hugh Stevenson, The Century Company, New York, 1908. Countless dissertations on the fourteenth-century English poem "The Pearl" also bear out the vagaries pearl symbolism took after its religious connection with the moon earth-mother was broken.

Chapter 3

The most complete work on pearls among the North American Indians was done by George Frederick Kunz, who made the pearl of this continent his specialty. As well as his (and Stevenson's) great work on pearls in general previously mentioned, Kunz produced a variety of other papers on the subject which vary in approach from technical ones written for the American Association for the Advancement of Science and the U. S. Fish Commission to popularizations for *Harper's Weekly.* For those who wish to use primary materials, a visit to the Indian relics in the Field Museum in Chicago or the pearl collection in the American Natural History Museum in New York is rewarding.

The recent book, *Travels of Marco Polo,* by Manuel Komroff (Julian Messner, Inc., Publishers, New York, 1952), gives a background for America's discovery. The finest history of Columbus is Samuel Eliot Morison's (Little, Brown & Co., Boston, 1955), but the discovery of pearls interests him very little. Kunz, in *The Curious Lore of Precious Stones,* has done a better job of collecting the pertinent references.

Jones, in *History and Mystery of Precious Stones,* collated the later stories of the great American pearls. Travel magazines such as *Holiday* helped me bring these stories up to date: I personally interviewed Mexican pearl experts and workers on the present-day status of pearl and mother-of-pearl.

The Jean Baptiste Tavernier references are from his great memoir, *Travels in India,* as translated by Valentine Ball (Oxford University Press, London, 1925).

CHAPTER 4

Queen Isabella's will was reproduced often; I liked the W. T. Walsh biography, *Isabella of Spain* (McBride & Co., New York, 1930), but her jewels were more completely recorded in Twining's *A History of the Crown Jewels of Europe.* Napoleon's purchases are also mentioned by Twining; the story of Marie Louise's escape is well told in Jones's *History and Mystery of Precious Stones* and in Kunz's *The Curious Lore of Precious Stones,* but only Kunz separates Eugénie's pearl parure from the total inventory of the sale of French crown jewels in 1887. Victoria and Alexandra's pearls are covered in detail by Claude Fregnac in his short but excellent work *Jewelry* (G. P. Putnam's Sons, New York, 1965); Lytton Strachey, the renowned biographer of Victoria, mentions her pearls only in passing, although it is he who tells the story of her attitudes toward keepsakes, includiug the bedside portrait of Albert (Harcourt Brace & Co., Inc., New York, 1921). Consuelo Vanderbilt Balsan's book, *The Gold and the Glitter* (Harper & Brothers, New York, 1952), records the effect Alexandra's jewels had on her; Mrs. Balsan was then the Duchess of Marlborough, and from her book also were drawn the stories of her own jewels and her changed attitude toward them after World War II.

George Washington's pearl ring was noted by Kunz as was Van Buren's necklace. American social history, however, is better told in Esther Singleton's *Social Life in New York Under the Georges* (The Bobbs-Merrill Company, Inc., New York, 1942), Bess Furman's *White House Profile* (also Bobbs-Merrill, 1951), and Dixon Wechter's *Saga of American Society* (Charles Scribner's Sons, New York, 1937). The delightful story of Mrs. Jack Gardner is culled from Cleveland Amory's *Proper Bostonians* (Harper & Brothers, New York, 1947). Amory's *The Last Resorts* (Harper & Brothers, New York, 1952) and *Who Killed Society?* (Harper & Brothers, New York, 1960) also give vivid pictures of the way in which the American rich of the late-nineteenth and early-twentieth centuries lived. The biography of *Nicholas and Alexandra* by R. K. Massie (Atheneum Publishers, New York, 1967) is an excellent chronicle of the last days of the Czars.

Only Kunz has collected the stories of the nineteenth-century American pearl rushes in detail. Other books on the subject are, in general, rewrites of his or recountings of special instances. Since the Kunz-Stevenson volume is enormous and hard to get, however, two may be worth mentioning: W. R. Catelle, *The Pearl; Its Story; Its Charm and Its Value* (J. B. Lippincott Co., Philadelphia, 1907) and Howard E. Washburn, *American Pearls* (University

of Michigan Press, Ann Arbor, 1908). Among periodicals, *Harper's Weekly* and the *Scientific American* showed considerable interest in the subject between 1900 and 1908; the only recent work I have found was published by the *Pacific Historical Review,* Berkeley, August, 1956 (Vol. 25, No. 3), "Pearl Diving in Lower California, 1533–1850."

The story of the Ceylon Fishery in 1906 is in *Growing* by Leonard Woolf (The Hogarth Press, London, 1961).

Chapter 5

The title of the government's special report on pearl culture—without which this chapter could not have been written—is titled: "Pearl Culture in Japan" and is report number 122, Natural Resources Section, General Hq., Supreme Commander for the Allied Powers, Tokyo, 1949. Since it is now out of print, however, it must be copied individually and is expensive. Another useful book, although one far more colored by the persuasive powers of Mikimoto's personality and the author's admiration, is *The Pearl King* by Robert Eunson (Greenberg, Publisher, New York, 1955). The particular material on oysters was collected from various sources, the most delightful of which was Hervé's "L'huître et la perle dans les lagons de l'archipel des Taumets," a report to the Oceanographic Institute of Indochina at its Fifth Scientific Congress on The Pacific Ocean, 30 September, 1936.

The background data for the great Japanese discovery was gathered from sources previously cited, notably Kunz and Stevenson.

Chapter 6

There are a few studies of today's cultured pearls worth reading, the most notable book being *The Cultured Pearl,* by Norine C. Reece (Charles E. Tuttle and Company, Rutland, Vermont, and Tokyo, Japan, 1958). Among modern article writers on pearls two stand out: A. E. Alexander, the chemist who was formerly a vice-president of Tiffany & Company and who now serves as a consultant on quality, and Frederick Pough, whose series of articles for *Jeweler's Circular Keystone* (Chilton Publishing, Philadelphia) took him on lengthy explorations of the Japanese pearl farms. More technical but also excellent is the article on grading pearls by Richard Liddicoat, Jr., for the Gemological Institute of America's magazine, *Gems and Gemology,* Summer, 1967.

What really made this material come alive to me, however, were my own interviews with such pearl merchants as Ernest Reuter of Leys and Christie, Hans Klapper of Imperial Pearl Syndicate, New York, and Izumi Yamamoto of Yamakatsu Pearl Company, Kobe and Ago Bay. Technical experts like Bert Krashes and Eunice Miles of GIA's New York office, and Alan MacNow of the Cultured Pearl Association were particularly helpful; so were such worldly retailers as Boris Tarna of the Nippon Pearl Company, Tokyo, and Douglas and Elaine Cooper of F. H. Cooper and Sons, Philadelphia and Jamaica. A stay

near the Japanese pearl farms of Mie Prefecture in Japan permitted time and study in the National Pearl Research Laboratory as well as several visits to farms in Ago Bay and in Toba Bay; countless visits with workers, salesmen, chemists, and designers were both enjoyable and illuminating.

On natural pearls of the period, A. E. Alexander, Maurice Shire, and Harry Winston were helpful although none could assist me in the awesome task of tracing the old, great pearls to their present whereabouts. For a story of how natural pearl merchants operated as recently as the 1920's, there is nothing more engaging than the book by Louis Kornitzer, *Pearls and Men* (Bles Publishing, London, 1935).

CHAPTER 7

The opening story can be read in its entirety in *The Complete Short Stories of Somerset Maugham* (Doubleday & Company, Inc., New York, 1953) under the title "The String of Beads." Most of the information in this chapter came from jewelers and gemologists previously mentioned in connection with Chapter 6. Two social chronicles were also helpful for contemporary material: *Eleanor Medill Patterson,* by Alice Albright Hoge (Random House, New York, 1966) gives a vivid picture of the rich and powerful publisher and her circle in the forties; *The Beautiful People* by Marilyn Bender (Coward-McCann, Inc., New York, 1967) focuses on the New York world of fashion in the sixties. The Isak Dinesen story "The Pearls" is most easily obtained in the Modern Library edition of *Winter's Tales.*

Dr. George Switzer's views on cultured and natural pearls were communicated to me in an interview with him in the Smithsonian; the quotation from Dr. Jordan was from a published statement in the Los Angeles *Times.*