"S. S. PACIFIC EXPLORER"--A PRELIMINARY DESCRIPTION

By Carl B. Carlson*

The recently completed factory ship, the Pacific Explorer, left in January for Central and South American waters to engage in the tuna fishery. It is expected that the vessel will act as a mother ship for a fleet of twelve or more fishing vessels, supplying their operating materials and preserving their catch. Thus, fuel and other supplies produced in the United States will be provided on distant fishing grounds, and the range and productivity of our fishing fleets can be greatly extended. The ship has sufficient capacity to freeze and transport 3,800 tons of tuna. During the period of summer in northern waters, the vessel will operate in the Bering Sea, canning or freezing king crabs and preparing frozen fillets from bottom fish.

BACKGROUND FOR THE PROJECT: American fishing activities have, in general, been confined to relatively nearby areas within a practical cruising range of our fishing fleets. Except in the tuna fishery, reliance on ice for preservation of the catch has also tended to restrict the range of our fishing vessels. As our population grows, it can be expected that protein foods from the sea will become increasingly important to our national welfare. Our fishing vessels may then have to travel to more distant areas.

Before World War II, the Japanese Government operated a fleet of exploratory vessels, reported to be up to 50 in number,[1/] whose activities ranged from Bering Strait through the north, west, central, and southern portions of the Pacific Ocean and into the Antarctic regions. The information obtained from these explorations led to an ocean-wide expansion of fishing effort until the annual, prewar, Japanese catch reached an average of 10 to 12 billion pounds from the Pacific alone, as compared with a United States catch of about 4.5 billion pounds from both the Atlantic and Pacific Oceans. A substantial portion of the Japanese catch consisted of premium items, such as tuna and king crabs, which were shipped into the United States and sold in competition with our own products.

DEVELOPMENT OF FACTORY SHIPS: The development of factory ships afforded the Japanese a method of expansion throughout the Pacific.

In 1892, crab canning was started by the Japanese on stocks taken from local waters. The industry grew slowly until 1923, when, as a result of several years of successful government investigation, factory ships were introduced. These provided a sound technical basis for expansion of the industry from the waters of Japan proper to Kamchatka and Siberian waters, and in 1930, to our side of the Bering Sea, and finally into Bristol Bay, which is the principal Alaskan center for canning red salmon. Prior to World War II, there was strong evidence that the Japanese were conducting experimental work which could have led to harmful exploitation of the salmon fisheries off Alaska. As a result of discussions between the United States and Japanese Governments, the Japanese gave assurances that measures would be taken to prevent such operations. Farther south, the Japanese extended their activities to Mexico through concessions granted by the Mexican Government. The Japanese tuna fishery expanded eastward from the home islands

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1/ Chapman, W. L., 1946, "Tuna in the Mandated Islands." Far Eastern Survey, 15 (20): 317-319.

to Wake Island and southward through Formosa, the Philippine Islands, North Borneo, and the Mandated Islands to Australia. Whalers were sent to the Argentine coast.

"Increasing exploitation of a crab fishery by foreign nationals in water immediately adjacent to United States' territory, for subsequent export into the United States, raised serious questions as to whether American interests were making adequate use of domestic fishery resources. Accordingly, early in 1940, the President requested the Secretary of the Interior to investigate the practicability of establishing an American king crab canning industry in Alaska. Initial inquiry indicated that lack of information regarding areas of abundance, methods for taking and canning king crabs, and a general fear of not being able to compete with the imported product on a cost basis, were the primary obstacles retarding domestic development. Since the cost of necessary exploratory work would be prohibitive for private enterprise under conditions then prevailing, Congress authorized the Fish and Wildlife Service to make the study."2/

The results of this work disclosed the presence of tremendous quantities of not only king crabs but also of edible bottom fish. In 1945, when the War Food Administration was searching for additional sources of protein food, the wartime Office of the Coordinator of Fisheries of the Department of the Interior recommended that these Alaskan bottom fish be utilized. The War Food Administration recommended that the Defense Plants Corporation (a subsidiary of the Reconstruction Finance Corporation), in the interest of national defense, acquire an ocean-going vessel, convert it to a factory ship, and construct five fishing vessels to accompany the factory ship and supply it with raw materials.

After the cessation of hostilities with Japan, the War Food Administration was unable to reaffirm its recommendation of the essentiality of the project strictly as an emergency food measure but, realizing the postwar potentialities, recommended that the project be referred to other interested agencies. The Director of War Mobilization and Reconversion--basing his actions on recommendations of the Department of the Interior, the State Department, and the Navy Department and on the fact that the conversion was well advanced--determined that it would benefit the Government and the fishing industry to complete the conversion and to construct four fishing vessels. To assure that the Government and the domestic fishing industry would obtain a maximum amount of useful economic, scientific, and other information from the operation of the vessels, provision was made for representatives of the Government to accompany the vessels and publish reports on their observations.

The Pacific Exploration Company was designated as the agent for the Reconstruction Finance Corporation in the construction and operation of the fleet of vessels. W. C. Nickum and Sons and H. C. Hanson were accepted as naval architects for the mother ship and the fishing vessels, respectively. Since much of the information required in designing a fleet of vessels for the varied purposes planned was not common knowledge among marine architects, the Fish and Wildlife Service delegated a fishery engineer to assist, on a part-time basis, in making available the facilities, knowledge, and experience of the Service.

The ship was so designed that it could act as an independent cargo carrier or serve as a mother ship for a fleet of fishing vessels in any part of the Pacific Ocean or adjoining waters. The fishing vessels were designed to operate as independent units in the tuna, otter-trawl, purse-seine, line-trawl, or bottom gillnet fisheries or to accompany a mother ship to any location in the Pacific.

2/"The Alaskan King Crab," published in Fishery Market News, May 1942 - Supplement, pp. 3-4.

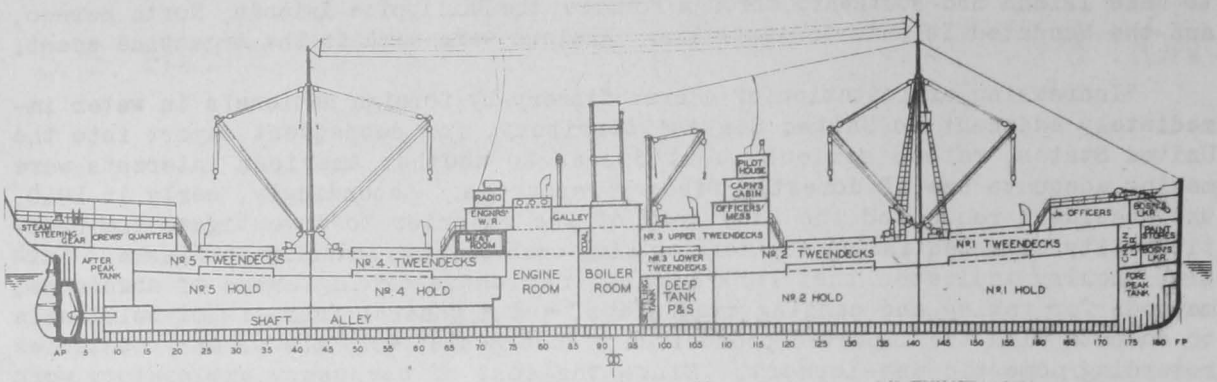

FIGURE 1 - S.S. PACIFIC EXPLORER (EX-MORMACREY) BEFORE CONVERSION

The mother ship and the fleet of fishing vessels are leased to the Pacific Exploration Company for a period of 7 years at a rental of $50,000 per year, or 55 percent of the profits, whichever is the greater. The Pacific Exploration Company is to pay all maintenance and operating costs.

DESCRIPTION OF THE "PACIFIC EXPLORER": The Pacific Explorer (ex-Mormacrey) was one of the 8,800-ton class of vessels built during World War I and had the following registry data:

OFFICIAL NUMBER	218,294	LENGTH	410.0 FT.
GROSS TONNAGE	5,946	BEAM	54.4 "
NET TONNAGE	3,744	DEPTH	27.2 "
HORSEPOWER	3,500	CREW	31

The vessel was of the 3-island type (see Figure 1), having a raised forecastle, a raised bridge deck structure amidships, and a raised poop. The propulsion engine was a triple-expansion type. For reasons of economy, it was decided that no changes would be made in the engine or boiler rooms.

PROBLEMS OF RECONVERSION: Several general over-all plans were considered in the reconversion to determine the optimum allotment of space and to provide the most efficient flow of materials through the ship. Some of the main factors which had to be considered were:

1. The first vessel of a given type is always experimental, and flexibility had to be provided to allow for alterations after a period of operation.
2. The vessel would be required to work with different products on the northern and southern trips.
3. Space on a ship is drastically limited, yet the flow of materials on this vessel had to be arranged for versatility and simplicity.
4. Mechanization had to be introduced wherever possible to reduce the manpower requirements.
5. A large amount of sheltered working space would be required for the northern voyages to provide for filleting, freezing, and canning operations.
6. It was necessary to provide maximum cubic capacity and abundant frozen storage space, particularly for the southern trips. Provision had to be made to freeze 130 tons of fish per day, based on fish and condenser water temperatures of 85° F.
7. Equipment to can 600 cases of crabs and to prepare 50,000 pounds of fillets in an 8- to 10-hour day had to be incorporated.

8. Machinery and equipment spaces had to be reduced to a minimum, yet many services such as fresh and salt water, steam, electricity, compressed air, vacuum, and refrigeration had to be supplied to various stations throughout the ship. All these installations had to meet the rigid marine-inspection requirements established for the safety of the ship and its personnel.

9. Approximately 240 persons had to be transported, housed, and fed in quarters suitable for voyages of 4 months' duration.

10. Adequate ventilation, an inter-communication system, and a fishing fleet control system had to be installed.

11. It was necessary to provide facilities for all the services of a mother ship to care properly for the accompanying fleet of fishing vessels and their personnel.

STRUCTURAL CHANGES: The final arrangement decided upon is shown in Figures 2 and 3. A new deck house was constructed to accommodate a ship's crew of 50 persons, including a doctor, administrative and scientific personnel of 7, and 60 occidental fish handlers. Quarters were built in the forecastle to house 124 oriental workers.

The wells forward and aft of amidships were covered to transform the vessel to a shelter-deck type. By removal of the interfering structure under the raised deck amidships, the whole former upper deck, with the exception of the boiler and engine casings, was made available for cannery and fish-handling purposes.

The full 18-foot deck height of the original holds would make cargo stowage difficult. Owing to the conditions of operation, only relatively small quantities of cargo would be stowed in the holds at one time, and much of the cargo might be adversely affected by excessively high stacking. Consequently, an orlop deck was added forward and aft as shown. The new orlop deck aft was welded to the shaft-alley covering to provide storage tanks for nearly 500,000 gallons of diesel oil to fuel the fishing fleet and for the diesel electric generators. These tanks can be cleaned, after they are emptied, and used for fish oil storage on the return trip.

Various bulkheads were added to the hull to provide compartments for working, freezing, and storage spaces. A structural bulkhead placed aft of the engine room provided spaces for the diesel electric and ammonia compressor machinery. As safety measures, both of these compartments were made gas-tight and escapes were installed. The various cold compartments were made with non-structural steel sheathing, and the spaces were insulated with a minimum thickness of 9 inches of fiber glass. The freezer spaces were protected by cork board insulation with a minimum thickness of 8 inches.

FISH AND CRAB PROCESSING: Two sets of outrigger booms, one forward on the starboard side and the other aft on the port side, were installed to provide mooring for the fishing vessels. Counterweight towers, with the weight connected directly to one of the mooring lines at each station, were constructed to compensate for the surge of the fishing vessels in a seaway when they are alongside. In the northern operation, it is planned to transfer the fish to the forward storage bins and take the crabs and tangle nets to the after deck by using the ship's gear. During the southern operations, the fish may be loaded both forward and aft but will be held temporarily on the upper rather than the shelter deck to protect them from the tropical sun.

The bottom fish will be conveyed from the bins to a rotary washer and then to the filleting table, which has provision for 70 workers. Conveyor belts are to conduct the waste products to the liver-picking table and then to the reduction plant, which has a capacity of 5 tons per hour and requires four operators. The cut fillets are to be transferred in pans to an inspection table and then to a continuous brine-dip tank. After being brined, the fillets will be weighed, packaged, transferred to racks, and then trucked to the upper-deck blast freezers. The fillet plant is designed to accommodate in excess of 85 workers.

It is planned to stow the tangle nets and king crabs on pallets and transfer the nets containing crabs to a net-picking table. After removal from the nets, the crabs will be conveyed to a butcher-and-trim table and then to a continuous cooker. After being cooked, the crabs will fall into a cooling tank on the upper deck, and the leg segments will be separated; next, the segments will be transferred to a shaking table and the meat washed and exposed to acid and brine dips. Subsequently, the pans of meat will be conveyed to a packing table and the filled cans conducted to the sealing machinery and the retorts. Provision is made on the crab-canning line to accommodate 127 workers.

REFRIGERATION: It is believed that the ammonia compressor plant of the Pacific Explorer has larger capacity than any other ever installed on a United States vessel. While there are refrigerated ships having a cubic capacity far in excess of the Pacific Explorer, they are designed for transporting meat and fruit, and few, if any, are expected to hold cargo at less than 15° F. It is estimated that the cargo space on the Pacific Explorer can be held at 0° F. or lower and that 130 tons or more of fish per day can be frozen at the same time. To insure continuity of operations and safety of the cargo in the event of a partial breakdown of the compressor plant, a suitable safety factor has been allowed.

It was decided to use a flooded system supplied by a two-stage compressor plant because of the large amounts of ammonia required to do the job and the very low temperatures desired in the freezers. Had a single-stage compression system been used, the piping requirements would have been far greater to transport the large volume of gases involved. The two booster compressors are driven by motors of 125 and 50 horsepower, respectively, and have respective capacities of 134 and 65 tons of refrigeration at a suction temperature of -25° F. and a discharge pressure of 24 pounds per square inch. Two of the high-stage machines are each driven by 175 horsepower motors and have a combined capacity of 230 tons of refrigeration, while a third high-stage compressor is driven by a 45-horsepower motor and has a capacity of 21 tons, all at a suction pressure of 24 pounds and a discharge pressure of 190 pounds.

The booster compressors draw gaseous ammonia from surge drums at various locations about the ship, and the partially compressed gas is discharged into a direct-expansion liquid and gas cooler. The gas is then further compressed by the high-stage machines and cooled to become high-temperature liquid ammonia. A portion of the high-temperature liquid is used in making ice and in cooling water for the ventilation system. The ice plant has a capacity of 15 tons per day. The remaining high-temperature liquid is cooled by being passed through coils in the direct-expansion liquid and gas cooler to become subcooled liquid for use in the storage and freezer spaces. Hot gas from the high-stage side may be used to defrost the various storage-room coils.

The subcooled liquid is pumped to surge-drum reservoirs from which the liquid ammonia is circulated through the various freezing coils throughout the ship. The

ammonia absorbs heat in these coils, evaporates, and is then drawn back to the surge drums and thence to the suction side of the boosters.

Each of the four upper-deck blast freezers will take a charge of 6,000 pounds of packaged fillets on a system of racks and trays. These fillets are expected to be frozen in less than 6 hours. By the removal of a portion of the trays, small tuna can be frozen on the same racks. In the large blast freezers on the second deck, the larger tuna will be placed on individual trays which are supported by an iron framework. Several portable conveyors of vertical and variable-angle types are to be used to transfer materials between various levels.

The power for the compressor plant, fish house, and ship service is supplied by 3 AC diesel-electric plants, each developing 300 kilowatts and having a prime mover of 450 horsepower. Here again the capacity is in excess of the actual requirements to insure the continuity of operations and the safety of the cargo in the event of partial breakdown.

Observers and technical personnel from the Fish and Wildlife Service who are accompanying the expedition will present a more detailed report of the ship and its operations at a later date.

TUNA FISHING

The area fished by the southern California tuna fleet reaches from the coast of southern California to and slightly beyond the equator, extending from the continental mainland to points approximately 800 miles off shore and includes areas around practically all the islands within these general limits, including the Revilla Gigado Islands, Clipperton Island, Cocos Island, and the Galapagos Islands.

The large "bait fishing" vessels forming the high-seas tuna fleet, which fish for skipjack and yellowfin, bring in from 60 to 70 percent of the total catch and work the fishing grounds as follows: In the winter months, or from November to the end of February, the fleet is found off the Galapagos Islands. The boats then fish off the mainland coast of Central America through March, April, and May. In June and July, they may fish in the Gulf of California or around Cape San Lucas. In August and September, the fleet covers the lower California coastal area with the neighboring banks and islands as far as Clipperton Island. In the fall months, they mostly return to the mainland coast of Central America. While this is the general procedure, the judgment and experience of the individual captain as to fishing conditions in the various known areas and advance information on the availability of bait, or presence of fish, are the principal factors governing exploitation of the fishing grounds.

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