

PEARL CULTURE IN JAPAN

By

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ABSTRACT

A historical review of the development of the cultured pearl industry in Japan has been made. This is followed by a description of the actual process of production of cultured pearls in Japan. An analysis of the present economic structure of the cultured pearl industry is made.

I. HISTORICAL DEVELOPMENT
OF PEARL CULTURE

Today, almost all over the world, people say simply 'pearl', meaning nothing but cultured pearl. It is because cultured pearls of good quality are now supplied abundantly to every part of the world. However, the historical process by which cultured pearl has taken the place of natural pearl which was once dominant in the market, started not very long ago. In July 1883, about 69 years ago, Mr. Kokichi Mikimoto completed a few pieces of cultured pearl after repeating experiments for many years. Mr. Mikimoto, 'The King of Pearl' would often say that he would adorn with pearl the necks of all ladies all over the world. His efforts to develop cultured pearl as well as his inspiring success is widely known, and all those who know cultured pearl keep Mikimoto in their minds as the great inventor of cultured pearl. However, there is one but important fact that people in general do not understand well: the pearl made in those days was not spherical as they are these days; that is, it was the so-called blister pearl or hemi-spherical pearl of which the flat section was fixed on the shell which

were first produced. Therefore, when the pearl was used for various kinds of accessories, it had to be in most cases backed with a certain kind of shell such as that of pearl oyster, and so long as it was shaped like a hemi-sphere, it could not take the place of natural pearl of good quality.

The principles of techniques to produce complete spherical pearl free from shell were established in 1907, about 20 years after the success of Mikimoto. The achievement goes to Mr. Tokichi Nishikawa, Tatsubei Mise and also Kokichi Mikimoto, and at the same time a number of other persons who cooperated with these inventors are not to be forgotten. The techniques established by the said three inventors have slight differences between each other and especially the techniques developed by Mr. Tokichi Nishikawa as leader, which has been the basis of pearl culture techniques for long to this day, made it possible to produce such good cultured pearl as could take the place of natural pearl even from the theoretical point of view; the technique is based on the knowledge of the mechanism of the formation of natural pearl and application of this knowledge just as it is. The principle of Nishikawa group's techniques was to make cultured pearl by inserting into the body tissue of a pearl oyster a piece of the mantle (which is generally shell substance secreting tissue of the oyster) picked from another oyster together with a proper nucleus made of shell, or sometimes

without it*, and forming sac-like tissue called 'pearl-sac' there. This formation of 'pearl-sac' that comes from shell substance secreting tissue was the most important condition that was absolutely necessary for the formation of natural pearl whatever the cause of formation was. Therefore, it can be said that they found the means of controlling this process artificially,

It is said that about 1919, for the first time, there came into the market the spherical pearls which were actually cultured by the method of the invention based on this technical principle. However, when compared with pearls of today, they were all very small, and the yield rate to the number of pearl oysters which were subjected to the above operation was very low. From this viewpoint, to compete with natural pearl and conquer it in the market, cultured pearl needed further improvement in various techniques including betterment of operational techniques. The most outstanding improvement, above all, is the application of hanging system culture that uses rafts and culture baskets. In those days, when hemi-spherical pearl was produced, pearl-oysters after the operation were put into sea bottom again and cultured there under the same conditions as in nature. In this case, it was difficult to avoid losses due to natural hazards not to speak of predation by natural enemies such as the starfish and octopus so that the survival rate of pearl-oysters as compared with the total number of pearl-oysters remained very low. But in the case of culturing pearl by way of hanging a wire basket from a raft that contained pearl-oysters at the middle depth of the sea, pearl-oysters were controlled much more carefully than before: it was possible not only to keep off predation but also to move the basket to safer places when in danger; it was also possible to remove regularly the barnacle, oyster, sponge and many other organisms that interfere with the life of

pearl-oysters during the culture period. And, in those days, when pearl-oysters were cultured at the bottom of the sea, the suitable culture areas had to be limited to a considerable extent, because the area had to have conglomeratic or rocky bottom and to be shallow to enable a man to work diving in water; on the other hand, in the hanging system culture, such limitations do not exist and one is able to use freely as culturing ground any portion of the surface where it is possible to anchor a raft in safety. The application of these techniques as well as achievement of techniques to produce spherical pearl are two props upon which have been founded the modern pearl culture industry, and the techniques of pearl culture were thus established systematically in the middle of the 1920's.

Table I shows change in production of cultured pearls and number of management units of pearl culture from 1926 to 1960. The quantity of cultured pearls produced in 1926 was under 700,000 pieces and number of management units was only 33, but during the period from 1937 to 1939 that was the golden age before the World War II, pearl culture reached its peak. In quantity it increased by over sixteen times and in number of management units, it increased by about nine times. By the way, the former statistics reported the quantity of cultured pearls produced by the number of pieces, and then it is necessary to observe that the size of a pearl produced during the period became remarkably larger. Table II shows each size of the largest pearl produced in each period. In 1919 there was no cultured pearl of over 7 mm in diameter. In 1923 there appeared one 8 mm in diameter, and in 1937 cultured pearl as big as 10 mm in diameter came to be produced, which is thought to be the maximum size so far produced by the pearl-oyster which is used to culture the pearl at the present stage. Success in producing such large-sized cul-

* At present, in most cases of marine pearl culture, a nucleus made of shell is inserted with a piece of the mantle, but in regard to fresh water pearl culture, e.g. at Lake Biwa, it is general that only a piece of the mantle is inserted without a nucleus. And in the latter case, pearls formed are naturally small and few pearls can be completely spherical.

TABLE I

Changes in Quantity of Cultured Pearl Produced and No. of Pearl Culture Management Units

Year	Quantity of Cultured Pearl Produced (Thousands)	No. of Pearl Culture Management Units
1926	669	33
1927	588	42
1928	1,781	47
1929	641	50
1930	819	62
1931	1,079	51
1932	3,655	108
1933	2,429	147
1934	4,510	220
1935	7,749	222
1936	7,071	258
1937	10,858	274
1938	10,883	289
1939	10,482	282
1940	9,253	—
1941	7,891	331
1942	6,030	107
1943	4,214	107
1944	1,751	107
1945	733	107
1946	387	—
1947	335	—
1948	50	187
1949	4,561	314
1950	6,466	359
1951	27,452	about 700
1952	31,410	about 1,200
1953	13,328 (Kg)	about 1,200
1954	16,890 (Kg)	1,456
1955	24,535 (Kg)	1,643
1956	26,620 (Kg)	1,734
1957	30,057 (Kg)	2,574
1958	48,085 (Kg)	3,001
1959	51,308 (Kg)	3,080
1960	60,408 (Kg)	3,484

tured pearls decided the general superiority of cultured pearl over natural pearl, and at the same time was typically the outstanding development of the techniques of pearl culture in these days. The home-market of Japan

TABLE II

Size of the Biggest Cultured Pearl Produced in Each Period

Year	The Biggest Size	
	Weight in grams	Diameter, in mm
1919	0.45	6.6
1923	0.75	8.0
1928	0.86	8.4
1932	1.21	9.5
1937	1.69	10.0

was, from the first, very limited for gem accessories such as pearl, so the development of production of cultured pearl was possible only by connecting with the overseas demand. Nevertheless, the steps to the war which began with the Manchurian Incident in 1931 followed by the China Incident in 1937, tightened the international tension and resulted in strong limitation to the free trade of cultured pearl. It was due to this influence that after the peak of the cultured pearl production in the years from 1937 to 1939, the production tended to decrease, though the number of management units still continued to increase.

At last, the outbreak of the World War II in 1941 all over the world cut off all trade, and dealt a severe blow to pearl culture. The remarkable decrease of production of cultured pearl since that year shows nothing but this fact, and decrease of number of management units to a certain constant number means that they survived upon the special organization of enterprises under War-time economics.

For a while after the end of the war in 1945, the restoration of pearl culture was not taken up easily. The economic chaos in the defeated nation and scarcity of materials did not permit pearl culture, which was considered as a luxury, to come back easily. At first, the army of occupation limited the free

TABLE III
Exports of Cultured Pearl

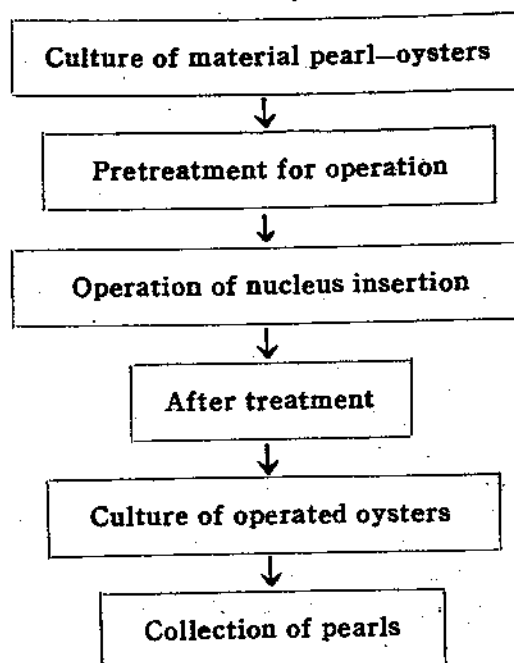
Countries	Quantity, Kg.	Value, in thousand US\$
U.S.A.	27,233	16,731
Switzerland	8,100	5,670
F.R. Germany	6,093	3,671
Hong Kong	2,579	1,724
Italy	1,874	1,254
R. France	2,512	1,399
United Kingdom	1,365	856
Canada	916	675
India	5,462	1,171
Sweden	609	376
Belgium	310	288
Singapore	167	107
Panama	141	110
Austria	207	149
Gibraltar	459	236
Lebanon	314	205
Others	1,842	1,164
Total	60183	35,786

trade of pearl, but the opening of the overseas market was most stimulative for the restoration of pearl culture. Moreover, after lack of production and trade of cultured pearl in the war-time, the post war pearl market was booming. Since 1949, pearl culture recovered its normal condition because of the complete abolishment of limitation of pearl trade by the army of occupation as well as the availability of materials. And then, soon exceeding the pre-war peak with admirable speed, pearl culture has come to the present prosperity of to-day. Table III shows the exports to some countries. It reports how many cultured pearls are supplied to every part of the world; even those belonging to the biggest-size class weigh only 2 grams a piece.

II. PROCESS OF PRODUCING CULTURED PEARL AND ITS TECHNOLOGICAL CHARACTERISTICS

Below is an outline of the process for producing cultured pearl.

Production Process of Pearl Culture



The above flowsheet explains it generally. First, production of cultured pearl begins with purchase and culture of pearl-oyster, that is material of pearl. In this case, the hanging-system culture by using rafts and culture baskets is also applied. The stage of growth at which the oyster is purchased is not always fixed; sometimes pearl-oyster is purchased when it is very young and in small shell and, after being cultured over 18 months, it is submitted to operation. The next process to be performed is pretreatment for operation. Usually pearl-oyster is densely placed in a bamboo-basket hung down rather deep. The reason is that, firstly, the existence of the mature gonads at the time of the operation has a bad effect on the yield

rate and quality of pearl, therefore, according to each season, people control the gonads not to mature in advance, or, on the contrary, promote spawning. The direct stimulus to promote spawning is usually given by changing the depth of hanging, both shallow and deep (that is, difference in the temperature of water by depth is main stimulus). Secondly, this also controls not only the gonads but physiological condition itself of pearl-oyster though this has not been completely scientifically verified. It is proved to some extent by the fact that quality of pearl is not good when the pearl oyster is not put to the above pre-treatment process, even when the condition of the gonad seems suitable. After the pretreatment is over, the operation to insert into the body a nucleus made of a shell and a piece of the mantle taken from another pearl-oyster is performed. For this operation some kinds of simple tools are used. There are many sizes of the nucleus to be inserted ranging from 2 mm to near 10 mm in diameter, and generally the size of a nucleus determines the size of pearl desired. But, to insert a large nucleus, a large mother-oyster is necessary, and besides, it is difficult from the technological point of view to insert a specially large nucleus. Next, the operated oysters are controlled specially in the culture ground in front of the work-shop for two weeks to a month. This process is called after-treatment. After that, being brought into another ground for culture, operated oysters continue to be cultured till collection of pearl. This period is usually from one to three years, and it depends on the size of pearl desired and the size of a nucleus inserted. During the culturing period, pearl-oysters in baskets are not merely kept hung down from the rafts.* It is necessary to remove regularly parasites, and in some grounds where water temperature decreases in winter, pearl-oysters are moved to the warm sea during that season. Besides, pearl-oysters are usually moved to the gro-

und to be finished where specially good pearls are expected to be got. This method has become popular recently as one of the remarkable technical improvements. According to the oceanographical condition of the ground in which pearl-oysters are cultured, the quality of pearls, especially the shade of color and lustre of pearls varies. The ground suitable for finishing is actually the area strongly influenced by fresh water but it must be combined with other grounds, since the water temperature in such areas falls low so the pearl-oyster can not live over winter. Thus after the period required to grow pearl-oysters, pearls are collected. The period is mostly in winter because winter is not only a sort of slack season unsuitable for operation but the best season for the quality of pearls.

The outline of production process of cultured pearl is as mentioned above. Then, what would be the characteristics from the industrial point of view? The first one, above all, is that it remains in the stage of handicraft. The simple tools to clean culture baskets and to remove pearls and X-ray equipment to test the presence of a nucleus inserted in a pearl-oyster came to be utilized recently. However, they are used exclusively for a very small part and period of the whole process, and it is still the handicraft by using tools of simple construction that forms the keynote of the whole process. This fact must be pointed out as the most basic characteristic, although it does not seem strange for persons who are familiar to pearl culture. The second characteristic, being connected to the above directly, is that work of culture, especially the operation which makes the center of the whole process, requires great skill. All those who have seen the operation even once must have wondered how difficult it is to insert in the body of a pearl-oyster a nucleus and a piece of the mantle and how skilfully workers perform the operation. Actually, the point in the oyster at which a nucleus and a piece of the mantle

* Lately, the wire basket has been replaced in some cases by a bag-like net of synthetic fibre, or, instead of the basket or nets nylon cord is passed through a hole drilled in the shell and the oyster is suspended by this cord to a stronger cord or rope. This latter system improves the rate of growth of the oyster and consequently the deposition of nacre. Also it has lowered production costs.

to be inserted and the process are very delicate matters in close relation with mortality of pearl-oysters and the quality of pearls got, and to perform it under the best conditions, a high grade skill and considerable amount of training are necessary.

Thirdly, the common final object aimed at in every part of the production process is nothing but improving the quality of pearls to be produced. Since pearls are jewellery accessories, it is natural that especially the

excellence of the quality is stressed. The foregoing description may make it clear that the history of technical development of pearl culture is no more than the history of improving the quality of cultured pearls. Rationalization of production process in the case of general industries means levelling up labour productivity, in other words, "by less labour" Contrary to it, in pearl culture "products with better quality" is looked upon to be the characteristic.

TABLE IV
Number of Pearl Culture Management Units by Size

Year	1955	1956	1957	1958	1959	1960
No. of rafts possessed						
Total	1,643	1,734	2,574	3,001	3,080	3,484
1 - 14	1,082	1,145	1,657	2,022	1,886	2,283
15 - 29	263	258	397	413	584	574
30 - 49	114	136	228	217	243	241
50 - 99	97	113	152	163	165	192
100 - 499	80	75	128	166	176	167
500 - 990	7	7	8	16	20	19
over 1,000	-	-	4	4	6	8

III. STRUCTURE CHARACTERISTICS OF PEARL CULTURE INDUSTRY

Table IV shows the size composition of pearl culture management units. Here, the breakdown of strata is made according to the number of rafts possessed by each unit. Pearl culture management units range extensively from large units which have over 1,000 rafts to small ones of less than 15 rafts. They make pyramid structure as a whole; large scale management units being very few, while small scale management units have the overwhelming majority. It does not explain qualitative difference in the two classes

but merely quantitative difference that number of rafts is large or small; while large scale management units are, of course, employing a lot of workers, small scale management units that make the base of the pyramid, especially those in possession of less than 15 rafts, are household management based exclusively on family labour.

Generally, in the matter of credit as in sale of commodities, large scale management units have more advantage than small

scale management units, so it is an economic rule that the latter are eventually driven away by the former. However, in pearl culture, many small scale management units not only keep up in competition with large scale management units but are increasing in number every year. That may be the most important characteristic of production structure in pearl culture. What explanation should be given to the problem? The essential answer to the problem may be given by the technological characteristics of pearl culture mentioned in the former paragraphs.

The production means used in pearl culture still remain in the stage of hand tools basically, and even if a sort of machine is introduced partly, it is still very simple and small scale. It implies that even such small scale management units consisting of family laborers are able to apply the machine with ease. The use of the sea-bed as a production area requires a concentration of activities in the shallow sea. However, when the hanging method is considered, it is possible to take a raft as the unit which makes it possible to divide and utilize a much greater area. If large scale production enterprises which need a great deal of capital are indispensable, then small scale management units which can not get it would be unable to exist.

When the production means are in the primitive stage of development, the result of production necessarily depends on whether a worker who uses the means is industrious or not and works actively or not. This is all the more true, since pearl culture, especially the step of the operation depends largely on skilfulness of hand and the latter determines everything. Therefore, it is easily realized that, in case of the small scale management unit in which the entrepreneur himself works together with his family, the above conditions to bring forth good results are fulfilled because of their personal interest in the result of the production.

The relation mentioned above is relative to the fact that technical improvement

of pearl culture aims exclusively at improving the quality of pearls. If the object is "by less labour", aims are naturally the improvement of production means and, therefore, the introduction of the means on a large scale, which are in general applied easily only by large-scale management units. On the other hand, when "pearls of better quality" is aimed at, there is not always such trend, but in most cases only the improvement of skill would be planned. Thus, the reason why small scale management units exist extensively under competition with large scale management units is found chiefly in the characteristics of techniques of pearl culture.

Would structural characteristics of pearl culture ruled by these conditions be unchangeable forever? The illustration is to be found in actual change of techniques. For instance, utilization of the ground for finishing mentioned above; though, in former days, the whole process of production was performed in the same ground, now in order to produce pearls of better quality, it is necessary to combine some grounds differing in oceanographical characteristics. In most cases those grounds are situated a good distance from each other, so lately they need considerable amount of funds to get and utilize the grounds, and in order to work under these conditions with efficiency a certain minimum size of management is necessary. In fact, it is chiefly large scale management units that have realized utilization of such finishing grounds, and in this case, advantage of large scale management units is more prominent. Another trend expected is that leveling up of the labour productivity, in other words "by less labour" will be accepted by this industry gradually. A few kinds of machines which were already introduced are thought to symbolize the trend. Therefore, at present, small scale management units still have a basis that enables them to manage well in competition with large scale management units, but it cannot be denied that the basis is being narrowed gradually. At least, there is no doubt that large scale manage-

ment units will secure a strong position as an important supporter of the industry of pearl culture.

Finally, as regards the structural characteristic of pearl culture industry, it must be mentioned that the large scale management units without exception deal with actual trading, and export in addition to brokerage of pearls, Mikimoto Pearl Co., Ltd. and other old-established large scale management units, in a sense, have grown both as pearl

brokers and as pearl producers. Other large scale management units which have developed recently would also extend their activity in brokerage and export, with a similar type of management. In this view point, the dominance of large scale units is definite considering the relation between powerful buyers and poor sellers. The relations in pearl trade are considered to correspond with the historical stage where the advantage of large scale units in production itself was not prominent but in trade as mentioned above.