facturing plants and localities in which they are situated, as well as the characteristics of the products themselves, are being made but slowly.

As competition increases and the producer's margin is reduced, the industry will probably find itself being forced to adopt more economical production practices. Taking advantage of everything that is known about preventing waste in processing plants can pay big dividends. Spoilage and waste can well be given a greater share of the southern producer's attention. Scrap fish, caught in connection with the vast shrimp trawling operations, offer potential sources of raw material for reduction into fish meals and the recovery and condensation of solubles. In so doing, fishermen's incomes would be supplemented, while processors could probably reduce costs of major profit items by utilization of these present waste products. Among the products which might be profitably extracted from the wastes are animal foods, protein hydrolysates for convalescent feeding, amino acids, adhesives, chemicals, drying oils, and chemical products. Research in governmental and private laboratories is proceeding along these lines and the time may not be too far distant before such wastes will have many uses.

Truly the fisheries are at the merchandising crossroads. The fishing industry has rarely been characterized by initiating outstanding advances in processing and merchandising. Now, however, it is a matter for the fishing industry to adjust itself to modern consumer demands and efficient operating practices or find itself out-priced, out-packaged, out-retailed, and out-itemed from the food market.

Packaging And Marketing Airborne Seafoods

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Consumption of Fresh Seafoods

AIR CARGO STUDIES at Wayne University indicate that people in this country would like to consume an additional one-half billion pounds of strictly fresh fish. A goodly portion of this 62 per cent increase above present consumption could be achieved if improved methods of producing, cooling, packaging, transporting and merchandising were employed to bring to market in prime condition the products of the sea.

The United States can hardly be called a nation of fish eaters when per capita consumption of fresh fish—as distinguished from processed fish—amounts to only 6.9 pounds annually. Even with the inclusion of canned, smoked, and salt fish and the sportsman's catch thrown in for good measure, our annual per capita consumption of 14.8 pounds is not impressive. In comparison with fish consumption in other countries the United States ranks fourteenth among the nations although in production it is exceeded only by Japan. Furthermore, this low national average consumption is by no means evenly distributed. Fish is eaten most nearest its sources of supply. Residents of tide water states eat fresh fish well above the national average. The states of Massachusetts and New York, for example, eat an average of approximately 13 pounds per capita.

As the distance between the consumer and the source of supply increases, consumption drops off until we find seven West North Central states averaging

only 3 pounds per capita and Oklahoma and Idaho down to approximately 2 pounds.

In general it may be stated that the feeble showing of fresh fish on the American menu is due to poor merchandising and the adverse effect on *quality* of existing methods of packaging, handling, transportation and temperature control.

The *quality* factor must be placed at the top of the list, for no amount of smart merchandising or of consumer education as to the selection and preparation of fish can atone for poor market quality.

Properly speaking, there is hardly such a thing today as a strictly fresh salt water fish at inland markets. As a rule the "freshest" salt water fish served in a midwestern home is 8 to 12 days old. Unlike meat, which requires a period of aging and therefore gains in flavor and texture with the passage of time, fish begin to deteriorate immediately upon leaving the water. Then, too, throughout the period of storage, shipping and marketing in the conventional manner, melting ice leaches out valuable minerals, proteins and flavor. Few species retain their high sea flavor and freshness beyond six or seven days. After that period of time they begin to develop stale odors.

Objectionable odors given off in the cooking of stale fish, or that remain on the housewives' hands from handling, retard consumption and account for some of the public disdain toward fish. Evidence of this is found in a national advertisement that recently used a housewife's fish cooking dilemma as the theme for its copy. In cartoon fashion this advertiser, one of the "good-air" makers, presented the happy solution for objectionable odors that develop in homes when fish are cooking. The advertisement pictured the housewife in a gas mask saying "Guess I better spend the evening in my gas mask." Next frame shows the fish cooking in an open frying pan on top of an electric stove. At this point, hubby arrives on the scene holding his nose and saying, "I used to think I liked fish—but phooey!" "I know, dear," said wife, "but what can I do??" Meditating she says to herself, "I guess I just can't cook fish any more, Hal always complains." In the next frame a neighbor informs the worried wife about the product that rids the home of objectionable odors. On a subsequent evening hubby comes home and not smelling anything cooking remarks, "Going to eat out tonight, Irene? I don't smell dinner cooking." "Ah, ha," replies Irene, "WE HAVE FISH, but you can't smell it, thanks to Good-Aire."

Does the fishery industry know how many persons are not eating fish because its preparation and cooking develops objectionable odors in the home? It is probable that a very considerable number of households in this country are being robbed of the pleasures of eating fresh fish not only because it usually lacks its original high sea flavor, but also because fish that is not fresh fouls up the house in preparation and cooking.

On this home odor problem there is some first-hand experience to report. The writer has been in the kitchen countless times while fresh fish, shipped by air, have been cooking. Only a little over a week ago, for example, 150 pounds of fresh shrimp were shipped by airfreight from Sea Island, Georgia. These shrimp were cooked at a private club in Detroit. In the small kitchen at the time these shrimp were cooking the odor that came off while they were in the boiling water was no more noticeable than if they had been cooking rice.

Experiences such as this have convinced the writer that you can ship into Detroit and other inland markets strictly fresh seafood *if* it is promptly precooled, properly packaged and shipped quickly to its destination by airfreight.

Ten experimental air shipments of shrimp have been made These were kitchen-tested on each of several days after their arrival. Likewise 65 experimental air shipments of other kinds of seafoods have been made—salmon from Alaska, dungeness crabs from Washington, oysters from Virginia, pompano from Florida, brook trout from Montana and Colorado, shad from Connecticut, and lobsters and haddock from Massachusetts, etc.—in all a total of approximately 75 experimental shipments to develop and test the principles underlying a successful packaging and air transport operation in seafoods.

It is not meant to give the impression that the last word has been said on methods of packaging and airfreighting seafoods. Rather, a modest beginning has been made and perhaps the beginning paragraphs have been written in the chapters yet to be produced on the possibilities in new methods of packaging and transporting these perishable products.

Commercial Operations

When the study "Markets for Airborne Seafoods" was begun back in 1945, no known air shipping of seafoods was then under way. Since this study, which has included 75 experimental air shipments of seafoods, various air carriers have undertaken to develop traffic in fresh fish. Most notable in this connection are the experiences of American Airlines in their shipments of lobsters and other kinds of seafoods from Newfoundland into Boston, New York, Cleveland and other inland markets, and Meteor Airlines operation from the Great Lakes into New York. Other carriers such as United Air Lines, Slick Airways, Chicago and Southern Airlines and Eastern Airlines also have shipped seafoods to some extent.

Perhaps the most significant airfreight operation in fresh fish at the present time is that of Meteor Airlines which is flying fresh fish from Michigan's Great Lakes into New York City. Last July representatives of the several interests involved came out to Wayne University after reading the research reports. Soon after this conference, 50,000 to 75,000 pounds of whitefish, pickerel and other fresh water species were being flown weekly from ten different points in the Great Lakes area. The fish are received in New York by fresh water wholesale fish receivers and the Great Atlantic and Pacific Tea Company.

The operation runs something like this: the fish are taken from the Lakes today, eviscerated, precooled (but not adequately), placed in light wooden wire bound containers, lightly iced (5 pounds of ice to 50 pounds of fish), trucked to the airport and loaded during the early part of the night—130 boxes per plane load. The shipment is then flown to New York where it is unloaded by means of a conveyor utilizing gravity to move each individual box of fish from the plane into the waiting truck. The fish are then trucked to the receivers located in the Fulton market in New York City so as to arrive between 6 and 7 a.m., and from there they move into retail outlets. In other words these fish are on the retail market 24 to 28 hours after being taken from the water.

Previously nearly all of the fresh fish from the Great Lakes moved into New York via railway express. With the introduction of airfreight, one full market-day is saved and added to the commercial life of the product. And one day, especially if it is the fourth to the sixth day, can mean a great deal commercially because of its effect upon the eating quality of the fish.

The costs connected with this significant operation are of interest. In general the costs per net pound of fish via airfreight are reported by Mr. Joseph Scott, coordinator of the operation, to be identical to the costs of shipping by rail express. Broken down these costs are as follows: $1.00 per hundredweight for

packaging; $1.00 for trucking (50c at origin and 50c at destination); $4.00 per hundredweight for the airline haul, airport to airport—a total cost of $6.00 per hundredweight.

Of course, the economics of the situation are not always so favorable to the air carrier and the fishery industry as is the case in the Great Lakes-New York operation. In this instance, the air carrier has specialized in a short-haul operation from the East Coast into Detroit and other nearby cities. Traffic out-bound from New York has far exceeded traffic for the return trip. Generally, the carrier was operating with very light loads or no loads at all on the return trip from the West to the East. Traffic in fresh fish from the Great Lakes, therefore, provides a full load for the return trip. Since it costs very nearly as much to fly a plane empty as loaded, it is obvious that even a low rate operation could be very beneficial to the carrier in this instance.

There are other situations over the country in which the economic factors seem to fall into the lap of the air carrier in an advantageous manner. American Overseas Airlines, for example, have a number of planes daily crossing the North Atlantic via Newfoundland to the States. By the time these planes reach Gander in Newfoundland, they use up several thousands of pounds of gasoline which must be counted as a part of their total permissible load in their taking off, let us say at Shannon. Being able to carry approximately 1,000 less gallons of gasoline, or 6,000 pounds, from Gander on to New York, makes room for 2 to 3 tons of cargo on this last leg of the trip. When it is realized that there are 20 such crossings of the Atlantic each day, this means that 50 to 100 tons of seafood could be carried daily from Newfoundland down to Boston and New York with but very little extra expense to the airline.

Other air carriers may find that they have a similar economic situation in their operation. For example, Pan American flying from the South may have unused capacity from the Dominican Republic or Cuba into Florida and from points in Alaska to Seattle.

If an airfreight operation in seafoods is to be successful, however, there must be something in addition to air cargo space. Especially must there be an abundant supply of seafood *suitable* for air shipment.

Propensity of Seafoods to Air Shipment

Factors which weigh with force in the determination of the kinds of fish most amenable to air shipment are consumer preference, price per pound, volume of catch, seasonal variation in the catch, and rate of perishability. All of these factors were used in devising the formula to measure the disposition of various species of seafoods to air shipment.

Consumer preference surveys conducted in Kansas City, Chicago and Detroit gave consumers an opportunity to express their preferences for various species of fin and shell fish most desired in air shipment. Top ten on the list were shrimp, pompano, red snapper, salmon, lobsters, swordfish, oysters, sturgeon, crabs and scallops—70 per cent of which are found in the waters of the Gulf and South Atlantic.

Price per pound was given considerable weight in the propensity formula because previous experience in predicting air cargo potentials showed that relatively high priced perishables benefit doubly from high speed transportation. Rate of perishability and seasonal variation in the supply also weighs importantly.

Using a weighted formula nearly 100 species of fish were given an air propensity rating and grouped into three classifications of air propensity: "excellent," "good," and "fair."

The species judged most likely to lead the air cargo parade are sturgeon, brook trout, pompano, swordfish, whitefish, oysters, crabs, lobsters, scallops, clams, shrimp, flounder and red snapper. All of these climbed into the top propensity bracket.

It is significant that almost all (95 per cent) of the total annual catch of shellfish rate "excellent" on the propensity index and the remaining 5 per cent rate "good." In this field lies a vast potential for airfreight. The air transporter of seafoods should be interested particularly in those species which show highest propensity to air carriage and that, at the same time, are caught in sufficient quantities to provide worthwhile loading over a long season of time.

Total annual production of seafoods in continental United States judged "excellent," or highly amenable to air shipment, is 433 millions of pounds. Not all seafoods are adapted to air carriage at this time. Of those that are adapted to air shipment, the highest concentration is to be found in the waters of the Gulf, Caribbean and South Atlantic. *Fifty per cent of the seafood production in continental United States having a high propensity to air carriage is found in these southern waters.* Seafood production in this area strongly inclined to air carriage amounts to upwards of 215 millions of pounds, most of which is shellfish, shrimp accounting for upwards of 70 per cent of the total.

Fresh fish and shellfish production by areas and air propensity classes for continental United States is found in Table 1. A breakdown of fresh fish and shell fish production for the South Atlantic and Gulf by air propensity classes appears in Table 2.

TABLE 1

SUMMARY OF AVERAGE 1939-1941 CATCH OF FRESH FISH AND SHELLFISH BY PRODUCTION AREAS AND BY AIR PROPENSITY CLASSES *
(IN THOUSANDS OF POUNDS)

PRODUCTION AREA	EXCELLENT		GOOD		FAIR		TOTALS	
	POUNDS	PER CENT	POUNDS	PER CENT	POUNDS	PER CENT	POUNDS	PER CENT
New England	38,258	8.8	74,328	18.2	498,958	57.1	611,544	35.64
Middle Atlantic	29,898	6.9	33,556	8.2	44,249	5.1	107,703	6.28
Chesapeake Bay	87,133	20.1	20,390	4.9	44,218	5.1	151,741	8.84
South Atlantic & Gulf	215,233	49.7	84,213	20.6	5,351	.6	304,797	17.77
Pacific	34,472	8.0	77,025	18.9	110,291	12.6	221,788	12.93
Great Lakes	25,512	5.9	41,117	10.1	13,555	1.6	80,184	4.67
Mississippi River and Tributaries	5	.6	10,267	2.5	31,779	3.6	42,051	2.42
Alaska	2,549	.6	67,808	16.6	125,619	14.3	195,976	11.42
TOTALS	433,060	100.0	408,704	100.0	874,020	100.0	1,715,784	100.00

*SOURCE: Larsen, Spencer A.; Reitz, William; Burgum, Katherine K.; *Markets for Airborne Seafoods*, (1948), Wayne University Press, Detroit. p. 66.

If, then, there exists (1) an air carrier who is interested in seafood traffic and (2) quantity production of seafoods having a high propensity to air carriage, the next problem is their preparation and packaging for shipment.

Packaging Airborne Seafoods

Airfreight calls for drastic changes in the methods of packaging seafoods. Generally it is advisable to eliminate dispensable weight, such as viscera, heads, ice, and heavy wooden containers.

Fish now are transported by surface means in cumbersome wooden boxes and barrels of varied shapes, dimensions, and weights. These containers range in size from 50 to 200 pound capacity, a 100 pound capacity box being quite generally used. This size of container was used as the unit of comparison in the cost study.

A wooden container which holds 100 pounds of fish weighs 27 pounds itself and calls for about 50 pounds of ice, being re-iced when necessary. The shipping of 100 pounds of fish in the conventional manner requires, then,

TABLE 2

AVERAGE 1939-1941 CATCH OF FRESH FISH AND SHELLFISH FOR THE SOUTH ATLANTIC AND GULF AREAS BY AIR PROPENSITY CLASSES * (IN THOUSANDS OF POUNDS)

PROPENSITY CLASS					
EXCELLENT		GOOD		FAIR	
SPECIES	POUNDS	SPECIES	POUNDS	SPECIES	POUNDS
Lemon Sole	79	Bluefish	3,314	Croaker	4,849
Pompano	685	Blue Runner	746	Scup	76
Shad	1,287	Butterfish	56	Buffalofish[1]	60
Snapper, Red	7,212	Drum: Black	1,266	Carp[1]	366
Striped Bass	440	Red	2,258		
Clams: Hard	1,342	Flounders:			
Crabs: Hard	29,513	Blackback	249		
Soft and Peelers	468	Fluke	157		
Lobsters: Spiny	411	Gray Sole	145		
Oysters: Eastern	24,332	Yellowtail and Dabs	682		
Scallops: Bay	158	Grouper	6,024		
Shrimp	149,306	Kingfish or King Mackerel	3,746		
		Mullet	36,923		
		Sea Trout: Gray	3,237		
		Spotted	6,827		
		Sheepshead	966		
		Spanish Mackerel	6,908		
		Spot	5,176		
		Catfish and Bullheads[1]	5,533		
Totals	215,233		84,213		5,351

1 Fresh water fish

*SOURCE: Larsen, Spencer A.; Reitz, William; Burgum, Katherine K., *Markets for Airborne Seafoods*, (1948), Wayne University Press, Detroit. p. 64.

about 77 pounds of container and ice or a minimum of 70 per cent of the net weight of the fish.

Wooden containers are purchased at an average cost of 1¼c for each pound of seafood capacity; a box designed to carry 100 pounds of seafood costs in the neighborhood of $1.25.

Obviously this conventional fish pack is unsuited for air shipments, and indeed it is doubtful if it is the best method for shipment by relatively rapid means of surface transportation. Conventional methods of packing fish are found wanting in air shipments because:

(1) There is too much useless weight.
(2) Water from melting ice damages other cargo.
(3) Melting ice and open containers result in objectionable fish odors and corrosive damage to planes and other vehicles.

In an effort to develop a new principle for the shipment of fresh seafoods, air cargo research at Wayne University enlisted the aid of the Goodyear Tire

and Rubber Company and the Hinde and Dauch Paper Company. After a great many trials of various methods of preparing seafood for air shipment, a light-weight corrugated container was developed. This light-weight container is moisture proofed with a Pliofilm envelope and insulated with Plycraft. The box holds about 45 pounds of seafood which, before packing, is precooled to 32 degrees F. This box weighs 4½ pounds or 10 per cent of its net load. Packed for shipment, the temperature rise in this package ranges from .5 of a degree F. to 1 degree F. per hour when the outside temperature is between 60 degrees and 90 degrees F.

When packed with seafood, the Pliofilm envelope is sealed so as to prevent moisture from getting to the container thereby lessening its strength and insulating efficiency. Both the inner and outer containers are closed securely with strips of tape.

Comparison of Costs

A comparison of the total costs of shipping 100 pounds of fresh fish via scheduled air carriers from different points of origin to Detroit is presented in Table 3. Both air and surface hauls include pick-up and delivery. The shipping costs include the expenses of packaging materials for which the conven-

TABLE 3

COMPARATIVE COSTS OF SHIPPING SEAFOODS BY RAIL EXPRESS AND AIRFREIGHT FROM REPRESENTATIVE CITIES TO DETROIT—(NOV. 1949)

	Cost of Transportation, Ice (for Rail Express only) and Box Per 100 Pounds of Net Weight of Fish	
ORIGIN	RAIL EXPRESS*	AIRFREIGHT*
New York	$5.00	$6.00
Boston	5.91	6.01
Norfolk	6.07	6.40
Jacksonville	9.01	10.35
New Orleans	9.01	11.30

**Both services include pick-up and delivery.*

tional wooden box and ice runs to $1.25 per 100 pounds of net fish and for the iceless insulated pack $1.50 per 100 pounds or an additional packaging cost of 25 cents per 100 pounds for air shipment.

In the cost comparison a shipment unit of 177 pounds is used for rail express which consists of 100 pounds of fish, 50 pounds of ice and 27 pounds of box weight.

A unit of 100 pounds is used for airfreight which consists of 91 pounds of fish and 9 pounds of container.

Cost comparisons for shipping facilities and transportation from several points of origin to Detroit show some, but relatively small, variation depending upon the points of origin and the type of air carrier employed. As already stated, the total costs of shipping fresh water fish from the Great Lakes to New York are reported to be the same for airfreight and for rail express when transported by a contract air carrier.

Generally, as will be seen in Table 3, the adjusted costs of shipping fresh fish from Boston, Norfolk, Jacksonville, and New Orleans, to Detroit via airfreight are only slightly higher than for rail express. As recent as four years ago costs of shipping by air were more than five times what they are today.

A dealer who is considering shipping seafoods via airfreight should remem-

ber that the methods and standards of such an operation are vastly different. Useless weight must be eliminated, the temperatures of the product kept in the thirties, and time saved.

A step by step guide for the packaging and marketing of airborne seafoods together with detailed information on production, consumption, costs and propensity to air carriage appears in the study "Markets for Airborne Seafoods." Developments in the industry since publication of this study indicate, however, that a realistic research job has been done. It is believed to be a blueprint that will work if sensible adaptations are made in it.

An Economic Survey of the Texas Fishing Industry

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THE TEXAS GAME, FISH AND OYSTER COMMISSION MARINE LABORATORY made an attempt to survey the dollar value of the Texas fishing industry. Little was known of the economic condition of the fishing industry along the Texas coast because Stevenson's work (1863) is, of course, outdated. The expansion of the frozen food industry has made the work of Woolrich (1946) inaccurate for general use. The work of Woolrich and Stevenson was and is of great value but with the change of the economic standards after World War II there was a need for a re-valuation of the Texas fishing industry.

McDaniel (1949) estimated that the commercial seafood industry had an investment in Texas amounting to $40,325,000.00. This estimate considered not only the investment along the coast but also the investment of many inland retailers, wholesalers and freezing plants dealing with marine products. The survey by the Marine Laboratory did not include these inland investments nor did it include seafood cafes inland or on the coast. McDaniel's estimate of the value of 2,220 fishing boats is only $4,400,000.00, which is very conservative. The number of fishermen on fishing boats is higher than reported in this survey but probably includes many of the part-time fishermen in skiffs.

Under the direction of Mr. J. L. Baughman, Chief Marine Biologist, Texas Game, Fish and Oyster Commission, Mr. Byron B. Baker, Jr., Mr. F. M. Daugherty, Jr. and the author contacted the owners of the various commercial fish houses, boats, shipyards and freezing plants. A standard questionnaire form was used to record the information given us. Each owner was assured that the information would be used to compile totals for each area and that the information would not be used singularly for any one house, boat, shipyard or freezing plant. In many cases the information was taken from the company books. All information is based on the calendar year 1948.

The extent of the fishing industry made it impossible to cover every detail and the values expressed represent only the basic value of the industry. In the expressed totals the figures were rounded off to the nearest one hundred or one thousand dollars depending on the figure in question.

The figures in Tables 1 and 2 represent only the major items considered. Many minor items are not included.

Commercial Fish Houses

In 1948 there were 83 commercial fish houses on the Texas coast with a total investment valuation of $2,583,000.00. The payroll for the permanent em-