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SECOND WORLD FISHING BOAT CONGRESS

CONTENTS

INTRODUCTION

The second World Fishing Boat Congress, arranged by the Food and Agriculture Organization of the United Nations, convened at FAO's Headquarters in Rome April 5-10, 1959. Fifty technical papers were presented and a total of 293 participants from 35 countries registered. The representation was: Austria 1; Belgium 4; Canada 6; Costa Rica 1; Cuba 1; Denmark 6; Dominican Republic 1; Finland 4; France 31; Germany 16; Ghana 1; Greece 1; Iceland 1; India 1; Ireland 4; Israel 3; Italy 70; Japan 10; Korea 2; Libya 1; Mexico 1; Morocco 5; Netherlands 17; Norway 10; Pakistan 1; Philippines 1; Poland 5; Portugal 2; Spain 3; Sweden 10; Switzerland 5; Tunisia 1; United Kingdom 42; United States 19; U.S.S.R. 4. In addition, representatives of the General Fisheries Council for the Mediterranean and the International Labor Office attended.

Fig. 1 - The opening session of the Second World Fishing Boat Congress held at FAO headquarters in Rome.

The theme of the Congress, PERFORMANCE, was divided into four main subjects: Tactics, Construction, Sea Behavior, and Productivity. These were discussed at separate sessions for which an annotated program outlined the background of the subjects and those to receive special attention at each session.

The discussion on tactical methods was split into sessions on fishing methods and deck arrangement, and command of operations. These sessions started with brief introductions of their papers by five authors on drift-netting, gill-net fishing, long-line fishing, pole-and-line fishing, and trawling.

The subject of construction was divided into sections on scantlings, new materials, fish holds, installation of machinery, and costs of construction.

The session on fish holds aroused much interest, and opinions were expressed that naval architects so far had not cooperated enough with fishery technologists in developing simple and economical installations. Various freezing methods such as brine, air blast, contact and tunnel freezers came up for deliberation.

At the session on installation of machinery, not individual engine designs as such but the installation of machinery in general was discussed. Special attention was given to a paper on vibration, and there was much debate on the relative merits of controllable pitch propellers and multiple reduction gears. A United States paper, in the section on costs of construction, gave an analysis of dimensions, weights, and costs of United States-built fishing vessels, but it was emphasized that construction costs are lower in Europe.

Sea behavior was divided into sessions on resistance and propulsion, seakindliness, stability, and safety at sea. The discussion revealed the importance of determining the true operating speed of fishing vessels in order to select their most efficient proportions and shape. Participants also dealt with the advantages and disadvantages of bulbous bows and transom sterns. Suggestions were again made that FAO should continue its work on minimum stability, and the Dutch delegate explained that his Government had great confidence in the Rahola criteria.

On productivity there was a symposium on boat types and a session on the choice of size and type and the fishing boat of 1975. At the symposium, many new types of boats were described, and in the choice of size and type session, the disadvantages and advantages of factoryship operation were thoroughly examined. A Japanese representative reviewed Japanese work on developing two large fishing vessels for atomic propulsion at the session on the fishing boat of 1975.

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Part I - Observations of a United States Government Fishery Methods and Equipment Specialist

Stewart Springer*

ACCOMPLISHMENTS OF THE FISHING BOAT CONGRESS: It is obviously important to bring about better understanding of the problems of fishing vessel operators by architects, and equally important to get operators to take optimum advantage of the services naval architects can give. In practice, the naval architect must work within very narrow limits in the design of fishing vessels. Investors in new vessels are notably reluctant to authorize changes of design or to risk the very severe economic penalties for failure of a new design to give over-all performance as good as obtained from tried and proved designs. There is, consequently, little opportunity to get operational tests of designs incorporating radical departures from conventional practice. Most new fishing vessels have some new but minor changes in the hull or equipment, and undoubtedly most of these are actually beneficial and produce better performance. But this permits only a slow evolution in design under a rigorous economic selection. Without occasional radical mutation this leads to dead ends. New materials, more compact and reliable power sources, and increasingly comprehensive information on performance characteristics of certain hull designs have given the naval architect wide opportunity to make changes.

At the same time, the investor in a new fishing vessel has to consider the ever-changing requirements of the market for fishery products, as well as the general competitive situation. It seems probable that there is not only the opportunity but also the need for occasional major change. The kind of change which may result from agreement of owner and architect is illustrated by the development of the stern-chute trawler. The meeting at Rome brought together for discussion the problems of operation and the problems of construction. We may properly, I think, be hopeful that the results will be good and far-reaching.

The theme of the congress was performance, with papers grouped under the headings: tactics; construction, sea behavior, and productivity. Papers relating to

* Chief, Branch of Exploratory Fishing and Gear Research, Division of Industrial Research and Services, U. S. Bureau of Commercial Fisheries, Washington, D. C.

construction and sea behavior were given somewhat more time than the others, perhaps because it is in these areas that naval architects make their principal contributions.

Experts appeared to be in agreement that there were many papers of technical excellence presented at the meeting and that the Congress was a valuable source of new ideas.

TECHNICAL PROCEEDINGS OF THE CONGRESS: Because papers and comments on them will be published later, no attempt will be made here to highlight specific points made in presentations. Such observations as can be made on overall accomplishments of the congress are necessarily personal conclusions of the writer.

Although the opening speech at the congress exhorted participants to use the imaginative approach, the discussions followed the course inevitable in scientific and technical meetings where new ideas, if any, are always roughly treated. Costs of construction, maintenance, and operation were factors entering discussions of most of the papers and the tenor of the meeting was toward the practical and conservative point of view.

There were many references to the relative merits of stern trawling and side trawling without much agreement on the part of speakers as to the efficiency or desirability of the stern trawler. Proponents of the type continue, however, to plan and build additions to the growing fleet of long-range stern trawlers. The questions concerning their merits may, thus, eventually be determined by large-scale competition.

Problems of the quality of fish arising from the need for long trips were discussed. As usual in such an exchange of views, where personal taste preferences are concerned, there was some reluctance to accept modern trends. In spite of this, some speakers pointed out that use of frozen-food products is increasing and that a wider application of freezing-at-sea methods is inevitable. Such a view seemed to be generally acceptable, provided wide use of freezing techniques could be brought about slowly. Most discussions of the question indicated that the costs for new equipment and the risks of incorrect diagnosis of the marketing trends make major moves in this direction financially hazardous for the owner-operator of fishing vessels.

Papers on specific design problems, on model testing, and on engineering problems relating to propulsion appeared to be more fruitful, although difficult for the observer not trained in naval architecture to understand, or, at the present time, to assess. Operators and builders should find some of these contributions useful in reducing construction costs and producing more efficient vessels.

The meeting was dominated, verbally at least, by persons interested in the larger and more complex vessels, and more particularly in the distant-water trawlers of the North Atlantic. Nevertheless, a number of the papers were aimed at problems of small vessels and should be especially interesting to the builders and operators of those vessels.

Two written discussions of an imaginative nature were introduced. One was an examination by Professor Takagi of Japan of the feasibility of atomic-powered factory trawlers. The other, by Lee Alverson and Peter Schmidt of Seattle, presented a preliminary design with an offset deckhouse for small stern trawlers, in an attempt to provide more deck space.

TRENDS IN WORLD FISHERIES REFLECTED BY THE CONGRESS: A growing need for making fishing more attractive as an inducement to capable young men to become fishermen was recognized in several of the presentations. The importance

of making vessels more habitable, more seakindly, and safer was stressed. Fortunately these aims are reasonably compatible with the need to make large fishing vessels more efficient. Improvements in small inshore vessels are probably equally important, but were not discussed as thoroughly. Since fishing vessels are becoming more complex, and even the smaller vessels are becoming loaded with equipment, the training of young men as fishermen was recognized as an important activity of the future.

The trend toward expansion of production by fishing in distant waters, and the use of more modern equipment, was brought out in discussions of stern trawlers, freezing-at-sea, and factoryship operations. While not spelled out specifically, it probably would have appeared to an observer with no previous knowledge of the fisheries, that technological improvements are resented by the fishing industry. This, of course, has some basis in fact. The world fishing industry is not ready to adopt or adapt all of the tools that modern technology can supply. The cost of change or innovation in the fishing fleets is not the only deterrent. An assortment of more or less related questions were present, by implication, in the discussions on the floor and in informal conversations outside the meeting.

Members of the fishing industry and fishery biologists have found some comfort in the thought, whether they subscribe to it or not, that economic forces will prevent the drastic overfishing of stocks of oceanic demersal and pelagic fishes because such overfishing is not profitable. The new element in the world fishing picture which seems to be causing concern is the intensified international competition by fleets which are subsidized in one way or another and are thus relieved of some economic limitations. It may be argued particularly that factoryship fleets concentrate very heavy fishing pressure on a limited area, moving to another only after the first has been swept relatively clean. Whether this constitutes a real threat to the world's stocks of the more desirable kinds of fishes has not received a great amount of attention from fisheries scientists. Solutions to conservation problems, particularly those which would give fishing interests a reasonably clear determination of the maximum sustainable yield by species and area, would remove some of the fears fishing vessel operators hold about the future.

Several speakers warned builders of vessels that consumers would not continue to tolerate or accept fish kept overlong on ice. Attention was called to the increasing quantities of packaged frozen foods coming into competition with fishery products. Also noted, was evidence of a change in preference on the part of consumers toward the properly frozen product. The fishing industry is in the early stages of a transition to the modern system under which the product is necessarily subject to standardized controls for quality at several points from catching to retail distribution. This is in contrast with the old system where one individual could at least follow and exert some influence on the handling methods from the time of capture to the delivery to the consumer.

The dilemma facing operators of fishing vessels making long trips involves the choice between making the change to freezing-at-sea methods now or waiting for more favorable conditions. One solution proposed on the basis of recent German experience provides for freezing equipment to handle the first portion of the catch, with icing facilities to handle that portion of the catch taken at the end of the trip.

Throughout the meetings it was apparent from discussions that distant-water fishing and near-water fishing present entirely different kinds of problems. Separation of these would have made the discussions more easily understood. A line of separation could not be precise, but a definition of distant-water fishing as that requiring more than five days absence from port might serve.

It goes without saying that the fishing vessel operator wants low-cost operation and a product that can be marketed favorably. The discussions of the congress indi-

cated that the operator recognizes the need for more comfort and safety for the crews, facilities for landing a product of sufficiently high and uniform quality to meet the new market demands, and vessels of greater efficiency in particular fisheries. At the same time the fishing industry is not able to support large-scale experimentation in design of vessels.

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Part II - Observations of a United States Government Fishery Technologist

By Joseph W. Slavin*

INSTALLATION OF MACHINERY: This part II is concerned only with the discussions of vessel design and operation that may be of interest to fishery technologists. Some notes are also included on personal discussions with fishery technologists, engineers, and naval architects. At this session papers were presented on the various aspects of the design and operation of steam, Diesel, and Diesel-electric engines. Some information was also given on the use of variable-pitch propellers.

Hopwood and Mewse in their paper on a comparison of steam- and Diesel-driven trawlers point out that the use of Diesel results in more space for storage of the fish, less fuel consumption, less maintenance, and more efficient fishing. It was most interesting to learn that many of the fishing vessels used in foreign countries are still driven by steam rather than Diesel engines; this is particularly true in the United Kingdom and Germany.

Some discussion was given to the efficiency of Diesel-electric propulsion as compared to Diesel. Gueroult of France remarked that Diesel-electric propulsion offers the advantages of ease of maneuverability and the use of compact high-speed engines. His observation was that the fuel consumption with Diesel-electric is higher than for a Diesel engine. Hunter of England stated that with Diesel-electric propulsion more efficient use could be made of the generators; thus the over-all fuel consumption is slightly less than that for Diesel engines. There was however no question about the superiority of Diesel-electric propulsion for factoryships where a lot of auxiliary machinery is required. This type of propulsion equipment should be given serious consideration in designing a freezing-fish-at-sea vessel. Heinsohn of Germany mentioned briefly that the free-piston engine being used on one of the German stern trawlers is lower in efficiency than Diesel engines. However, some bugs still have to be taken out of this machinery. The free-piston engine is a relatively new development and should be watched closely.

It was also mentioned that the use of variable-pitch propellers on fishing vessels is increasing. On the medium and small trawlers a variable-pitch propeller offers the advantage of increased speed, whereas on a larger vessel its use will result in increased efficiency during trawling. In this connection Dwight Simpson mentioned that he is designing two new fishing trawlers, about 100 feet long, for Boston fishing interests. Both of the vessels will be equipped with variable-pitch propellers.

STERN TRAWLING: Heinsohn in his paper on "Design Studies for Stern Trawlers" stated that there are no appreciable differences between the cost of constructing stern trawlers and conventional trawlers, provided the vessels are over 180 feet long. For smaller vessels stern trawlers are more costly. He recommended that on small stern-trawling vessels the engineroom be located forward to provide a large enough chute for hauling up the net. This means that the propeller shaft must run through the fish hold, generally an undesirable arrangement. Heinsohn later in a private discussion expressed the opinion that stern trawling can be satisfactorily applied to a 150-foot vessel. About the only disadvantage of this method of fishing is the difficulty in getting the net free if it hangs up on some obstruction while fishing. This however is not a major problem and can be dealt with through experience.

*Mechanical Engineer, Fishery Technological Laboratory, Division of Industrial Research and Services, U. S. Bureau of Commercial Fisheries, East Boston 28, Mass.

The comments received on stern trawling were both favorable and unfavorable to this method of fishing, with the former being in the majority. Captain Glanville of Ireland stated that stern trawling will permit more productivity, greater safety at sea, and ease of handling; it is a must for the future. In complete agreement was Soublin of France who made a trip on a Russian stern-trawler factoryship. He mentioned that the technique of stern trawling on Soviet trawlers is well perfected from every point of view; it results in increased production, good-quality fish, and enables the crew to work under better conditions. Soublin, however, questioned the principle of this method of fishing since it may eventually contribute to depletion of many fishery resources. This latter point was also stressed during the Congress by other contributors. In other comments on this subject, Takahashi of Japan mentioned that they had constructed a 7,500-gross-ton stern-trawler and freezer vessel. However, some difficulty in operation was encountered because of the short length of the chute. It was interesting to learn that the size of the winches (60 to 90 hp.) used for stern trawling were the same as those used for conventional trawlers. A similar opinion regarding winch size was expressed by Cardoso of Portugal. He mentioned that his Government is building an experimental stern trawler to encourage industry to adopt this practice.

In opposition to stern trawling, Fred Parkes commented that he did not think the Germans were too pleased with this method of fishing. He seemed to be of the opinion that this method still has to be proven in many respects, especially for the smaller vessels. Hunter of England was also somewhat doubtful about the merits of stern trawling. He thought the chute to be a safety hazard and was concerned about the loss of space in crew's quarters due to the use of the chute.

In conclusion, the advantages of stern trawling apparently outnumber the disadvantages. Serious consideration should, however, be given to the use of a door to block off the chute and prevent fishermen from getting washed overboard when handling the trawl wire.

In this connection an English firm has designed a 100-foot stern trawler that does not require a chute for hauling up the net. I visited the office of this firm during my trip through England and saw movies of the operation of a model of this device. Briefly, the gear employed consists of a hydraulically-operated boom located at the stern of the vessel. This boom is moved vertically through a 90-degree arc as may be necessary to let out and take in both the net and the trawl doors.

PRODUCTIVITY: In the paper on "Modern Refrigerated Factory Ships in Japan," it was pointed out that ten factoryships have been built in Japan since 1953. They are used principally for salmon fishing and whale catching. The vessels are equipped with modern conveyors, refrigeration machinery, quick-freezing equipment, cooling equipment for refrigeration of the cargo holds, and canning equipment. Each catcher fleet usually employs two refrigerated factoryships and one unrefrigerated factoryship. In the Northern Pacific Ocean, for salmon fishing, about 30 catcher boats (50 to 80 gross tons each) are assigned to one refrigerated factoryship. Ammonia-compression refrigeration systems are used on all Japanese factoryships to provide refrigeration. Cold calcium-chloride brine flowing through steel-pipe coil grids is used to refrigerate the hold to a temperature of 0° to -4° F. Freezing is usually accomplished in a special shelf-freezer in which brine is circulated. In this process the fish are pressed between the metal shelves and the shelves lowered into the cold brine. After 5 to 6 hours the shelves are raised and the slabs of fish are removed to cold storage.

In introducing the paper on "Choice of Boat Type and Size for Polish Deep-Sea Fisheries," Orszulak mentioned that four types of fishing vessels should be considered for the Polish fisheries. Three of these would be stern trawlers consisting of (1) a processing-freezing vessel of about 1,000 tons, (2) a freezer vessel of 1,000 tons, and (3) a smaller vessel of 550 tons for salted herring. The fourth vessel would be a side-fishing trawler of about 550 tons for catching herring for salting. The factors that should be considered in selecting a fishing vessel are (1) size of

catches, (2) method of preservation, (3) distance to and from the fishing grounds, and (4) time that the vessel is required to stay at sea. In concluding, the speaker mentioned that a new processing-freezer stern trawler (similar to the Russian stern trawlers) is now under construction in Poland. This is the first vessel of this type to be built in Poland. I understand that in all about 45 of these vessels will be built in Poland in the near future. Later, in response to a question on Polish factory vessels, Orszulak stated that one of these new freezer trawlers will handle 50 tons of raw fish a day. Each vessel will have 3 filleting lines, one for white fish longer than 70 centimeters (28 inches), one for ocean perch, and one for filleting white fish smaller than 70 centimeters (28 inches). The vessel will also be equipped with a liver-oil plant, fish-oil plant, and a fish-meal plant having a capacity of 25 tons per day. The Polish factory trawlers will use ammonia-compression refrigeration systems and calcium-chloride brine systems for cooling the fish holds. Of particular interest is the observation that one Polish or Russian factoryship of this size could, during a year (280 fishing days), catch over 28 million pounds of fish.

Eddie, in a resume of his paper on "Propulsion and Processing Machinery for Deep-Sea Trawlers," stated that the Torry Research Station has become interested in this subject in connection with the economic aspects of freezing fish at sea. He pointed out that many trawlers are now operating at high speeds so they can spend as much time on the fishing grounds as possible and spend a minimum amount of time "steaming." However, if freezing at sea is employed instead of icing, the vessel can stay on the fishing grounds as long as possible. Therefore, it is not necessary that freezer trawlers operate at high speeds. Thus a savings can be made in the costs of operating the propulsion machinery of freezer trawlers over that of the cost of operating the propulsion machinery of conventional trawlers. In this connection, Eddie pointed out that a 15-knot British icing trawler spends an average of 160 days a year on the fishing grounds, whereas a 13.5-knot part freezer-icing trawler would spend about 180 days a year on the fishing grounds. Thus an increase in fishing time would also result, in addition to decreased fuel costs for propulsion equipment. This is a very important point and represents a fresh approach to the problem of reducing the over-all vessel operating costs associated with freezing fish at sea. Eddie, however, in his analyses did not determine the increase in cost resulting from the operation of freezing equipment as opposed to the purchase of ice. He did mention, however, that British investigators have found that very little extension of keeping quality is obtained by using antibiotic ice. Thus the use of antibiotics on fishing vessels will not result in an appreciable increase in the time that the vessel can spend on the fishing grounds.

There was a lively discussion of the papers presented at this session. The first contribution was a discussion by the Soviet Union on the operation of their factory vessels. They mentioned that Russian stern-trawling factory vessels have been in operation since 1955 and that the operation of these vessels is quite satisfactory. The products produced on these vessels consist of frozen eviscerated fish, frozen fish fillets, and byproducts such as fish meal and oil. The livers of cod are also saved. The productivity of these freezer trawlers is 60 percent higher than conventional trawlers; also the operating costs are 18 percent less than conventional trawlers. It was also stated that more research on preservation of fish is needed to find a method that will make it possible to transport considerable quantities of fish without freezing them. Improvements in vessel design are necessary to overcome stability problems and permit successful use of refrigerated sea water on long-distance vessels. The Russian presentation seemed to be a fair appraisal of factoryship operation, and to be of considerable interest to the group. There is no question that this type of operation will result in quite a change in the world fisheries picture in future years.

Birkhoff of Germany mentioned that he doubts that factory trawlers are economical because of the low price received for frozen fish and the high labor costs

associated with handling frozen fish at sea. There would be more chance of economic success by having a factory vessel act as a mothership and receive the catch from smaller trawlers, rather than using the factory vessel as the catching vessel. An economic appraisal of the operation of factory trawlers and motherships would be very interesting. Also in regard to factoryships, Harper Gow, who has an interest in the vessels Fairtry I and Fairtry II, gave an account of the development of those vessels. He mentioned that the Fairtry I has completed about four trips per year in the past four years. The operation of this vessel was so satisfactory that they built the Fairtry II which, while essentially the same as the Fairtry I, does contain some improvements designed to solve some of the problems that were found in operating the first vessel. These consist of minor modifications in the stern-trawling gear and chute to prevent the gear from catching in the propeller, enlarged facilities for filleting the fish, and equipment for producing larger quantities of fish meal and oil. In this type of an operation the production of fish meal and oil often spells the difference between profit and loss. It was mentioned that in spite of the increased labor costs it is better to land the majority of the catch as frozen packaged fillets rather than as eviscerated fish, frozen in block form. About 75 percent of the fish caught by the "Fairtry" vessels are now being filleted and frozen on the vessel. The remainder are being frozen as eviscerated fish in block form, or are being processed into fish meal and oil. Each "Fairtry" vessel has 4 to 5 filleting machines and a crew of 80 men to operate the processing equipment.

Gow also mentioned that at first personnel problems almost resulted in termination of this venture, but incentive payments and liberal vacation plans ended these problems. There is one other relatively minor problem in stern fishing; namely, the difficulty in hauling large catches aboard the vessel. It is extremely difficult to "split the bag" as is done on conventional side-fishing trawlers. He believes that it will be possible to solve this problem in the near future.

Eddie, in his discussion, agreed that new vessels should be used for freezing fish at sea; present vessels cannot be satisfactorily converted for this purpose. He also mentioned that at the Torry Research Station they have found that fish can be satisfactorily frozen, thawed, and re-frozen without any loss of quality. Also fish can be satisfactorily frozen in a pre-rigor condition. British and United States investigators are now in substantial agreement on many aspects of freezing of fish at sea. In fact the Torry Research Station is having a new freezer-trawler designed by a naval architect. This trawler will use vertical plate freezers to freeze eviscerated cod in blocks. The fish will be stored at -20° F. in the vessel's hold.

In summary, in this session on productivity it was pointed out that factory freezing vessels are meeting with considerable success in many countries. There is, however, a serious question of whether these vessels will be suitable for all countries; economic and political factors within individual countries will largely determine the appropriateness of operation of these vessels.

ATOMIC FISHING BOAT OF THE FUTURE: A somewhat speculative paper on the possible design of a Japanese atomic fishing vessel was presented by Takagi of Japan. It pointed out that Japan now has 157,000 powered fishing vessels using coal or oil. It will in the near future be necessary for these vessels to go farther and farther away from port to fully utilize their hold capacity. Tagaki stated that in many cases the limited fuel capacity restricts the cruising radius of these boats. Atomic propulsion would enable the vessels (motherships) to cruise for several years at a time unloading fish to large carrier vessels or at other ports of the world.

Japan would like to put an atomic power plant of 8,000 hp. on a 285-foot long oceanographic research vessel. This vessel would have rooms for over 1,000 people. They also have in mind the outfitting of a smaller 5,000-gross-ton training ship with an atomic power plant. This vessel would be used for training students in

oceanography. In concluding, Takagi mentioned that proposals for outfitting the aforementioned vessels with atomic power are being considered by the Japanese Government. He hopes that these projects, if approved and successfully carried out, will provide a basis for the construction of atomic-powered fishing vessels in Japan.

NOTES ON PERSONAL DISCUSSIONS: Much valuable information was received as a result of conversations with naval architects, engineers and fishery technologists attending the congress.

Heen of FAO mentioned that two freezing vessels of about 150 feet in length are now operating out of Norway. These vessels are landing both frozen eviscerated fish and frozen fillets (packaged in 5- and 10-pound packages). Also at the Fisheries Research Laboratory at Bergen, Norway, studies are being conducted on the development of a vertical plate freezer for freezing fish fillets at sea in block form. This freezer has been tested at the laboratory with some degree of success, and will soon be tested at sea on a commercial trawler.

I talked to Jerzy Kukucz, Professor of Fish Technology, Polytechnic School, Danzig, Poland. He is the head of a new fish technology department that was established at that University about a year ago. At the present time about 165,000 metric tons (364 million pounds) of fish are landed annually in Poland. Within the next ten years it is planned to increase these landings to about 500,000 metric tons (1.1 billion pounds). This will be done by using stern trawlers similar to those of the Russian type. These factory vessels will produce frozen fillets and fish meal and oil. Attempts are now being made to start a frozen food distribution system in Poland; this is needed to increase the distribution of the frozen fish that will be landed by the factory vessels. It was also mentioned that present freezing and frozen storage facilities in Poland are very inadequate.

I also talked to William MacCallum, Fisheries Research Engineer, Fisheries Research Board of Canada, Technological Station, Halifax, Nova Scotia. At the present time his station is conducting studies on the preservation of groundfish in refrigerated sea water. In addition bacteriological, protein, and fish meal and oil studies are being conducted at that station. Results of some preliminary tests on storing haddock and ocean perch in refrigerated sea water show that these fish are of no better quality than fish stored in ice. In fact in some cases the fish stored in sea water were of lower quality than those stored in ice. More extensive experiments on the use of refrigerated sea water are planned. MacCallum also mentioned that the results of other studies conducted at the Halifax station show that there is no appreciable increase in the keeping quality of groundfish due to the use of antibiotic ice. This contradicts the favorable results obtained by Tarr and his co-workers. Other tests on frozen packaged cod and haddock show that those fish should not be stored at 0° F. for longer than 6 months. Results of United States studies show that storage for 9 to 12 months at 0° F. is satisfactory, provided the product is of high quality when frozen. MacCallum also mentioned that they are planning to initiate studies on the development of equipment for improving the handling of fish on the vessel and at the dock.

Gordon Eddie, the principal engineer and a scientific officer at the Torry Research Station at Aberdeen, Scotland, and I had considerable discussions concerning the differences in our projects on freezing fish at sea. The English are having a new freezer-trawler designed, and they are trying to "sell" freezing fish at sea to industry. Several large firms in England are showing considerable interest in this process. Eddie is quite optimistic about its use in the very near future. Eddie and his co-workers have also taken a look at the use of refrigerated sea water for white fish. Results so far show no increased keeping quality for refrigerated sea water-stored fish over that of regular iced fish. They have also found that fish stored in refrigerated sea water for ten days or more contain large amounts of spoilage bac-

teria. Tests are being continued. Studies at Torry on the use of antibiotic ice for storing fish on the vessel show a three-day extension in the keeping quality of the treated fish (at a very low level of quality) is possible over that of regularly-iced fish. No work is being done at Torry on the development of equipment for improving the handling of fish. It is interesting to note that we are the only fisheries research organization that is doing work of this type.

In other conversations I learned that an Italian firm is now outfitting tuna vessels for catching tuna off the coast of Morocco. The fish will be eviscerated and stored in ice on the vessel. Arcoulis of Greece, the operator of several Greek freezer trawlers, was quite enthusiastic about freezing fish at sea. He is blast-freezing large quantities of groupers and sea bream on vessels that are fishing off the western coast of Africa.

Information was obtained on a preliminary design of a 147-foot Dutch stern trawler. The vessel has a chute with a safety door and a completely sheltered deck for handling the fish. The fish hauled up in the net are dropped to the lower deck where they are gutted, washed, and iced in the hold. This type of vessel offers many advantages as a New England freezing-fish-at-sea trawler.

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Part III - Fish Quality Stressed

By Joseph W. Slavin*

CARE OF THE CATCH: Methods of retaining the quality of the catch so as to increase the productivity of the vessel and the acceptability of the fish were discussed in some detail at the congress. In introducing the paper on "The Care of the Catch," Eddie of the Torry Research Station, acting in the absence of the authors, pointed out that fish preservation problems for each area of the world vary considerably. Methods of preservation suitable for one fishery or country therefore may not have the same relative value when applied to another fishery, where conditions differ. This is a salient point and explains why from time to time there are what seem to be conflicts between research results obtained from different countries.

This paper is principally concerned with the control of fresh fish spoilage on the vessel through the use of proper handling, washing, and icing procedures. Temperature is the most important single factor affecting spoilage; therefore the fish must be iced as soon as possible after catching, using a ratio of at least 1 part of ice to 3 parts of fish. British distant-water trawlers, because of the long period at sea, use a ratio of ice to fish of about 1 to 1. In addition to employing sufficient quantities of ice, proper application of the ice is essential for maintenance of quality. The ice should therefore be deployed so as to be mixed thoroughly with the fish and to also provide an effective barrier between the hold surfaces and the fish. Also, important are the observations that (1) deckhead refrigerated grids should be used only to cool the ice on the way to the fishing grounds, (2) the fish hold should be shelved off at 18- to 30-inch intervals to prevent excess pressure and weight loss in the bottom layers of fish, and (3) bacteriological spoilage of the fish may result from using contaminated ice. In this latter instance antibiotics may be of value in the suppression of bacterial multiplication in the ice. The importance of cleanliness in the fish holds is also emphasized, even though the exact value of this practice cannot always be directly measured. In this connection easy-to-clean metal-lined fish holds are preferred over the conventional wooden-lined holds.

FISH ROOM--ENGINEERING AND ARCHITECTURE: "The Fish Room--Engineering and Architecture," by MacCallum contains a wealth of technical information on the design and construction of fish holds that will be of considerable value to the naval architect in designing new and efficient fishing trawlers. In introducing his

* Mechanical Engineer, Fishery Technological Laboratory, Division of Industrial Research and Services, U. S. Bureau of Commercial Fisheries, East Boston 28, Mass.

paper, MacCallum pointed out that naval architects can perform a great service for fishermen and vessel owners by designing vessels which will enable storage and handling of the catch under optimum conditions. His observations were that in the design and construction of the holds of fishing trawlers (1) the proper type and thickness of insulation should be used to reduce ice melting, (2) waterproof membranes should be used on the warm side of the insulation, (3) stanchions should be arranged so that all movable pen boards are interchangeable, (4) hatches should be large enough to permit rapid unloading of the catch, and (5) the inside of the hold should be coated with suitable paint or resin compounds or lined with corrosion resistant alloys.

Data is presented in this paper (1) on the insulation requirements for the fish holds of both large and small vessels and (2) on the effect of insulation thickness on the quantity of ice that must be carried to adequately preserve the catch. Information is also given on methods for determining optimum fish-hold size and on the evaluation of various types of insulating materials, coating compounds, waterproof membranes, aluminum alloys, and other materials. Techniques employed in the construction of fish holds for both large and small vessels are also discussed in some detail.

ICING VERSUS FREEZING: The paper on "Icing Versus Freezing" is an objective comparison of the advantages and disadvantages of freezing or icing of groundfish aboard the fishing trawler. In introducing this paper the author pointed out that naval architects, engineers, and vessel owners and operators must, prior to designing a vessel for freezing or icing fish at sea, carefully consider the effect that these procedures will have on handling aboard the vessel, storage capacity of the vessel, unloading and handling ashore, quality and acceptability of the product, and on the costs of operation. The author, also mentioned that fish preservation and handling problems of different areas sometimes vary considerably; thus freezing at sea may offer special advantages for certain areas, and icing at sea may offer similar advantages for other areas.

In making the study of icing versus freezing, the author used as a basis the United States experimental freezing trawler Delaware and the British freezer trawler Northern Wave. On the Delaware, round haddock and cod were brine-frozen prior to rigor mortis, stored whole in the vessel's hold, unloaded by conventional means, and stored at 0° F. ashore. When removed from storage they were thawed in circulating water, filleted, and the fillets packaged, refrozen, and marketed in the conventional manner. In the Northern Wave project cod were eviscerated at sea, stored with ice, and then after rigor mortis set in plate-frozen in the form of fish slabs. The rectangular slabs of fish were then stored at -20° F. in the vessel's hold and after unloading at the same temperature ashore. Upon removal from storage the slabs of frozen fish were thawed in circulating air, the fish filleted, and the fillets marketed in the chilled or smoked state. It is pointed out that fish frozen at sea on the Delaware and the Northern Wave were of acceptable quality after 8 months of frozen storage.

In his analysis the author stated that freezing fish at sea on the experimental vessels resulted in increased handling aboard the vessel, reduction of the capacity of the vessel, an increase in the time required to unload the vessel, and increased handling at the shore plant--as compared with icing on the vessel. Increased costs may also result from freezing at sea due to extra personnel, higher vessel cost, operation and maintenance of freezing equipment, and frozen storage and associated handling costs ashore. However these costs may well be offset by the advantages associated with freezing at sea; namely, maximum utilization of the vessel's hold every trip, the landing of fish of uniformly high quality, and the storage of frozen fish ashore for use to level out production during slack periods. Thus freezing at sea may be most applicable for a combined vessel-processing plant operation. The author also recommended that new vessels be built for freezing groundfish at sea, rather than convert existing trawlers. In concluding, the author mentioned that in

this connection the U. S. Bureau of Commercial Fisheries has worked up a preliminary design of a new 170-foot freezer trawler which will freeze 3,000 pounds of fish per hour and will have a capacity of over 250 tons of round brine-frozen fish.

OTHER RELEVANT PAPERS: Eric Heen, Chief of the Fisheries Technology Branch of FAO acted as rapporteur and referred to other papers relevant to those on fish quality. In this connection the papers on "Design Studies of Stern Trawlers," by Heinsohn, "Modern Refrigerated Factory Ships in Japan," by Soto, and "Propulsion and Processing Machinery for Deep-Sea Trawlers," by Eddie were most interesting. The latter paper is particularly applicable because it points out that if freezing at sea is employed, it is not necessary for the vessel to return to port as quickly as if icing procedures are used. Thus a cost savings can be obtained in operating a freezer-trawler by reducing the size of the propulsion machinery and the speed of the vessel. In concluding, Heen stressed that much work has been done on the use of antibiotics for fish and their application must be closely appraised; also chilling in refrigerated sea water has been accepted for species of fish such as tuna, mackerel, salmon, and halibut and should be investigated for other species.

FISH HOLDS: The discussions on the session on Fish Holds were for the most part broken down into the subjects of "Chilling" and "Freezing."

Chilling: In his written discussion, the Director, Fishing Industry Research Institute, Capetown, South Africa, referred to some of the important work being done at that station. Of particular interest is the observation that reducing the size of the crushed ice to small pieces of $1\frac{1}{2}$ inches square does not increase the cooling rate of the fish. However, the use of very small pieces of flake ice does result in an increase in the cooling rate. Other salient points are that the ratio of fish to ice should be 1:1 for South African vessels to enable maximum fish-quality retention, and the weight loss for the fish stored at the bottom of the pen is 3 to 7 times greater than that for the fish stored at the top of the pen. Information was also given on the fish wash flume that is now in use on South African trawlers and on current preservation research studies being conducted at Capetown.

Commodore Silva of Portugal mentioned that fish can be satisfactorily kept in ice aboard Portugal trawlers for 10 to 12 days. Many of these trawlers employ mechanical refrigeration to keep the ice from melting on the way to the fishing grounds; the refrigeration is shut off when icing of the fish begins.

Other contributors pointed out that fish-hold linings should be resistant to bacteria, durable, and easy to clean. They stressed the importance of plastics and special varnishes and resins for coating the hold. It was also reported that chlorinated sea water is being used aboard trawlers in the United States and that sea water containing 60 parts per million of free chlorine is effective in washing the eviscerated fish prior to icing, and in washing the vessel's hold in port. This method is finding wide acceptance in the New England fishing industry. Differences in the apparent keeping quality of ice-stored groundfish due to geographical location were also discussed. It appears that in some countries people are accustomed to a somewhat stale fish and therefore prefer it to a fresh relatively bland product; this accounts for some of these differences.

Freezing at Sea: Much interest was shown in the freezing of fish at sea, and there were many valuable contributions on this subject. Of particular interest was a discussion on "Quick Freezing at Sea" delivered by Gino Gianesi, a consulting engineer from Italy. He pointed out that several Mediterranean fishing vessels have been equipped with quick-freezing installations to fish in the Atlantic Ocean, in the tropical waters off West Africa. The fish (consisting of sea bream, groupers and other species common to the West Coast of Africa) are usually gutted, washed, put into boxes, and loaded directly into the vessel's low-temperature blast freezers,

where they are frozen in about three hours. After freezing they are transferred to a -5° to -13° F. refrigerated hold. These fish are usually marketed in the frozen state in Greece and other Mediterranean countries. Gianesi also reported that the frozen fish are of good quality even after seven months of storage and that this activity has given excellent results and is considered to be out of the experimental stage. The author also pointed out that the 124-foot Greek transport vessel Euridiki converted to a freezer trawler in 1951 was perhaps the first vessel to be used commercially for quick-freezing at sea. This vessel is equipped with an ammonia-compression refrigeration system having a capacity of about 60 tons of refrigeration. Two air-blast freezers operating at temperatures as low as -49° F. are used to freeze about 6 tons of fish a day. Over 120 tons of frozen fish can be stored in the -4° F. to -13° F. refrigerated fish hold. Successful operation of this vessel resulted in conversion by this company of two larger 229-foot trawlers each having a freezing capacity of 15 tons of fish a day and a frozen fish hold about three times the size of the Euridiki. Three other vessels were then converted to freezerships by another Greek fishing concern. They are the Evangelistria I, II, and III. The first, a converted mine sweeper, is 157 feet long, has an ammonia-compression refrigerating plant with a capacity of 120 tons of refrigeration, and will freeze 12 tons of fish per day in four air-blast quick freezers. This vessel has two refrigerated holds with a total capacity of about 230 tons of frozen fish. The Evangelistria II and III are about 177 feet long and have freezing systems very similar to that of the Evangelistria I. They each have a freezing capacity of 14 to 15 tons of fish a day and a storage capacity of about 300 tons of frozen fish. In concluding, Gianesi mentioned that quick-freezing at sea can now be considered as practical and perfectly safe and that it will be developed in the future, especially in areas where traditional fishing activities along the coast are declining.

Elie Arcoulis, Managing Director of The Evangelistria Company, the owner of several of the Greek-freezer trawlers described, commented on some of the aspects of icing versus freezing. He mentioned that the work on the Delaware and the Northern Wave was experimental and therefore cannot be used as a true basis for determining the economics of freezing fish at sea. They have found in Greece that freezing increases the productivity of the vessel and that the frozen fish can be handled faster than can iced fish. Thawing of the fish in air can be accomplished satisfactorily and with little difficulty. In general, Arcoulis was quite enthusiastic about freezing at sea and reported that this process was meeting with considerable success in Greece.

The remaining contributions were concerned with some of the more controversial aspects of freezing fish at sea. Eddie of the Torry Research Station in Aberdeen, Scotland, mentioned that in the Delaware project they were lucky to get away with brine-freezing; this process was tried in Europe many years ago and was found to be unsatisfactory, the fish being of poor appearance and quality. He also mentioned that the results of the Delaware and Northern Wave projects could not be compared directly since there were different experimental objectives for each study and because of the differences in the fisheries. In a more detailed written statement, Eddie made the interesting observation that the Northern Wave fish were soft because of biological factors owing to catch areas, not because of the freezing process. Eddie also pointed out that the costs of unloading frozen fish from the Northern Wave were less than that for wet fish, water-thawing is not acceptable for large cod where appearance and texture are important, fish can be satisfactorily frozen in a pre-rigor condition, dielectric thawing of frozen fish is being investigated in order to reduce thawing time and costs, and the use of freezing at sea reduces the need for high vessel speed; thus a savings in propulsion machinery can be effected. He also emphasized that freezing at sea need not result in slower handling, although one or two extra men may be required. The advantage of maximum utilization of capacity on every trip may result in capital savings in the number of vessels required to produce a given quantity of edible fish. It was most interesting to note that United

States and British investigators while differing on some of the details concerning freezing at sea, were in substantial agreement on many of the major issues.

In other discussions, Rankine of the United Kingdom emphasized that frozen fish should be stored at -20° F. on the vessel. He also stated that the freezing capacity of the Delaware can not be compared directly with that of the Northern Wave because of the iced-buffer storage used on the latter vessel. In addition, he gave some very interesting information on a modified plate-freezing installation for a new freezership.

The problem of consumer acceptability of sea-frozen fish was expressed by several participants. Parkes of England said that in the United Kingdom a 190-foot trawler was outfitted for freezing at sea. The frozen fish consistently sold for less money than did the iced fish, as a result the project was an economic failure. Heinsohn of Germany, the designer of several large stern trawling factoryships, commented that sea-frozen fish while being of excellent quality are still difficult to market in Germany and in many cases they sell for lower prices than do iced fish. There is, however, much more consumer demand for sea-frozen fillets than for sea-frozen eviscerated fish landed in blocks. This point was also stressed by Gow of England in his discussion of the operation of the factoryships Fairtry I and II.

SUMMARY: These discussions emphasize the need for employment of fish preservation and handling practices that are best suited for the particular fishery in question. For example, in certain fisheries, where vessels are now returning to port half empty, freezing fish at sea may be the solution. In other fisheries it may be more desirable because of quality and marketing aspects to keep the fish in a fresh condition using sufficient quantities of ice, or in some cases, refrigerated sea water. There is no doubt that more effective tailoring of fish preservation techniques to meet industry requirements will do much to solve current problems of low production and high costs.

APPENDIX - LIST OF PAPERS PRESENTED AT THE SECOND WORLD FISHING BOAT CONGRESS

Topic: TACTICS

Session: Fishing Methods and Deck Arrangement

PRINCIPAL FISHING BOAT TYPES, by A. C. Hardy, London, E. C. 2, England.

NOMENCLATURE AND SYMBOLS, by H. Svenkerud, Naval Architect, FAO, Rome, Italy.

DRIFT-NETTING: DECK DESIGN AND EQUIPMENT, by J. G. de Wit, Deputy Inspector of Fisheries, Ijmuiden, Netherlands.

GILL NET FISHING: DECK DESIGN AND EQUIPMENT, by Thomas E. Colvin, Naval Architect, Waukegan, Illinois, U. S. A.

LONGLINE FISHING: DECK DESIGN AND EQUIPMENT, by Yoshiaki Kanasashi, President, Kanasashi Shipbuilding Co. Ltd., Shizuoka Prefecture, Japan; Chomatsu Doke, Director, Miho Shipyard Co. Ltd., Shimizu City, Shizuoka Prefecture, Japan; Seigoro Chigusa, Director, Nissin Kogyo Co. Ltd., Nakanoshima, Kita-ku, Osaka, Japan.

POLE AND LINE FISHING: DECK DESIGN AND EQUIPMENT, by Shogo Muramatsu, Chief, Design Section, Yaizu Shipbuilding Co., Ltd., Yaizu City, Shizuoka Prefecture, Japan.

TRAWLING: DECK DESIGN AND EQUIPMENT, by A. von Brandt, Director, Institut für Netzforschung, Hamburg, Germany; C. Birkhoff, Rickmers Werft, Bremerhaven, Germany.

TWO NEW TRAWLERS FOR THE NORTH PACIFIC, by Dayton Z. Alverson, U. S. Bureau of Commercial Fisheries, Seattle, Washington, U.S.A.; Peter G. Schmidt, Jr., President, Marine Construction and Design Company, Seattle, Washington, U. S. A.

DES BATEAUX DE PECHE SICILIENS SPECIALISES (Specialized Sicilian Fishing Boats); by Nito Fodera, Directeur, and Raimondo Sara, both du Centre Experimental Pour l'Industrie de la Peche et des Produits de la Mer, Section Technologique, Palermo, Sicilie; Alberto Cambiano, Architecte Naval, Institut Nautique, Palermo, Sicilie.

Session: Command of Operations

CENTRALIZED CONTROL OF TRAWLERS, by A. C. Hardy, London, E. C. 2, England. H. E. H. Pain, S. G. Brown Ltd., Watford, Herts, England.

Topic: CONSTRUCTION

Session: Scantlings

STEEL AND WOOD SCANTLING TABLES (WESTERN COAST OF U. S. A.), by H. C. Hanson, Naval Architect, Seattle 4, Washington, U.S.A.

SUGGESTED STANDARD SCANTLINGS, by Dwight S. Simpson, Naval Architect, Boston 10, Massachusetts, U. S. A.

COMMENTS ON PAPER NO. 10--SUGGESTED STANDARD SCANTLINGS--SIMPSON, by D. A. S. Gnanadoss, Assistant Director of Fisheries, Madras, India.

Session: New Materials:

GLASS REINFORCED PLASTIC HULLS, by Patrick D. de Laszlo, Director, Halmatic Ltd., Portsmouth, England.

Session: Fish Holds:

THE CARE OF THE CATCH, by G. A. Reay, Director, and J. M. Shewan, both of Department of Scientific and Industrial Research, Torry Research Station, Aberdeen, Scotland.

THE FISH ROOM - ENGINEERING AND ARCHITECTURE, by W. A. MacCallum, Research Engineer, Fisheries Research Board of Canada, Technological Station, Halifax, Nova Scotia, Canada.

ICING VERSUS FREEZING, by Joseph W. Slavin, Acting Chief, North Atlantic Technological Research, U. S. Bureau of Commercial Fisheries, East Boston 28, Massachusetts, U. S. A.

Session: Installation of Machinery:

PROPULSION ENGINES FOR FISHING BOATS, by Ivar Stokke, Head, Department of Internal Combustion Engines, The Technical University of Norway, Trondheim, Norway.

STEAM VERSUS DIESEL, by G. Hopwood, Chief Engineer, Mirrlees, Bickerton and Day Ltd., Cheshire, England; N. W. N. Mewse, Marine Superintendent, J. Marr and Son Ltd., Fleetwood, Lancashire, England.

PROPULSION SYSTEMS FOR MOTOR TRAWLERS, by Franz Süberkrüb, Consulting Naval Architect, Hamburg, Germany.

RECENT TRAWLERS FITTED WITH MULTIPLE REDUCTION GEARS, by Alexandre Chardome, Civil Engineer and Manager, Beliard, Crighton and Co., Ostend, Belgium.

DEVICE FOR RAISING AND LOWERING PROPELLERS, by Keigo Inamura, Chief, Fishing Boat Section; Motojiro Ninomiya, Chief, Engine Branch, Fishing Boat Section; both of Fisheries Agency, Kasumigaseki, Chiyodu-ku, Tokyo, Japan.

Session: Costs of Construction:

AN ANALYSIS OF DIMENSIONS, WEIGHTS AND COSTS, by Harry Benford, Associate Professor; Miklos Kossa, Naval Architect; both of the Department of Naval Architecture and Marine Engineering, University of Michigan, Ann Arbor, Michigan, U. S. A.

Topic: SEA BEHAVIOR

Session: Resistance:

COMMENTS ON HULL FORM DESIGN OF FISHING BOATS, by H. I. Chapelle, Curator, Division of Transportation, Smithsonian Institution, United States National Museum, Washington 25, D. C., U. S. A.

MODEL TESTS OF SOME FISHING LAUNCHES, by Thomas C. Gillmer, Associate Professor of Marine Engineering, U. S. Naval Academy, Annapolis, Maryland, U. S. A.

REVIEW OF B. S. R. A. TRAWLER RESEARCH, by H. Lackenby, Chief Naval Architect, The British Shipbuilding Research Association, London, England.

AN ADVANCED HULL AND PROPELLER DESIGN, by J. Thomas Tothill, Naval Architect, Ship Laboratory, National Research Council, Ottawa, Canada.

STATISTICAL ANALYSIS OF RESISTANCE DATA FOR TRAWLERS, by D. J. Doust, Naval Architect, Ship Division, National Physical Laboratory, Feltham, Middlesex, England.

COMMENTS ON THE PAPER "STATISTICAL ANALYSIS OF RESISTANCE DATA FOR TRAWLERS," by D. J. Doust; by Norio Fujinami, Naval Architect, FAO, Rome, Italy.

THE LOADS IMPOSED BY TRAWLING GEAR, by W. Dickson, Senior Scientific Officer, Marine Laboratory, Torry Research Station, Aberdeen, Scotland.

SOME TURKISH FISHING BOATS, by Ata Nutku, Professor of Naval Architecture, Technical University, Istanbul, Turkey.

Session: Seakindliness:

NEW PERSPECTIVES IN SEA BEHAVIOR, by G. Vossers, Head, Seakeeping Laboratory, Netherlands Ship Model Basin (N. S. M. B.), Wageningen, Netherlands.

BEHAVIOR OF TRAWLERS AT SEA - II, by Walter Möckel, Captain, Naval Architect, Hamburgische Schiffbau-Versuchsanstalt, Hamburg 33, Germany.

REMARKS ON THE SHAPE OF DUTCH COASTAL FISHING BOATS, by W. Zwolsman, Naval Architect, Holland Launch N. V., Zaandam, Netherlands.

TESTS WITH A TRAWLER MODEL IN WAVES, by J. D. van Manen, Under-Director; G. Vossers, Head, Seakeeping Laboratory; H. Rijken, Naval Architect; all of Netherlands Ship Model Basin, Wageningen, Netherlands.

THE PRISMATIC COEFFICIENT, by Jan-Olof Traung, Chief, Fishing Boat Section, Rome, Italy.

TRAWLER FORMS WITH BULBOUS BOWS, by D. J. Doust, Naval Architect, Ship Division, National Physical Laboratory, Feltham, Middlesex, England.

TESTS OF FISHING BOAT MODELS IN WAVES, by Kaname Taniguchi, Chief, Nagasaki Experimental Tank Laboratory, Mitsubishi Shipbuilding and Engineering Co. Ltd., Nagasaki, Japan.

Session: Stability:

NOTES ON STABILITY, by Atsushi Takagi, Professor, Department of Naval Architecture, Faculty of Engineering, University of Tokyo, Bunkyo-ku, Tokyo, Japan.

TRANSVERSE STABILITY OF TUNA CLIPPERS, by John Randolph Paulling, Jr., Assistant Professor of Naval Architecture and Marine Engineering, University of California, Berkeley, California, U. S. A.

A METHOD TO DETERMINE FREEBOARD IN RELATION TO STABILITY, by Olgierd Jablonski, Naval Architect, The Maritime Institute, Gdansk, Poland.

SAFETY FROM CAPSIZING, by Kurt Wendel, Professor of Ship Design and Theoretical Naval Architecture, Technical University of Hannover, and University of Hamburg, Germany.

Session: Safety at Sea:

CAUSES OF ACCIDENTS, by Wm. C. Miller, Naval Architect and Marine Engineer, Wm. C. Miller and Associates, San Diego 1, California, U. S. A.

Topic: PRODUCTIVITY

Session: Symposium of Boat Types:

DEVELOPMENT OF A BOAT FOR INDIA'S SURF COASTS, by Peter Gurtner, Naval Architect (India), Organization of the United Nations FAO, Rome, Italy.

COMMERCIAL OUTBOARD FISHING CRAFT, by David D. Beach, Naval Architect, Waukegan, Illinois, U. S. A.

PHILIPPINE FISHING BOATS, by Santos B. Rasalan and J. B. Malig, both of Bureau of Fisheries, Manila, Philippines; Ildefonso Lachenal, President, Luzon Slipways, Navotas, Rizal, Philippines.

TRADITIONAL JAPANESE SMALL FISHING CRAFT, by Yoshinori Otsu, Chief; Nobutatsu Yokoyama, Chief, Hull Branch; Tsutomu Kobayashi, Naval Architect; all of Fishing Boat Laboratory, Fisheries Agency, Tsukishima, Tokyo, Japan.

DESIGN AND MASS PRODUCTION OF SHRIMP TRAWLERS, by L. C. Ringhaver, President, Diesel Engine Sales, Inc., St. Augustine, Florida, U. S. A.

DEVELOPMENT OF A TRAWLER OF UNORTHODOX DESIGN, by E. C. B. Corlett, Managing Director, Burness Corlett and Partners Limited, Naval Architects and Marine Consultants, Worting and London, England; J. Venus, Managing Director, Seawork Limited, London, Managing Director, P. K. Harris (Shipbuilders) Ltd., Appledore, Managing Director, T. E. Mitchison Ltd., Gateshead-on-Tyne, England.

THE NETHERLANDS POST-WAR FISHING FLEET, by P. Boogaard, Chief, Shipping Department, Ministry of the Building Industry, Rotterdam, Netherlands.

DESIGN STUDIES FOR STERN TRAWLERS, by Heinz Heinsohn, Rickmers Werft, Bremerhaven, Germany.

DIESEL WHALE CATCHERS, by Tomijiro Nakata, Chief, Design Division, Hayashikane Shipbuilding and Engineering Co. Ltd., Shimonoseki City, Yamaguchi Prefecture, Japan.

MODERN REFRIGERATED FACTORYSHIPS IN JAPAN, by Shigeru Sato, Chief, Design Section, Hitachi Shipbuilding and Engineering Co. Ltd., Innoshima Shipyard, Innoshima, Hiroshima Prefecture, Japan.

Session: Choice of Size and Type:

CHOICE OF BOAT TYPE AND SIZE FOR POLISH DEEP-SEA FISHERIES, by Jerzy Swiecicki, The Maritime Institute, Gdansk, Poland.

PROPULSION AND PROCESSING MACHINERY FOR DEEP-SEA TRAWLERS, by G. C. Eddie, Torry Research Station, Aberdeen, Scotland.

NAVIRES FRANCAIS DE GRANDE PECHE SALEE, by E. R. Gueroult, Architecte Naval, Paris 2e, France.

DES BATEAUX DE PECHE SICILIENS SPECIALISES, by Alberto Cambiano, Architecte Naval, Institut Nautique, Palermo, Sicilie; Vito Foderá, Directeur, and Raimondo Sará, du Centre Expérimental pour l'Industrie de la Pêche et des Produits de la Mer, Section Technologique, Palermo, Sicilie.

POINT DE VUE d'UN ARMATEUR DE BATEAUX DE PECHE, by L. Soublin, President de la Federation des Armateurs a la Peche, Fecamp (Seine-Maritime, France).