WHEAT STUDIES

OF THE

FOOD RESEARCH INSTITUTE

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PROJECTED WATERWAYS IN NORTH AMERICA AS RELATED TO EXPORT OF WHEAT

THREE waterway improvements designed to serve North American wheat export trade are in operation, in progress, or in contemplation. The Hudson Bay route via Churchill was opened for the first shipments in the fall of 1931. Improvements of the Mississippi and its principal tributaries are in progress, designed to extend the region served by barge shipments to the Gulf. The project for the St. Lawrence seaway has reached the stage of formal treaty between the United States and Canada. Advocates of these improvements, to be made toll-free at public expense, have long held out hopes of substantial gain to wheat farmers of the United States and Canada.

We hold optimistic forecasts of the early or deferred results to wheat growers to be unwarranted. The Hudson Bay route seems likely to have significance mainly for Saskatchewan. The Mississippi route will mainly divert export shipments of Kansas and Nebraska wheat from present rail or rail-and-lake routes. Two active export areas—Texas-Oklahoma and the Pacific Northwest—are not involved. The St. Lawrence seaway would probably not reduce costs of shipments to Europe by over 5 cents a bushel during the season of open navigation, and the weighted annual saving on export wheats would be less. Whatever savings are made would be divided, in proportions varying from year to year, mainly between the growers of export wheats affected and European consumers.

We see little prospect that the net gain to American wheat growers as a whole would be significant. Canadian wheat growers would stand to gain more, unless or until expansion of acreage wiped out the price benefit. The rate of expansion of wheat growing in the Prairie Provinces of Canada might be the determining factor. There is a fair possibility that, with expansion of acreage in Canada, farm prices of wheat in the United States might tend to be lowered by the opening of the St. Lawrence seaway. Some time in the 'forties the divergent views on incidence will be tested in the crucible of experience.

STANFORD UNIVERSITY, CALIFORNIA

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The central feature of the series is a periodic analysis of the world wheat situation, with special reference to the outlook for supplies, requirements, trade, and prices. Each volume includes a comprehensive review of the preceding crop year, and three surveys of current developments at intervals of about four months. These issues contain a careful selection of relevant statistical material, presented in detail in appendix tables for reference purposes, and in summary form in text tables and charts.

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The series is designed to serve the needs of all serious students of the wheat market, in business, government, and academic circles, by summarizing and interpreting basic facts and presenting current developments in due perspective. The special studies are written not merely for students of the wheat market, but as well for various groups of readers who are especially concerned with the fields discussed.

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PROJECTED WATERWAYS IN NORTH AMERICA AS RELATED TO EXPORT OF WHEAT

I. INTRODUCTION

The conflict between waterways and railways is as old as the steam locomotive. Complementary in theory, waterways and railways became competitive in practice and in politics. The railways were developed largely by private capital; waterways have usually been state projects. Ever since this country became a heavy exporter of grain, wheat growers have waged with the rail carriers a contest over freight rates. Whatever the price of wheat and whatever the freight rates, wheat growers have contended that the transportation charges on wheat were in excess of the cost or the value of the service. Whenever farm wheat prices were low, revolt against freight rates was intensified. The changes in rates during and since the war have not served, in the opinion of growers, to improve the absolute or relative position of wheat.

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During the 'eighties and 'nineties, American export wheats competed in world markets largely with the wheats of Russia, the Danube countries, and India. These export wheats had relatively short rail hauls to seaboard. At that time, also, our exports from the eastern part of the hard spring-wheat belt had a relatively short haul to Duluth. Significant changes occurred around the turn of the century. These included the westward extension of the growing of spring wheat, the rapid expansion of wheat growing in the hard winter-wheat belt, and the extensive development of wheat growing in Canada, Argentina, and Australia. The extensions of wheat growing in North America implied longer rail hauls to seaboard; the new wheat-growing areas of Argentina and Australia lay relatively close to seaboard. These relations were unfavorable to export of North American wheat, and provoked renewed agitation for lowering of freight rates.

A crucial turn in the situation has resulted from the operations of the Panama Canal. The effects of this short-cut were not foreseen; probably the inevitable effects have been exaggerated by competition. American railways are not permitted to engage in our coastwise ship trade. Foreign ships are not permitted to operate in American coastwise traffic. These restrictions left it in the hands of unregulated domestic steamship companies operating between the two coasts to combine to maintain high freight rates. But just the opposite has occurred. Rates from coast to coast have been so low as to have deflected a large volume of freight from the transcontinental rail carriers. One effect has been to favor industries in seaboard states at the expense of those in interior states. When the Mississippi Valley came to realize that the Panama Canal, *in effect,* had shortened the traffic distance from coast to coast and had lengthened the traffic distances from the Mississippi Valley to the coasts, this provoked an agitation for compensatory routes. The grain growers thus secured active support from a hitherto neutral group, the manufacturers and merchants in the Mississippi Valley. This combination of rural and urban advocacy, supplemented by the support accorded to projects of water transportation by three successive national administrations, explains the scope and force of the present movement.

In Canada the more recent agitation for waterways may be said to have been based on the realization that lower export rail rates were not obtainable. The export rates on wheat from the Prairie Provinces of

Canada are considerably lower than comparable rates in the United States. The railways in Canada belong either to the privately-owned Canadian Pacific system or to the government-owned Canadian National system. The private railway has been relatively prosperous, but the state railway has incurred heavy deficits. Since rates must be the same on both systems, further reduction of wheat rates would imply increased subvention by the state to the national system. Under these circumstances, the Prairie Provinces prevailed upon the government to establish an export waterway. While the farmers in our hard spring-wheat belt looked with envy on the lower freight rates charged on wheat moving out of the Prairie Provinces of Canada, the Canadian farmers revolted against them and acted to open up a Hudson Bay route.

The improvement of waterways may have other objectives than navigation. Flood control, irrigation, generation of power, and disposition of sewage may be objectives which, in a particular project, are of equal or larger importance. Whenever the objectives are several, advocacy is greatly facilitated; but the analysis (and the ultimate accounting) is correspondingly confused. In the navigation projects here to be considered, flood control is prominent in one, level regulation and generation of power in another; irrigation is not involved.

Hydroelectric power has been regarded as justifying public investment, on which a return may be expected. The outlays for disposal of sewage, control of flood, and improvement of navigation have been regarded as proper debits against public funds, invested for the general welfare rather than for pecuniary return. It is sought to provide interior waterways as free routes of traffic. The question of the effects on private railways and state highways of diversion of traffic to free waterways has been generally dismissed with broad statements that the country is growing and has the transportation needs of an expanding population, and that the various forms of transportation will find equitable and remunerative levels.

In the brief examination here to be undertaken we confine ourselves to a cursory survey of the export traffic in North American wheat, followed by a non-technical description of the waterways undertaken and proposed. We shall then examine the saving sought to be attained and the division of the corresponding gain between producers, intermediaries, and consumers. The problem is largely one of export trade, since the improvements in navigation under consideration are mostly from the interior to seaboard and are designed to unify, or at least to integrate, the interior and ocean stages of export movements. The proponents of waterways have appealed to wheat growers for support of their projects, in designating wheat as one of the commodities whose movement would be facilitated and cheapened. Wheat growers of the United States, frustrated in the application of the Hoch-Smith resolution (by decision of the United States Supreme Court), have intensified their support of development of waterways. In our view, export waterways hold little promise for American wheat growers, but have a different meaning in Canada. We shall endeavor to indicate the reasons for this view, without entering exhaustively into technical considerations. We make no attempt to review the literature on the controversy.

II. THE WHEAT REGIONS CONCERNED IN EXPORT TRADE

The great interior (properly called "mediterranean") wheat region of North America[1] extends from Texas to the Peace River of Alberta. In the United States this wheat region extends from the western slope of the Alleghenies to the eastern slope of the Rocky Mountains; in Canada it extends from longitude 95° W. to the Rocky Mountains. The extent of the region and the magnitude of the exportable surplus have brought into increasing prominence the question of export transit. For half a century attempts have been made to shorten the rail haul and lengthen the water haul;

[1] The Pacific Coast wheats are not involved, and those east of the Alleghenies may be ignored for the purpose in hand.

the spokesmen of wheat growers have long portrayed the development of waterways as indispensable to the lowering of transit costs. It is a doctrine of the Canadian Prairie Provinces that part of the export wheat ought to go out most cheaply over the Great Lakes, another part out of Hudson Bay, and still a third part through Vancouver, to secure a relative lengthening of the water haul and shortening of the rail haul, with the dividing lines of these shipment regions adjusted according to circumstances from year to year. Winter makes trouble on all routes. The central American wheat region has also three water outlets—over the Great Lakes, down the Mississippi, and direct from Gulf ports. We lack any Pacific outlet comparable with Vancouver for wheat grown east of the Rocky Mountains. Galveston in one sense is comparable with Vancouver, but in another sense the Texas ports rank with the ports on Puget Sound in their relation to export wheat.

From the beginning of significant exports from the upper Mississippi Valley, which long antedated Canadian exports, vessels on the Great Lakes competed with rail shipments. Out of the exigencies of operations on the Great Lakes grew the system of trading in wheat futures. The Erie Canal had the purpose, among other things, of extending water transportation of wheat to New York. Impediments to transit from Lake Superior to Lake Huron, from Lake Huron to Lake Erie, and from Lake Erie to Lake Ontario were gradually reduced by appropriate constructions, of which the new Welland Canal was the last step.

With the development of active export of wheat from Canada arose a system of cross-shipments, whereby American wheat went out via Montreal as well as via American ports, while Canadian wheat went out via American ports as well as via Montreal. With Buffalo as the chief diversion point, this cleavage of the wheat export traffic, mostly seasonal in character, arose from circumstances which were widely misunderstood or misconstrued. In each country the advocates of a national waterway have utilized this circumstance of the wheat export trade in support of their propaganda.

The states whose export of wheat might be benefited by waterways are Michigan, Ohio, Indiana, Missouri, Iowa, Minnesota, the Dakotas, Montana, Nebraska, and Kansas. The importance varies greatly with the different states; at present these exports pass out by different routes in accordance with varying circumstances, one of which is the closed season on the Great Lakes. Since the war, the lines separating these various traffic flows have fluctuated from time to time in accordance with changes in the rate structures and variations in Atlantic and Gulf ocean freight charges.

Ocean freights on grain have usually been low compared with land freights. With a freight rate per bushel of 15 cents from St. Louis to Baltimore and of 24 cents from Omaha to New York, an ocean freight rate of sometimes no more than 5 cents to Liverpool has made the land freight look high. Farmers in North Dakota have found that it costs close to 20 cents to ship a bushel of grain to Duluth, 2 cents from Duluth to Buffalo, then 9 cents from Buffalo to New York, and possibly 6 cents to Liverpool. A freight rate of 20 cents from points in Oklahoma and the Panhandle of Texas to Galveston has loomed large when the ocean rate from Galveston to Liverpool was 6 cents. In Canada the land rates from Alberta to Vancouver (20 cents from Calgary) compared with the ocean rate to Liverpool (12 cents) look large for a short rail haul against a long ocean haul. All-rail rates from Winnipeg to Quebec have generally been so far above water rates as to be prohibitive during closed lake navigation. From Australia and Argentina, where the rail hauls are short, the ocean rates to Europe have been surprisingly low, considering the long haul. All in all, North American wheat growers, especially those whose exportable surpluses go to Europe, regard land freight rates as too high. Alleviation has been sought in two ways: (1) in the construction of inland waterways to ocean ports, providing new competition and alternative routes; and (2) by bringing ocean steamers closer to the wheat fields.

1. The projected and partially completed transit improvements of the Mississippi River and its branches include canalization of the Ohio River from Pittsburgh to Cairo, of the Mississippi River from St. Paul to the mouth, of the Missouri River from Kansas

City to the Mississippi River, and construction of a navigation route from Lake Michigan to the Mississippi. These improvements are designed to permit the movement of relatively large barges adapted to the shipment of bulk grain to ports. Canada has no such corresponding development (after completion of the new Welland Canal), since there is no serious plan to promote barge transportation from the interior to Fort William–Port Arthur, or to Churchill on Hudson Bay, by canalization of rivers.

2. There are two projects for bringing ocean steamers closer to the wheat fields—one completed, the other contemplated but not yet adopted. The completed project is the establishment of an ocean port at Churchill on the west side of Hudson Bay. Churchill has a rail connection with the wheat fields of the Prairie Provinces, and the haul is relatively short. The ocean haul is also relatively short on account of the high latitude; hence the combined haul from wheat field to Liverpool is much shorter than via the Great Lakes, or overland, to Montreal and thence to Europe. The other project is the St. Lawrence seaway, designed, through appropriate canalization and locking, to permit ocean steamers to pass to the head of Lake Superior. The St. Lawrence waterway (now preferably called seaway) was projected earlier than the development of the port at Churchill, but has been deferred for reasons of cost and questioned feasibility, and also because of the need of agreements between Canada and the United States.

When one regards the geography of the wheat regions and the locations of the mills and terminal markets, one is led to the view that the prospect of improving the exportability of wheat over the Mississippi waterway is limited except for one area. Minnesota exports little wheat; the exports from the Dakotas and Montana cannot be drawn away from the Great Lakes to the Mississippi River. The southern hard winter-wheat region drains naturally to the Gulf, and it is hardly possible to imagine the movement being deflected to a river port, for example Memphis, and thence to New Orleans. The export wheats of the northern hard winter-wheat region (Kansas and Nebraska), however, stand now at a disadvantage in that the rail routes to the Gulf and to the Great Lakes are both relatively long. Low barge rates from Kansas City would divert the export flow to the Mississippi River, thus bringing the northern hard winter wheats in more direct competition with the southern hard winter wheats in the export trade. The waterway from Lake Michigan to the Mississippi could hardly lend itself to transportation of much wheat. Spring wheat would hardly be shipped down the Mississippi and up the Illinois River to Chicago; and it is unlikely that winter wheat would be shipped by barge northward from St. Louis to Lake Michigan instead of southward to New Orleans. Navigation on the Ohio River has no importance in export wheat trade. The amount of wheat moving on the Mississippi River between St. Louis and New Orleans has been small: 139,257 tons in 1931 and 174,680 tons in 1930.[1] In short, despite a great deal of special pleading, improvements of the Mississippi River and its connections hold out limited promise to wheat growers (except as indicated) in respect of export outlets. The St. Lawrence seaway holds out much greater promise on comparable analysis. But because of heavy cost and the need of international agreement, the improvements of least promise to the United States and Canada have been completed first.

III. THE MISSISSIPPI WATERWAY

This central waterway includes the Mississippi River from the Twin Cities—Minneapolis and St. Paul—to the Gulf of Mexico; the Ohio River from Pittsburgh to the Mississippi; the Missouri River from Kansas City (or later possibly Omaha) to the Mississippi; and the Chicago River, the Chicago Drainage Canal, and the Illinois River connecting Lake Michigan with the Mississippi River. The estimated distances are as follows, in statute miles:

[1] *Annual Report of the Inland Waterways Corporation to the Secretary of War, 1931* (Washington, 1932), p. 28.

	Number of miles
Mississippi River, from Twin Cities to Gulf (Southwest Pass is 114 miles below New Orleans)	1,966
Ohio River, from Pittsburgh to Mississippi River (195 miles below St. Louis)	965
Missouri River, from Kansas City to Mississippi River (14 miles above St. Louis)	390
Chicago River, Chicago Drainage Canal, and Illinois River, from Chicago to Mississippi River (36 miles above St. Louis)	351
Total	3,672

The Ohio River contributes the largest volume of water, followed by the Missouri and the upper Mississippi; this also is the usual order in which spring floods appear. The main problem of flood control is to minimize in the lower Mississippi the results of excessive or overlapping floods from upstream. The main problem of navigation is to conserve the waters of the spring in order to maintain navigation levels during the drier periods.

The Lower Mississippi River

From the mouth of the Missouri River to the mouth of the Mississippi River the distance is 1,296 miles. It is proposed to maintain a channel of a minimum depth of 9 feet at low water; were it not for the occasional exigencies of flood control, this would merely entail dredging and installation of weirs. Floods, however, may destroy the existing channel without creating a new channel, and it is the objective of the Jadwin plan for control of the Mississippi to protect the channel of navigation, as well as to dispose of flood waters by spillways.

The lower Mississippi has two important branches from the west—the Red and Arkansas rivers, which descend the eastern slope of the Rocky Mountains and flow through the hard winter-wheat belt. If these rivers were navigable (for example, to Dodge City, Kansas, and Quanah, Texas), barge transportation would be made available to a large area raising wheat. The Arkansas River is given as navigable to Fort Gibson, Oklahoma, and is practicably navigable to Morrelton, Arkansas, for a few weeks each year. The Red River is navigable for about 300 miles from its mouth, but only for a few weeks each year. Despite the fact that these rivers flow through the hard winter-wheat region, there is no possibility of developing them as waterways. The drop is heavy and extreme variations occur in the volume of water; also, water is drawn off for irrigation and sinks into the sandy soil.

The Ohio River

With the completed improvements, a 9-foot channel is now available throughout the year except in the event of very unusual shortage of water. The only rapids are to be found near Louisville, where vessels pass through a lock. An elaborate system of dams has been installed, some fifty in number. These dams are movable and are more accurately described as regulating weirs. Each dam has a concrete base, the weirs may be raised or lowered according to the height of the water, and a long and wide lock is provided. The effect is to form a series of pools, between which channels have been excavated to the required depth, and regulated by the water flowing over the dams. The system is admirably adapted to barge traffic and permits the handling of an enormous traffic, mostly downstream.

The Missouri River

The plans for the improvement of the Missouri River contemplate eventual canalization to a depth of 9 feet at low water. The construction would consist almost entirely of dredging, supplemented by weirs, with perhaps in some places movable dams and retaining walls. In all probability the current could not be relied upon to keep the channel clear by scouring, and continuous dredging would be necessary.

The Upper Mississippi River

Apart from the dam built for power near Keokuk and the rapids near Rock Island (where locks provide for navigation), the river is rather placid. The volume of flow is subject to marked reduction following the high water of late spring and early summer. The water supply has been declining, apart from exceptional years, owing

to destruction of forests in Wisconsin and Minnesota, to extensive drainage operations, and to the gradual drying of lakes. Thus for months at a time the water flowing down the stream would not be sufficient to maintain the projected depth of 9 feet, except with the installation of numerous dams and locks. Despite extensive if desultory improvement, there is not now 6 feet of navigable water at low level in the entire stretch, and this is secured largely by means of simple jetties. If 9 feet of navigable water is to be provided through the summer and autumn, extensive improvements will be necessary. In some sections the construction of dams and locks and the carrying out of canalization are made difficult and expensive by the depth of unstable silts. Such a system of dams, locks, and channels as has been constructed on the Ohio could be constructed on the upper Mississippi only at heavy expense.

The Lake Michigan–Mississippi Canal

The proposed waterway connecting Lake Michigan and the Mississippi River is to connect the Chicago River, the Chicago Drainage Canal, and the Illinois River. The minimum depth of channel desired is 9 feet. A practicable channel and depth of water can be maintained only by diverting water from Lake Michigan. If this diversion were unlimited in volume, this waterway could be constructed by canalization, a few dams with locks and possibly a few moving dams. There are now seven locks between Chicago and the Mississippi River. A small power plant has already been installed. If the diversion of water from Lake Michigan is limited, this would entail more elaborate construction to maintain the depth of navigable water. It is to be observed that this project brings into competition two water routes — the one running northeast from the Mississippi to Chicago, and the other running south down the Mississippi.

These are the projects under construction. It was once proposed to make the waterway from Chicago to New Orleans deep enough for seagoing vessels of moderate draft, say 22 feet. It was also proposed to build a deep canal from Lake Superior to the Mississippi River. It will be years before the constructions under way are completed, and there seems now no prospect that the proposed deep channels will ever be undertaken. The prospective cost of the construction now under way is not known nor the expense of maintenance. It is, however, settled policy that navigation shall be free, without tolls.

IV. THE GREAT LAKES–ST. LAWRENCE SEAWAY

The Great Lakes may be regarded as expanses of the St. Lawrence River. The highest lake, Superior, is about 602 feet above sea-level. Through the St. Mary's River, Lake Superior discharges into Lake Huron, which has an altitude of 581 feet. From Lake Huron the water is discharged through the St. Clair River into Lake St. Clair and thence through the Detroit River into Lake Erie, which has an altitude of 572 feet. The flow next passes through the Niagara River (and the Welland Canal) into Lake Ontario, with an altitude of 246 feet. From Lake Ontario the flow passes through a succession of pools and rapids into the Gulf of St. Lawrence.

Navigation therefore meets obstacles at four locations. (1) In the St. Mary's River the drop of over 20 feet has been overcome by the installation at Sault Ste. Marie of large duplicate locks, which provide 24 feet of water on the sills. Between Lake Michigan and Lake Huron is no obstruction to navigation. (2) The reefs and shoals in the St. Clair River, Lake St. Clair, and the Detroit River have been overcome by the dredging of channels to the depth of 24 feet. (3) To get around Niagara Falls, Canada has completed the new Welland Canal, with large locks having a depth of 30 feet on the sills, the canal itself dredged to a depth of 27 feet. Large lake freighters may now descend to Kingston, only 173 rail miles from Montreal. (4) About 68 miles below Lake Ontario the St. Lawrence River passes through a stretch of 114 miles of rapids and swift waters, interspersed with stretches of quiet river and lakes of considerable area. The cumulative length of rapids is about 40 miles. Six canals, all

on the Canadian side of the river and provided with 21 locks lifting 208 feet, now furnish a shallow navigable channel. Navigation is limited to craft with a maximum length of 260 feet, a breadth of 43 feet, and drawing not much more than 13 feet. These dimensions do not permit large Atlantic or lake steamers to pass, and navigation from Lake Ontario to Montreal is thus restricted to small "canal" boats. Since the chain is no stronger than the weakest link, the present Great Lakes–St. Lawrence seaway offers only a restricted navigation to small boats of shallow draft, carrying not over 100,000 bushels of wheat.

The projected Great Lakes–St. Lawrence seaway involves further minor improvements at the places just mentioned, and very extensive construction of dams and locks in the St. Lawrence River below Lake Ontario. It will also be necessary to deepen the water at the Great Lakes ports and probably provide for maintenance of the levels by regulatory and compensatory works. It may prove necessary to restrict the diversion into the Chicago Drainage Canal and outflow through the Niagara River and the Welland Canal.[1]

The proposed improvements in the St. Lawrence River represent an enormous advance over the present navigation equipment. The projected improvements (not yet accepted in detail by agreement with Canada) are to provide for a channel 80 feet wide and 27 feet deep at low water, with 9 locks not less than 800 feet long. This would involve construction both on the international river and on the lower river in Canada. Four or five large dams would convert the rapids into pools; extensive canalization, with appropriate locks, would also be required. Power houses would be built to utilize the impounded water. Eight to ten years would be required to complete the undertaking.

The importance of maintenance, or elevation, of the levels of the Great Lakes has only gradually come to be appreciated. The area drained by the Great Lakes is relatively small, and the land area drained is not large compared with the lake area. The rainfall is not heavy and is subject to wide variations. The net outflow down the St. Lawrence is small compared with the total volume in the lakes, and this holds true of each individual lake. The water level of each of the four lakes is the net effect of inflow, rainfall, evaporation, and outflow. In consideration of the known facilities and disabilities of lake navigation, it is clear that the utility of the St. Lawrence seaway would depend largely upon the coexistence of such water levels in the lakes as would be adapted to the voyage. If a 27-foot depth of navigation at low water in the St. Lawrence is to be fully utilized by vessels, this implies a depth of at least 27 feet at lowest known level (for example, that of 1925) at all of the points of obstruction and at all of the ports designed to receive ocean-going vessels. This would imply extensive reconstructions between the lakes and would entail the deepening of many harbors, with redesign of the shore facilities for loading and unloading freight. The diversion of the water of Lake Michigan into the Chicago Drainage Canal is an incident to which an exaggerated publicity has been given. If the other conditions necessary to the using of the 27-foot channel in the St. Lawrence River are achieved, a diversion of 10,000 cubic feet per second could be compensated for; but if these conditions are not achieved, a much smaller diversion might have an injurious effect on the lake level.

The distance from Fort William to Montreal is 1,054 nautical miles; from Duluth 1,163 nautical miles. Since the distance from Montreal to Liverpool is 2,785 nautical miles, the export routes of the spring wheat of North America to Liverpool would be from 3,839 to 3,948 nautical miles.

Whether ocean steamers of the usual type would proceed inward to the cities on the interior lakes has been the subject of much technical discussion. Shipping experts incline to the view that, even though the depth of water permitted ocean steamers to pass inland as far as they desire, a transfer of cargo at Montreal would prob-

[1] It is known that a large supplementary water supply could be secured by diverting southward some water of the Albany River in Ontario, at a relatively low expense for the digging of a short canal, though attended with the submergence of a considerable area of low-grade land at present not in use.

ably be found economical for most boats. The boats best fitted to operate economically on the Great Lakes and down the river are not adapted to efficient economical operation on the high seas; ocean-going vessels of modern type are not designed to operate efficiently and economically on the Great Lakes. The lake vessels (holding over 300,000 bushels of wheat) are long and narrow, have their engines and fuel astern and quarters in the bow, and are not high-powered. Ocean-going vessels have a much wider beam and have a different disposition of their heavier engines, fuel, quarters, and cargo space. Doubtless a tramp steamer of the old type could pass to the head of the lakes to load with wheat. But it is doubtful if such a tramp steamer could compete with a modern lake steamer transferring her wheat at Montreal to a modern ocean steamer. What the next ten years bring forth in improvements in steamship construction may determine the issue. Largely on sentimental grounds the proponents of the scheme have adopted the theory that ocean steamers of many types and sizes from all parts of the world would go to the head of the lakes, whereas the opponents of the scheme, convinced that it will be economical to transfer freight at Montreal, are opposed to providing a depth of navigation water which they feel will not be used.

Navigation on the Great Lakes is ordinarily open for nearly eight months of the year, with the St. Lawrence open for a somewhat shorter period. It would be possible, presumably, to prolong by a month the season of open navigation with the use of ice-breakers at appropriate points. This would involve increase in the rates of hull and cargo insurance, and of the grain freight during the added month, with a heavy cost devolving on the governments for maintenance of ice-breakers.

Montreal has particular incentives. Montreal hopes through the St. Lawrence seaway to regain that control over outbound wheat which was lost when the Erie Canal was opened—just as Canada hopes through the re-establishment of protectionism in Great Britain to recover the advantageous position lost to her when the Corn Laws were repealed in 1846. Montreal hopes to restrain Canadian grain from passing out through American ports, while attracting American export wheat to her harbor.

In the case of the St. Lawrence seaway it is sought to have the sale of electrical power bear the entire burden of cost through long-term amortization; it is purposed to provide a free boatway. Even with this in mind, the bare survey of the project suggests not merely that the grain trade would carry no burden of cost or maintenance, but that cargoes other than grain must really justify the project.

All-American and All-Canadian Routes

Of historical interest only, but deserving passing comment, are two once-proposed national waterways to the sea — the all-American Great Lakes – Atlantic seaway and the all-Canadian Great Lakes–Atlantic seaway. Strong efforts have been made to recommend a canal route from Lake Erie or Lake Ontario to the Hudson River. The route usually proposed extends from Oswego on Lake Ontario to the Hudson River at Albany, utilizing in part the existing barge canal. From Lake Ontario to the summit level is a climb of 174 feet, with a drop of 420 feet to the sea. Despite the heavy drop, conditions are not favorable to the development of power. Large and numerous locks would be required, as well as many bridges. According to engineering estimates, the cost of construction would be heavier than that of the St. Lawrence seaway and would be carried by the United States alone, and not offset by any considerable power earnings. The sentimental argument that it would be an all-American waterway may be dismissed as irrelevant; in any event, if the Welland Canal were used to pass from Lake Erie to Lake Ontario, there would still be a Canadian part of the route. If an American canal from Lake Erie to Lake Ontario were to be constructed, this would involve a heavy additional outlay. All things considered, it is therefore proper to say that the all-American canal is of historic interest only, despite the fact that the St. Lawrence seaway has not yet been undertaken.

The project of the all-Canadian Great Lakes–St. Lawrence seaway dates back

into the last century. As in the case of the all-American canal, the promoters were able to add a jingo appeal. In 1904 a parliamentary investigation on the engineering practicability of a waterway from the Georgian Bay to Montreal was instituted, and a technically favorable report on the engineering aspects of the plan was presented in 1909. In 1914 a royal commission was set up to investigate the "commercial feasibility" of the waterway. Beginning at the mouth of French River in Georgian Bay, the route suggested ascended the French River to Lake Nipissing, across this lake to North Bay, whence it traversed the divide to meet the Ottawa River at a point near Mattawa, thence descended the Ottawa River to its mouth near Montreal. The length of the estimated route was 440 miles, the lift from Georgian Bay to the summit was 98 feet, and the drop from the summit to Montreal 659 feet. The plan provided for 27 locks, with 22 feet of water on the sills. Navigation in Nipissing Lake and on the Ottawa River, which would have required some dredging, comprised 346 miles. Sixty-six miles of channel were to be dredged and 28 miles of canal excavated over the summit. It was estimated that there was sufficient water to maintain the depth designed and to operate the locks throughout an open season of about 200 days per year. It was proposed to construct dams for generation of electrical power, a project, however, rendered dubious by the distance from consuming centers. The construction of the export port on Hudson Bay has closed discussion of this project.

V. THE HUDSON BAY ROUTE

After the World War the renewed agitation of the Prairie Provinces of Canada for a cheaper route to Europe was focused on Hudson Bay. The project is old; the port originally selected, decades ago, was Port Nelson.[1] A branch of the Canadian National Railway extended northward from The Pas, and this was advanced to Kettle Rapids on the Nelson River. Preliminary surveys of the terrain and of the prospective harbor at Port Nelson awakened distrust. The work was halted and careful surveys made of Churchill and Port Nelson. Discovering numerous advantages for location at Churchill, the engineers recommended a change of plans. The advice was adopted, and the railway was rapidly constructed to Churchill, where elevators, docks, and modern loading facilities have been installed, with a capacity approaching 10 million bushels per month. In 1931 two experimental shipments of wheat were made to Europe.

The distance from Churchill to Liverpool is given as 2,967 miles, 182 miles more than from Montreal. Since Churchill is closer to most of the Saskatchewan region than Fort William, roughly the distance from the head of the lakes to Montreal is saved.[2] The hazards of navigation are two —ice[3] and fog. So far as depth of water is concerned, the channels of navigation are known. The Canadian government has carried on extensive surveys of the conditions of weather, ice, and fog in Hudson Strait. It seems probable that dependable navigation will entail the occasional use of ice-breakers, that radio signals will have to be installed systematically, and that seaplane bases may perhaps need to be maintained at several points on the south side of Hudson Strait. It seems possible that it may prove advantageous to convey the wheat carriers out in fleets, and that airplanes will need to be kept available during the navigation season. Ice may be encountered as late as in July and is likely to reappear in September. The hazard in the Hudson Strait is likely to be encountered in the east end at the opening of the season and in the west end at the closing. The open season may be only during August–October, in unfavorable years barely that; in favorable years navigation may be practicable from mid-July until November. According to available information, it seems probable that during the open season the conditions of navigation tend to be favorable after boats have passed out of

[1] A project was once suggested to build a canal from Hudson Bay to Lake Superior.

[2] To be exact, Churchill is 872 nautical miles closer to Liverpool than is Fort William.

[3] Icebergs come down Davis Strait.

Davis Strait into the North Atlantic Ocean; there is less fog by the far northern route than in the usual trans-Atlantic lane. The experiences of several shipping seasons will be necessary before the advantages and hazards of the Hudson Bay route can be appraised, and during this time at least insurance charges will remain high.

If the Hudson Bay route proves advantageous, it will be in respect of cost rather than of speed or service. The route is especially advantageous to Great Britain and Scandinavia. The distance from Saskatoon to Churchill is 814 miles, from Regina 843 miles; from Winnipeg the distance is 977 miles, involving a backtrack westward. The distance from Saskatoon to Fort William is 899 miles, from Regina 776 miles, and from Winnipeg 419 miles. Obviously the Churchill route is designed especially for the wheat of Saskatchewan. Much depends on the eventual freight rates to Churchill, contrasted with those to Fort William and Port Arthur. For 1932 the following rates are in effect, in cents per hundred pounds, suggesting that there will be little saving in this respect:

From	To Churchill	To head of lakes
Edmonton	26	24
Battleford	22	23
Saskatoon	21	22
Moose Jaw	22	20
Regina	22	20
Brandon	23	16
Winnipeg	23	14

The installation cost of the Hudson Bay route, including the establishment of the port and the building of the railway from The Pas, has been relatively low. Presumably the costs are to be merged in the national debt of Canada (or in the debt of the Canadian National Railway), and the expense of the aids to navigation through Hudson Bay and Hudson Strait are to be carried on the budget of the Dominion government. If the wheat rate is thus to represent merely the cost of the operation of the boat, the anticipated lowering of the freight rate from the Prairie Provinces to Europe will depend upon the volume of traffic, the level of current charter and insurance rates, and the volume and particularly the nature of westbound cargo. If the westbound cargo consisted of finished goods such as clothing, fabrics, house furnishings, and tools, the boat could carry wheat back to Liverpool at a very low rate and still make an acceptable round-trip income; but if the boat were loaded with coal, the wheat would have to carry a heavier burden on the eastbound trip. At current prices of British coal, it might be possible to lay coal down at Churchill at a price which would be regarded as low for American coal of corresponding grade laid down at the head of the lakes. It is possible that the coal traffic will be a major factor in the wheat movement from the Prairie Provinces.[1]

The natural limitations of Churchill are recognized. The cost of living will be relatively high in a cold port busy three months and idle nine months, and this will find a reflection in shipping costs unless subsidized by the state. Churchill elevators cannot be used for seasonal storage of wheat. The Canadian elevators on Georgian Bay and on the lower lakes have a capacity of over 50 million bushels; the elevators in Buffalo have a capacity of nearly 50 million bushels; in addition, lake vessels store wheat while lying during the winter at the lower ports, thus providing additional storage for as much as 20 million bushels. The wheat stored in these positions is not merely awaiting reopening of navigation; the owners are able to take advantage of price rises and ship it over rails to export ports open the entire winter. Also, they distribute wheat from these elevators into domestic trade. The wheat locked in at Churchill would have to bear a heavy storage charge, which would wipe out the subsequent saving of freight.

[1] In the case of the two cargoes shipped in 1931, the cost was computed as slightly lower than from the head of the lakes via Montreal; the insurance was 2 cents a bushel higher, but the government absorbed the fobbing charges at Churchill. This suggests that with the development of back cargo it will cost a little less to ship wheat from Churchill to Liverpool than now by small lake boat from the head of the lakes to Montreal and cargo vessel to Liverpool. Cf. *House of Commons Debates* (Canada, April 15, 1932), Official Report, unrevised edition, Vol. LXVIII, No. 49, pp. 2262 ff. For the 1932 season several routine operations of shippers and charterers seem in prospect, and it is understood that the Saskatchewan wheat pool has sold 2 million bushels for delivery through Churchill during 1932 and 1933, the government to absorb the port charges.

In short, it seems probable that shipments from Churchill must be assembled from some interior point like Saskatoon. Boats will not come unless the wheat is waiting, and wheat will not go forward unless the boats are waiting. It will be necessary to enlarge and alter the terminal facilities at points like Saskatoon and Moose Jaw in order to adapt them for concentration of cargoes to be sent under a railway-permit system to Churchill for immediate passage through the elevator into the vessel. In effect, this implies (almost) that the shipping operation has its headquarters at interior terminals and that the rail haul to Churchill is the first step in the loading operation. This limitation represents a serious drawback. A similar condition once existed at Vancouver; this has since been overcome by improvements in facilities, lowered freight rate, and organization of the grain trade, and wheat is now shipped to Europe over this long sea route with conspicuous success. But Vancouver could accomplish her achievement only because the port is open every day in the year and berths on liners as well as charters on freighters and tramps are available. One explanation offered for the success of Vancouver is that this port is open when Montreal is closed; obviously, this circumstance contains a still more serious implication for Churchill. At the same time, transportation through Vancouver is not yet as free as the port is open. During December–March wheat is shipped to Vancouver under a railway-permit system designed to give priority to grain being forwarded to fulfil charter engagements. The restriction is not due to limitation of port facilities or scarcity of boats; it is imposed by the railways on account of the physical difficulties in moving trains over the mountains during the winter.

VI. THE EXPECTED SAVING IN FREIGHT COST

The purpose of developing water transportation for export wheat is not to shorten the time of voyage or to improve the service, but to lower the cost by shortening the rail haul, lengthening the water haul, and reducing the rehandling. The practical questions are two: What will be the freight saving per bushel of grain? To whom will the saving accrue?

Canadian wheat now leaves the head of the lakes and proceeds (1) by small boats direct to Montreal; (2) by large lake boats to Georgian Bay ports, thence by rail to Montreal; (3) by large lake boats to Port Colborne, Toronto, or Kingston, and thence by small boats or rail to Montreal,[1] and (4) by large lake boats to Buffalo, and thence by rail to New York, Philadelphia, Baltimore, or Norfolk, or by small boats to Montreal. There are also in some years heavy transshipments of stored wheat from Buffalo to Montreal by lake or rail; also, wheat stored at Port Colborne may go to Buffalo for export via American ports.

At present, wheat from the American spring-wheat belt may pass to export over several alternative routes from the head of Lake Superior. (1) It may go by small boats direct to Montreal. (2) It may go by large lake boats to Port Colborne, Toronto, or Kingston, thence transshipped by rail to Montreal. (3) The commonest method of shipment is by large vessels from Duluth to Buffalo; from Buffalo it may pass by boat and rail to Montreal, by barge on the New York state canal to New York, or by rail to New York, Philadelphia, Baltimore, or Norfolk.[2]

The soft red winter wheats which pass to export may be sent by rail to ocean ports from Norfolk northward to New York, or collected at ports on Lake Michigan and Lake Erie for water shipment to Buffalo, or sent south to Gulf ports. From Buffalo these wheats would follow the same routes of export indicated for spring wheat.

Hard winter wheats pass to export eastward either via all rail or via lake and rail. Once arrived at Buffalo, these wheats would follow the same routes of export indicated for spring wheat. Such wheats

[1] Under Montreal we include Quebec and Sorel.

[2] The various routes for shipments and cross-shipments of Canadian and American wheats, including also recross-shipments, afford opportunities for error in the final reports of exports from North Atlantic ports.

also go out via New Orleans.[1] The large and rapidly developing hard winter-wheat region of Oklahoma and Texas exports wheat largely through Gulf ports, especially Galveston.[2] There is, however, a wide intermediate hard winter-wheat region for which cheaper export facilities have long been sought either via the Great Lakes or the Gulf of Mexico or eventually via the Missouri-Mississippi River.

It is contemplated in the improvement of the Missouri and Mississippi waterway to make it feasible to ship export wheat by rail to points on the Missouri and Mississippi rivers, and thence by barge to New Orleans, where the grain would be transferred to vessels bound for Europe. A low combined rate would attract to the river route some export wheat which now goes out via the Great Lakes.[3] There are, indeed, enthusiasts who profess to believe that spring wheat, so far as it may be available for export, could be shipped south the length of the Mississippi River to New Orleans. Others hope that both spring and winter wheats could be carried by water to Chicago for export via the Great Lakes. Presumably, the Mississippi waterway would not draw to New Orleans wheat which now goes to Galveston by rail.

Wheat may leave the Atlantic Ocean ports on a passenger liner (a favorite dead-weight load), a scheduled freighter, or a tramp steamer, with New York holding the greatest advantage in liners and Montreal the least advantage in tramp steamers. Liners need dead-weight cargo for berthing and wheat is very suitable. Any gain by shipping on ocean vessels direct from Duluth-Superior and Fort William–Port Arthur to Europe over the costs of the routes now available during the season of open lake navigation would be largely the expression of the saving achieved by loading an ocean-going vessel at the head of the lakes, with avoidance of the charges incidental to rehandling and transshipment at the eastern lake ports and at the Atlantic Ocean ports, and a saving on the final rail haul, unless lower rates of ocean freight and insurance were also obtained.

We shall limit our examination of cost to the St. Lawrence seaway, partly because the circumstances are more susceptible of analysis and partly because it seems to have been assumed that savings would be equal or comparable in the two cases.

One estimating method rests on an accounting of the shipping operation.[4] One selects a series of vessels of various sizes and speeds, propelled by steam engines or by Diesel engines, and in the case of steam engines burning coal or fuel oil. One includes tramps and cargo liners, including, therefore, vessels of lesser and of higher efficiencies. There are numerous factors: size and wage-rate of crew, cost of fuel, insurance on hull and cargo, interest on investment, upkeep, and depreciation. This is a method customary among charterers.

Two simple approximations are to estimate the prospective rates by distance and by time. Estimating by distance, one assumes that the cost from the head of the lakes to Liverpool, contrasted with that from Montreal, would be proportioned to the distances. Estimating by time, one assumes that the cost from the head of the lakes to Liverpool, contrasted with that from Montreal, would be proportioned to the times. According to Gregg and Cricher,[5] in whose publication the details may be found, the rates thus estimated from Duluth-Superior to Liverpool were as follows, in cents per bushel:

By charterers' method....	5.4 to 12.8 cents
By the distance method...	9.2 cents
By the time method.....	9.4 to 11.2 cents
Suggested range	8.0 to 11.2 cents

[1] Wheat delivered by barge to New Orleans for export has largely come from Illinois and Missouri and from Nebraska on a favorable rate through Omaha to St. Louis. This route of export is now alternative to the Great Lakes route rather than alternative to the all-rail route to the Gulf.

[2] Wheat combines well with baled cotton in a shipload.

[3] Other things equal, the completion of this project would tend to divert export of hard winter wheat from the Great Lakes route to the Gulf route. If the wheat were barged from Kansas City to New Orleans at the same proportional rate charged from St. Louis to New Orleans (8 cents per 100 pounds), this would imply a rate of 6.5 cents per bushel from Kansas City to New Orleans, against the present rate of 14.1 cents. In our view, extension of the Mississippi barge service to Kansas City would practically withdraw hard winter wheat from the Great Lakes route.

[4] Cf. E. S. Gregg and A. L. Cricher, *Great Lakes-to-Ocean Waterways* (U.S. Department of Commerce, Domestic Commerce Series, No. 4, 1927), pp. 62–75.

[5] *Op. cit.*, pp. 62–75.

Contrasting these estimates with current rates prior to 1927, Gregg and Cricher suggest a saving of from 6.4 to 9.6 cents per bushel as the gain expected to accrue on wheat shipments from the head of the Great Lakes to Liverpool by ocean-going vessels through the St. Lawrence seaway.

A more direct method of estimating the possible saving in costs is to break down the structure of the present trip-cost and appraise the possibilities of reduction. For this purpose the route may be divided into three legs: (1) from the head of the lakes to the lower lake ports, (2) from lower lake ports to ocean ports, and (3) from ocean ports to Europe.

1. Rates from the head of the lakes to lower lake ports represent highly efficient shipping. The rates are higher during the opening and closing weeks of the season. Duluth-Superior and Fort William–Port Arthur enjoy the same rates to lower lake ports. There is a great deal of wrangling over lake wheat rates, and the situation is complicated by the circumstance that coastwise and foreign commerce are involved in the case of shipments from both Duluth-Superior and Fort William–Port Arthur. Fobbing charges at the head of the lakes would be the same for lake steamers and for ocean-going steamers, also insurance afloat and interest on cargo. In recent years grain has been shipped from Chicago to Buffalo for as little as 1.5 cents per bushel and for 1.75 cents from Duluth-Superior and Fort William–Port Arthur to Buffalo and Port Colborne.[1] There is no reason to expect that an ocean-going steamer of practicable type could haul wheat over this leg of the journey cheaper than the large lake vessels; perhaps there would be a loss.

2. The ocean-going vessel would save transfer charges at lower lake ports, roughly a cent a bushel. When wheat is transferred at Port Colborne or Buffalo to a small boat for Montreal, the rate to Montreal has been 3 cents a bushel plus the cost of transfer. The direct rate from the head of the lakes to Montreal in a small boat has been less than 5 cents per bushel. An ocean-going steamer ought to haul wheat from Buffalo, Port Colborne, or Kingston to Montreal at the same cost as from the head of the lakes to these ports, proportional to the distance. This would mean a rate of less than 1 cent per bushel for the second leg of the voyage. Therefore, saving the transfer cost at lower lake ports, an ocean-going vessel might be expected to carry wheat over the first and second legs of the journey (head of the lakes—lower lake ports—Montreal) for 2.5–4.0 cents. At present, it is possible to ship wheat from the head of the lakes to Montreal and transfer it to an ocean-going vessel in that port for less than 6 (or even 5) cents per bushel. This is, however, a cut rate and one hardly likely to endure.[2]

The freight rates east from Buffalo to the ports extending from New York to Norfolk are based on the so-called "at-and-east-of-Buffalo rate," which includes the transfer charge at Buffalo of 1 cent a bushel. The rate to New York is 9.1 and to Baltimore 8.8 cents per bushel; the fobbing charge at the port is 1.1 cents. The Canadian railroads offer comparable rates from lower lake ports to Montreal. The rate over the Erie Canal from Buffalo to New York is 2.5 cents per bushel; to this must be added 0.25 cents for insurance and a charge for transfer at Buffalo of 1 cent; the total is 3.75 cents per bushel, to which must be added the later fobbing charge in New York. Using the Erie Canal, it is possible to deliver wheat f.o.b. in New York for 7.9 cents per bushel from Chicago, 8.25 cents from Fort William–Port Arthur, and

[1] The current low rates are too low for trustworthy comparison.

[2] The advantages of the new Welland Canal (completed in 1931) have not yet been utilized. If a large lake boat can carry wheat from the head of the lakes to Port Colborne for 1.75 cents per bushel, a distance of 969 miles from Duluth, it ought to carry the wheat from Port Colborne to Kingston, a further distance of 192 miles, at an almost proportional rate. Probably wheat can be carried from the head of the lakes to Kingston for 3 cents per bushel, even if the boat travels empty back to Lake Erie ports to secure return cargo. The rail haul from Kingston to Montreal is 173 miles, over which the rate proportional with that from Georgian Bay to Montreal would be about 3 cents, with the railroad absorbing the loading charge. Therefore it would seem that with the installation of efficient reloading equipment at Kingston, the lake and rail rate from the head of the lakes to Montreal ought to be reduced to 7 cents a bushel. Transferred to small boats, the rate would be lower. Prescott, still nearer to Montreal, cannot be used by large lake carriers because they cannot secure hull insurance below Kingston.

8.55 cents from Duluth. Using the lake and rail route, wheat can be delivered f.o.b. New York for 13.25 cents from Chicago, 13.6 cents from Fort William–Port Arthur, and 13.9 cents from Duluth, with Baltimore 0.9 cents cheaper. Here would be an obvious saving by the proposed seaway of several cents per bushel, depending on the route.

3. Once the vessels loaded with wheat leave the ocean ports, most vessels loaded at the head of the lakes for direct voyage to Liverpool would show a loss. Berth rates are usually cheaper than charter rates. Wheat is shipped by parcel on liners from Montreal and also from Philadelphia and Baltimore, but the liner opportunities are not to be compared with those available at New York. New York also offers the largest selection in scheduled freighters. Cargo rates on tramp steamers are unusually high from Montreal, and high from New York; rates from Philadelphia and Baltimore are lower, in so far as the rates are influenced by the fact that tramp steamers tend to rendezvous at Hampton Roads. Fobbing charges are low (or absorbed) at Montreal. Insurance rates on hull and cargo are substantially higher from Montreal (and of course from Churchill) because this city lies north of the limiting line marked in the insurance policies issued under the British North American Warranty. Vessels whose voyages originated at the head of the lakes would operate at a substantial disadvantage in the ocean leg of the voyage, since insurance rates would be higher and the berth and cargo rates also higher than in the case of vessels from New York, Philadelphia, Baltimore, and Norfolk. It used to be current experience that wheat could be shipped to Liverpool from New York for from 1 to 4 cents per bushel less than from Montreal, according to circumstances. But recently Montreal rates have been lowered. Lately liner rates across the ocean have been as low as 3–4 cents per bushel.

In short, comparing proposed direct shipment of wheat from the head of the lakes to Liverpool with the present operations involving one or two transfers, the rates would be no better than a stand-off in the first leg, the ocean-going vessel using the St. Lawrence seaway would gain in the second leg, and would lose in the third leg. Recently it has been possible to ship wheat from the head of the lakes to northern ports like Liverpool and Rotterdam (c.i.f.) for less than 13 cents per bushel. Indeed, occasional parcels reaching New York over the Erie Canal in time to secure a last-minute acceptance of a low berth rate just before the sailing of a liner have been delivered at Liverpool for less.

There is no method of estimating a weighted price on actual ocean shipments through the open season, just as there is no method of securing a weighted figure for estimates of costs through the proposed St. Lawrence seaway. We are not able to convince ourselves that the saving reasonably to be expected could reach 5 cents per bushel during the season of open navigation. J. H. Rainville[1] (the president of the Commission of the Port of Montreal and an outstanding proponent of the proposed seaway) has estimated the probable cost from the head of the lakes to Montreal at from 5 to 5½ cents per bushel, suggesting a saving of from 3½ to 4 cents. Strictly as an estimate of the possible saving by the proposed seaway under the present cost via Montreal, a gain of not over 4 cents per bushel would be indicated. This would correspond to the ultimate saving if ocean shipment costs from Montreal were as low as from New York, which is not the case. Accepting this qualification, we feel safe in placing at 5 cents a bushel the limit of possible saving with the use of the St. Lawrence seaway for shipping wheat from the head of the Great Lakes to Europe.

Once such a series of estimates is in hand, one must make certain assumptions as to back-haul cargo to complement the eastbound voyage with cargo of wheat. The boat may return from Europe in ballast, and the revenue from wheat would need to provide the entire revenue of the round trip. The boat may return loaded with coal, which carries a lower rate than wheat, and wheat would need to carry more than half of the burden of the round trip. The boat may return with cargo whose rate corresponds to that of wheat,

[1] "La Canalisation du Saint-Laurent," *L'Actualité Économique*, April 1932, pp. 7–16.

and the wheat would need to carry no more than half the burden of the round trip. Finally, the boat may return loaded with package freight paying a high rate, and the wheat would need to carry less than half the burden of the round trip. From these numerous data one may adjudge the cost of carrying wheat from the head of the lakes to Europe over a range of estimates from a very favorable but improbably low rate to a very unfavorable but also improbably high rate. Into this conjecture there is no purpose in entering.

In all estimates it is to be kept in mind that westbound ocean traffic from Europe to North America is lighter than eastbound traffic from North America to Europe, to a degree that varies from year to year and from month to month. It is also to be kept in mind that the initiative in the movement of wheat across the Atlantic lies in the main with European importers. For the most part (with conspicuous exceptions like wool), goods pass to export because importers purchase them in the exporting countries, instead of exporters shipping them on open consignment to importing countries, there to be sold on sample, by auction, or otherwise.

The distance from Duluth to Liverpool is 3,948 nautical miles, 906 nautical miles more than from New York. The distance from New York to Liverpool is 3,042 nautical miles, contrasted with 2,785 nautical miles from Montreal to Liverpool. According to McElwee and Ritter,[1] an 8,800-ton steamer with a designed speed of 10.5 knots and a cruising speed of 9.5 knots would require 56 days for the round trip between Duluth-Superior and Liverpool. Such a boat could make four round trips during the open season; with a larger and faster vessel, say 13 knots, it would be possible to make five round trips during the open season. The vessels available would be either tramps or cargo liners; they would enter from the ocean with the opening of navigation, since it would not be economical to have them laid up over the winter at the head of Lake Superior instead of seeking charters elsewhere in the world during the winter. These boats would not for the most part take the initiative in coming for wheat cargoes, but would need to be chartered in advance, as is done in the movement of the Argentine and Australian wheats. Judged by experience in other parts of the world, the charter rates would fluctuate from year to year. If the present plethora of ocean tonnage persists, the charter rates over the St. Lawrence route will be low; the insurance rates, however, high. A cargo boat of 10,000 tons will carry over 300,000 bushels of wheat. To carry 15,000,000 bushels, fifty trips would need to be made; the amount of chartering will be a large undertaking. (These distances and tonnages are approximate.)

An important correction remains to be noted. By the use of methods of direct appraisal, one obtains a range of freight costs for the individual voyage, but this cannot be applied to the total movement during the year. To secure a weighted figure of the estimated saving per bushel of wheat, one must make allowance for the season of closed navigation on the St. Lawrence route. The open season at the head of the lakes averages close to 230 days; the average length of the navigation season at Montreal is 215 days.[2] If one estimates the open season by insurance rates (which are high for the first and last weeks of the open season), the open season, commercially defined, is somewhat shorter. It is fair to say that the open season for the improved St. Lawrence seaway would not average over seven months per year. Practically speaking, no ocean vessels would leave the head of Lake Superior later than December 1 and no ocean vessels would arrive at the head of Lake Superior for loading earlier than May 1. Therefore, whatever the cheapness of the St. Lawrence seaway, it would apply to the movement during only seven months, while the higher costs of the other routes would apply during five months. The movement of wheat is of course not evenly spaced through the twelve months. During the past five years the export shipments of North American wheat from North Atlantic ports during December–

[1] R. S. McElwee and A. H. Ritter, *Economic Aspects of the Great Lakes–St. Lawrence Ship Channel* (New York, Ronald Press Company, 1921), p. 73.

[2] The average opening date of the St. Lawrence is April 18, the average closing date December 7.

April was 37 per cent of the average annual movement from the same ports. (The highest proportion was 44 per cent, the lowest 33 per cent.) Some such adjustment as this would need to be applied to the direct measurement of freight costs during the open season in order to secure a weighted figure per bushel of total export.

It may be argued that to take advantage of the lower rate the export of wheat would be concentrated during the season of open navigation; but this argument fails when the factual circumstances are analyzed. The new-crop hard winter wheat is available for export via the Great Lakes during the months of August–November; the wheat available for export earlier than August 1 would come from the panhandles of Oklahoma and Texas and would pass to export through Gulf ports. The favorable season for export of hard winter wheat is early in the new-crop year, when old-crop European supplies are low and when prices of old-crop North American hard spring wheat tend to stand relatively high. Under these circumstances, the naturally favorable period for export of southwestern hard winter wheat is over, other things equal, before lake navigation is closed. Therefore, it is difficult to imagine piling up Kansas and Nebraska wheat in Europe before the spring-wheat crop is harvested, merely to take advantage of a lower water freight rate to Europe.

American and Canadian hard spring-wheat shippers have in an average year scarcely more than two (at the outside, three) months of lake navigation for export of the new crop. The wheat leaving the head of the lakes before the closing of lake navigation goes partly to export direct, but usually more is placed in storage at lower lake ports, whence it may be shipped by rail to open North Atlantic ports. With the reopening of navigation on the St. Lawrence, the old wheat stored at lower lake ports will move to seaports, and old-crop wheat still lying at the head of the lakes or at interior terminals will move by lake to lower lake ports.

Now, both for spring wheat and winter wheat it would not pay to pile up wheat in storage in European ports, in order to save on the lower freight rate estimated to be obtainable by direct shipment from the head of Lake Superior to Europe. Storage in ocean ports is expensive; in addition, such a piling up of wheat in European ports would not conform to mill requirements. The cost of storage in interior terminals in the wheat region and in terminals on the lower lakes is so much less than the cost of storage in Europe and in Atlantic ports of North America as to overbalance the saving on the through freight rate during the open season. It would not be found economical to concentrate the year's export of wheat into the seven months of open navigation. The rate of flow would be determined largely by the European importer, who would balance the difference in storage charges against the difference in freight charges.

Whatever the rates during the period of open water navigation, these must be balanced with the rates during the period of closed water navigation to secure a weighted figure for the wheat export of the crop year. This weighted figure would indicate a saving substantially lower than the saving presumably indicated in a comparison of alternative methods of shipment during the open season. If not over 5 cents per bushel were the saving during open navigation, the weighted saving on the annual export would be substantially less.

The seasonal problem is crucial for Canada. Suppose Canada, desirous of securing the increased farm price accruing from the lower export rate, were to attempt to have that amount of wheat leave Churchill and Montreal before the close of navigation which would correspond to the amounts that had been shipped by all routes up to the opening of spring navigation. Put in another way, suppose Canada were to endeavor to have loaded on boats to leave St. Lawrence Bay and Davis Strait by December 15 the exports which under the present system hold for the new crop from October to April inclusive. This undertaking might represent the ocean shipment by the two routes of, let us say, 200 million bushels. How would the wheat be carried and where would it be stored in Europe? The distance from Churchill to Liverpool is shorter; but so is the open season. The vessels which might make four or five round trips per

season from the head of Lake Superior to Liverpool would make three round trips per season from Churchill to Liverpool. These estimates are probably low for the future, since Diesel-driven boats designed for bulk loads could make the round trips in less time. A boat of 10,000 tons would carry some 300,000 bushels of wheat. Therefore nearly 700 boatloads would be involved. Assuming that half were to go by each route, this would imply some 350 boatloads leaving Montreal and Churchill during ten weeks. Assuming that the schedules were arranged so that boats loaded at Churchill and Fort William the first day when new wheat was available and boats passed out of Hudson Strait and the St. Lawrence Bay on the last day of open navigation, even if one assumed a round-trip time of only forty days, the tonnage requirements would reach staggering dimensions. That such a concentration of shipping could be marshaled without increase of charter rates is hardly to be believed.

With the arrival of this huge mass of wheat in Europe in advance of importers' requirements, the already high storage rates would rise. In short, increase in storage rates and charter rates consequent upon concentration of shipping to utilize the open navigation might more than balance the saving to be shown by the route under other circumstances. In consequence of congestion of European storage facilities with Canadian wheat, the price would fall. From this lowered European price would then be subtracted the elevated storage charges and charter rates. Since under these circumstances there would be no exporters' bids in Canada during December–April, the requirements of the Canadian millers would maintain only a sluggish spot market. From these considerations it becomes clear that the benefit otherwise to be expected can be secured for the farm price of Canadian wheat only if the cheapest water rates are employed, the lowest storage rates utilized, and the flow of wheat to Europe proportioned to the changing milling requirements of the season. If the Hudson Bay and St. Lawrence routes were open throughout the year, the major argument of the proponents of waterways would apply to Canada, so long as the wheat acreage did not expand more rapidly than the trend of wheat consumption in the world. But the limitations imposed by five months of closed navigation on the St. Lawrence and nine months of closed navigation out of Hudson Bay suggest that there might be little net lowering of cost to be applied to the weighted farm price of wheat.

VII. THE INCIDENCE OF THE SAVING

Whatever estimate is accepted of the saving to be attained by shipping wheat over the St. Lawrence seaway, then arises the question to whom this saving will accrue. Will the saving in expense be reflected back to producers, or forward to consumers? If 5 cents a bushel were saved on wheat exported during the season of open navigation, would the farm price of wheat be raised in North America or the wheat price be lowered in Europe?

In the argument that the saving will accrue to producers, wheat is pictured as unity, the Liverpool price is regarded as the base-line with the American exporters continuously bidding up to the daily Liverpool price (minus the inclusive transportation charges and a minimum profit to the exporters) and domestic buyers competing with each other and with exporters. On the assumption that all the sellers and buyers are participating in the market and that the entire crop is sold, the inference is drawn that the farm price of wheat would parallel the Liverpool price, with the Liverpool price unaffected by the reduction in freight cost under consideration. The argument implies that at the Liverpool price the exporter buys the last installment on the basis of the lowered freight rate and that his bid determines the elevation of the price of our crop. The argument seems to make the assumption that the world market is naturally a "sellers' market."

The opposing extreme view runs to the effect that, with the completion of inevitable adjustments consequent upon lowering of the freight rate, the saving would accrue to foreign importing countries. Railway traffic experts tend to hold that when ex-

port rates to the seaboard are lowered the railroad loses, the wheat price at seaboard declines to correspond with the rate reduction, and no gain is obtained by the growers in the form of a higher farm price. The same reasoning is applied to reduction in any item of cost of export shipments.

In our opinion, both extreme expectations are unfounded. We deal here with an example of the incidence of a new burden or gain. The raising or lowering of a freight rate is like the raising or lowering of an import or export duty or of an excise tax. It involves one item of expense in the group of distributive costs. A series of reactions and interactions are set up, the effect of which tends to divide the saving. According to this view, if shipment costs to Europe were reduced 5 cents per bushel, this would be divided between producers in North America and consumers in Europe, with possibly a small fraction being retained by the intermediary trade. The division would not be constant but would shift from year to year. If exporters' supplies from the surplus-producing countries were abundant, and the adjustment between exporters' supplies and importers' requirements were easy, Europe would get most of the saving. If, however, exporters' supplies in surplus-producing countries were short, and the adjustment between exporters' supplies and importers' requirements were tight, the producers in North America would retain most of the saving. To use trade parlance, with a "sellers' market," producers in North America would hold the saving; but with a "buyers' market," consumers in Europe would seize it.

Years ago Alfred Marshall made the following statement in relation to the incidence of burden:[1]

> The greater part of economic science is occupied with the diffusion throughout the community of economic changes which primarily affect some particular branch of production or consumption; and there is scarcely any economic principle which cannot be aptly illustrated by a discussion of the shifting of the effect of some tax "forwards," *i.e.* towards the ultimate consumer, and away from the producer of raw material and implements of production; or else in the opposite direction, backwards.

It is significant to observe that the inference of incidence is not consistently drawn in regard to imports and exports of goods through the proposed St. Lawrence seaway. One of the stated objectives is to lay down foreign raw materials more cheaply at interior industrial centers. It is therein implied that the saving on inbound freight would accrue to us in the importing country and not to producers in the foreign countries from which these materials are drawn. The contradiction lies in the expectation of a reflection of the saving exclusively in one direction or the other. In our view, the predicated freight saving on both imports and exports to be achieved over the St. Lawrence seaway will always be split between the exporting countries and the importing countries, in proportions that will vary from commodity to commodity and from season to season.

A study of the prices of wheat futures and of cash wheats in the different markets of Europe and of North America (including exporters' declarations of value and adequate consideration of types, varieties, grades, premiums, and discounts) will make it clear that it is unwarranted to regard any particular Liverpool price as the datum-line from which the price at any country elevator in Canada or the United States can be directly obtained by mere subtraction of the transit cost. Such relationship does not hold in fact, and there is no reason why it should. The initiative of the wheat export trade lies not with the exporter, but in Europe; the exporter buys in this country to fill an order closed by negotiation. The exporter is only intermittently a buying factor in the domestic market. The exporter is not prepared to take all the wheat offered at the Liverpool basis minus the shipping differential, but usually only small parcels. Europe wishes only a part of our exportable surplus in any year, and the rate of flow is optional with Europe. The grain is not all sold; instead there are carryovers on farms, as well as in country elevators, mills, and terminals. It is not true as a market fact that "the shipper has the right to sell his grain in the European

[1] In a "Memorandum on the Classification and Incidence of Imperial and Local Taxes" (C9528 of 1899) prepared for the Royal Commission on Local Taxation in 1897 and included in *Official Papers by Alfred Marshall* (London, Macmillan, 1926), p. 340.

market if he so elects, and in order to keep the grain at home the people of America must pay the Liverpool price less the cost of transportation";[1] the predicated European market does not exist.

Moreover, the "Liverpool price" is not a line but a range. Circumstances in surplus-producing countries (and especially in Chicago) influence the Liverpool price quite as much as (or more than) the Liverpool price influences prices in surplus-producing countries. It is impossible to simplify the argument by making the reservation "other things equal and weighted"; it is impossible to imagine the freight rate from North America being lowered 5 cents and have all other circumstances in the world of wheat continue to remain equal and weighted.[2] A large supply of wheat in the Southern Hemisphere would reduce European demand for American wheat, despite lowering of the freight rate from here to Europe.

Finally, a strict application of the law of supply and demand leads to the conclusion that an increase or a decrease in any item of cost between producer and consumer will be divided, in varying proportions under different circumstances. One must include appraisal of the elasticities of supply and demand, of substitution with other grains, of the prices of other grains, and of the influence of price factors outside of the grains. It is to no purpose to enter on a mathematical exploration of the subject. It suffices to state the view, based on theory and supported by trade experience, that, if the weighted freight charge per bushel of wheat from the United States to Europe were to be reduced or raised by 5 cents, this would be in part reflected backward to the farm price and in part forward to the European price of American wheat. The division, the incidence, would vary from year to year. A corresponding declaration may be applied to Canadian wheat, whether the freight gain comes from the Hudson Bay or the St. Lawrence route.

A cursory examination of the regional relations will indicate how indeterminate are the variables. Our limited exports of soft red winter wheat proceed largely from Ohio, Indiana, Illinois, and Missouri; such exports are usually the culls of the crop. It is not clear whether exporting the culls tends to raise or lower the prices of the better or best grades. If the farm price of soft red winter wheat were raised a few cents over the otherwise price, it is impossible to predict the effect upon wheat in this region. Should expansion of acreage, however, occur, the possible effect would be an increase in exports and a corresponding reduction of the price of this type and grade of wheat in Europe. Such a contingency would hardly result in reduction of acreage of soft winter wheat in Europe, or of soft wheat in Australia, in northern Argentina, or in the Pacific Coast states. It is not possible to measure the elasticity of supply of soft wheat in Europe or in the surplus-producing countries competitive with the United States, or the elasticities of demand for this wheat in Europe and in the United States.

For hard winter wheat the contingencies are somewhat clearer. The exports from Texas and Oklahoma would continue to go out by rail to Gulf ports. The exports from Kansas and Nebraska would presumably enjoy low rates from Omaha and Kansas City via both the Great Lakes and the Mississippi waterway, but regional considerations might obtain for the Mississippi route the lower rate. Most of the wheat of Kansas and Nebraska passing to export is contract grade (No. 2) red or yellow hard winter wheat, with more or less discount wheat. It serves mostly the purpose of filler wheat in European mills. If the farm price of hard winter wheat were raised a few cents over the otherwise price, this might favor expansion of acreage in Nebraska and Kansas. The outcome would depend somewhat upon developments in tractor farming, and a slightly increased farm price of wheat would be only one of several factors influencing this agriculture. Should expansion occur, this would tend to result in enlargement of export, which would tend to

[1] MacElwee and Ritter, *op. cit.*, p. 262. Cf., also, A. H. Ritter, *Transportation Economics of the Great Lakes–St. Lawrence Ship Channel* (1921), pp. 216–24; for a contrary view, see H. G. Moulton, C. S. Morgan, and Adah L. Lee, *The St. Lawrence Navigation and Power Project* (Washington, D.C., The Brookings Institution, 1929), pp. 149–57.

[2] The claim is similar to that made for the export debenture, though less strong. Cf. J. S. Davis, *The Farm Export Debenture Plan* (Stanford University, 1929), pp. 121–52.

lower the European price of filler-grade hard wheat. The chief export competitor is Argentina. Argentina might or might not contract acreage in response to a slightly lower world price. In fact, however, we are not able to measure elasticity of supply in Argentina or in Europe or the elasticity of demand in Europe.

In the hard spring-wheat belt, the outcome to be expected would be different with bread wheat and with durum wheat. We export only the culls of the crop of hard spring wheat of bread type and but little of those. The effect of removal of these culls upon the prices (or premiums) of the better and best grades is not clear. If the farm price of hard spring wheat were raised a few cents a bushel over the otherwise price, this would hardly result in expansion of acreage or increase in exports.

For durum wheat, however, an increase of acreage would be expected. This would expand the already large exportable surplus of durum wheat and lead to heavier exports. The two large importers of durum wheat, Italy and France, are maintaining an artificially high price of domestic wheat, and under these circumstances a lowering of the price of American durum wheat would not directly influence the elasticity of either demand or supply in those countries. The competitive exporters of durum wheat are Canada, Russia, and northern Africa. The possible reaction in Canada will be mentioned below. In Russia, acreage is not responsive to price and, therefore, there is no elasticity of supply in the usual sense. In northern Africa, price is only a secondary factor in acreage, and the wheat of that region enjoys a large preferential market in France. Therefore, for durum wheat the probable outcome would be expansion here in response to a primary increase of domestic price, to be followed by a later decline of domestic price, consequent on enlarged production.

In summary, the effect to be expected on the farm price of wheat in the region transportationally tributary to the Great Lakes does not lend itself to more than provisional forecast, since only trial and error can determine the relative influences of the numerous variables. If an increase in the farm price of 5 cents per bushel in Ohio, Michigan, Indiana, Illinois, Missouri, Iowa, Nebraska, and Kansas were to lead to an increase of acreage, this would result, with normal yields, in an increase in exportable surplus of more or less unrepresentative grades of wheat. If such an increase in exportable surplus eventuated in increased exports, this would tend to lower the prices of filler wheats in general in Europe, which would tend to depress the price of Liverpool futures, which would tend to find reflection in Chicago futures. Little or no effect would be expected in the case of Marquis wheat (or other bread wheats) in the hard spring-wheat states. Durum wheat would be the one most affected, and an increase of 5 cents per bushel in the farm price would tend to expand durum wheat acreage at the expense of Marquis wheat acreage, resulting in an increase in the exportable surplus and in export, with decrease in the European price of this wheat. In short, the concept that European domestic and imported wheat is a unity and American wheat another comparable unity, with the simple price relations of a single market, does not correspond to the intricate circumstances of the case.

In the above presentation we have considered the saving primarily in relation to the wheat passing to export. The proponents of the view that the farm price of wheat is the Liverpool price minus the shipping differential, unaffected by subsequent changes in incidence of the burden, do not limit the argument, as previously intimated, to export wheat. The second stage in their argument is that *all* the wheat being sold for domestic use during the time when *some* wheat is being sold for export would have its farm price correspondingly raised. It is assumed that when an exporter buys a parcel of wheat he bids effectively against the wheat merchants in all interior points, terminal and country, and that the "street prices" of all wheats are everywhere proportionately influenced by the price which it is predicated the exporter pays for a parcel of wheat to complete a sale to a European importer. This assumption disregards entirely the quantitative contrast between the large amounts of wheat being sold for domestic use and the small and intermittent amounts of wheat being sold

for export. The exporter does not bid directly on the spot or futures market against the American miller and terminal grain merchant, for the most part; more often he merely picks up bargains in odd lots of wheat in particular positions, which are little more than crumbs from the table of the miller's operations. Most mill purchases are on sample, with varying premiums over futures, based on milling considerations of the domestic flour market; the exporter rarely bids on a premium wheat in this country. If the exporter were prepared to buy relatively unlimited amounts, there would be some plausibility in the argument that the spot export price would influence the spot prices of wheats at all country points. But in seasons of low and irregular exports, exporters are not in the market in the sense of buying the last installment; they are mostly dealing in distressed wheat.

There is still a third stage to the argument.[1] This is the declaration that the saving secured in a lowering of the freight rate will accrue to the farm price of wheat in the United States, even though *no* wheat passes to export. It is implied that exporters are in the position of a stockbroker who has announced that he will take all of a named stock offered at a certain price; that is, it implies that the exporters have standing offers to buy wheat (on their own initiative without specific orders) at the Liverpool price minus the shipping differential, that all domestic millers and merchants must meet such exporters' bids, and that the wheat price at country points and on the farms must correspond to the hypothetical standing bid of exporters. This is similar to the familiar tariff argument that domestic mills bid up the prices of American hard wheat to the level of the price of duty-paid Canadian hard wheat plus inbound freight. For such assumption no statistical demonstration exists, since the argument by hypothetical formula disregards the variations between different futures prices of different markets and months, and between cash prices and futures prices, and the continuously changing adjustments between types, varieties, and grades of wheat. How inapplicable is the argument by formula is illustrated by the circumstance that the European importer bids on the basis of Chicago futures, and much of the time during recent years Chicago futures have stood closer to Liverpool futures than a shipping differential and have often approached or exceeded the Liverpool quotations.

We conclude, therefore, that even from the standpoint of the proponents of the St. Lawrence seaway a good case cannot be made out for benefit to American wheat growers. The saving through lowering of cost would be but a few cents per bushel, at best. The volume of exports to which this would directly apply is small and presumably contracting. Of the small promise held out for wheats whose exports would pass out over the Great Lakes, durum wheat would hold the best outlook. Our prospective exports of wheat over the St. Lawrence seaway will continue to be largely unrepresentative wheats, mostly of lower grades and lesser qualities, representing not a broad movement of export but the cumulation of individual special cases. Perhaps from 3 to 5 cents a bushel might be saved on the cost of shipping wheat from the head of the lakes to Europe during the seven months of open navigation, which would be reduced in the weighted price of the annual export of the region involved. We do not believe it would be reflected ipso facto to the entire crop of the region involved, but would be most in evidence during the weeks of most active export. The saving would be divided between American producers and European consumers, in varying proportions.

The situation is somewhat different in Canada. The population of Canada grows slowly; wheat acreage expands more rapidly. With average yields, it is to be expected that the crop of Canada, rising above 500 million bushels, will gradually approach 700 million bushels. Some 70 to 75 per cent of the average crop now passes to export, as grain or flour, and the proportion is likely to increase. The buyers for export are thus the dominant factors in the market. Therefore the price of wheat for domestic use tends to correspond with the price of export wheat, though the relation of Winnipeg futures to Liverpool futures seems quite often to run counter to this

[1] Cf. MacElwee and Ritter, *op. cit.*, p. 262.

rule. The disproportionate amount of the crop that must pass to export and the difficulties imposed by the closed season of navigation represent two circumstances of highly significant importance.

If through the operations of the St. Lawrence seaway and the Hudson Bay route the farm price of wheat were to be raised by a few cents a bushel over the otherwise price, would this influence the Canadian acreage of wheat? The attainment of the long-sought water routes would be expected to accelerate the extension of wheat growing. Expansion of wheat acreage would have the direct effect of expansion of export, which would tend to lower the price of wheat, especially hard wheat, in Europe. This might tend to lower the wheat acreage in Argentina, if not in Russia and the United States. It is doubtful if it would tend to lower the acreage of soft wheat in Europe and Australia. The effect on elasticity of European demand cannot be conjectured. If the price of premium hard wheat in Europe were to decline, this would tend to enlarge the use of this wheat and lessen the use of filler wheat.

It is clear that the implications of the opening up of the Hudson Bay route and the St. Lawrence seaway are much more important for Canada than for the United States. But growers of wheat in states tributary to the Great Lakes might be secondarily affected. If wheat acreage were to be stimulated in Canada, the effect on the world price might result in a net loss on American wheat grown tributary to the Great Lakes. The experiences of recent years have proved that there is a limit to the premium Europeans will pay for hard spring wheat. It is clear that beyond a certain volume Canadian wheat cannot be sold in Europe for a premium and the grades below No. 1 or No. 2 may go at a discount. If lower freight costs to Europe were to accelerate the rate of expansion of wheat acreage in Canada, large crops would furnish such exportable surpluses as to lower the relative position of hard spring wheat in Europe and to depress all wheat prices. It is conceivable that such a lowering of European wheat prices might reduce the farm price of Canadian wheat by more than the extent of the freight saving. When the influence of the projected waterway is thus analyzed by contrast between the United States and Canada, the suggestion becomes warranted that the effect on the farm price of Canada might spell failure with the farm price of the United States. In both countries, a sellers' market is assumed or implied. If a sellers' market were to exist, this would affect our export wheat no more than that of Canada; but if a buyers' market were to exist, the price in Canada, with representative wheat to export, might be injured less than in the states which lie transportationally adjacent to the Great Lakes.

In passing it is appropriate to point out that recent years have witnessed substantial reduction in ocean freight rates on wheat from Argentina and Australia. We have not heard the claim in Argentina and Australia that the saving in ocean freight rates has accrued to the wheat growers of those countries. Quite the contrary, examination of the prices of Argentine and Australian wheats suggests that the saving in freight has been passed on largely to the European buyers, and in this view opinion in those exporting countries coincides with opinion in Europe. In 1926–27, when the British coal strike led to increase in ocean freight rates, the Europeans bore most of the burden.

In searching for comparisons and analogies, attention is naturally drawn to the Suez and Panama canals. In the case of these two routes for the shortening of transportation, the operation was entirely on the water; this, however, can hardly modify the argument on incidence. With each decade the costs and efficiencies of ocean carriage are being modified by developments in construction of boats, improvements in engines, changes in fuels, alterations in design, elaboration of devices for loading and unloading, lowering of net charges for crews and insurance, etc. During recent years the cost of moving wheat from Australia and Argentina to Europe has been strikingly reduced, and further internal reductions are in progress in those countries in the substitution of bulk handling for bag handling. We have been unable to find any computation purporting to show the net saving in carriage of wheat accomplished

by the Suez Canal in shortening the distance from Australia to Liverpool, or by the Panama Canal in shortening the distance from the Pacific Coast to Europe. Nor have we heard the claim advanced that the savings have accrued to wheat growers in Australia and in the Pacific Coast states. Indeed, quite to the contrary, it seems to be generally believed in Europe that the saving of the Suez and Panama canals has accrued largely to them. The opinion is prevalent in Europe that, so long as the initiative of importing rests with the importer and the exporters press abundant supplies upon Europe, the importing continent will receive the benefit of improvements in transportation resulting in a lower cost from distant farms in exporting countries.

The Panama Canal has taken from the transcontinental railway a great deal of coast-to-coast tonnage. When articles to be sold at fixed retail prices are thus shipped, the saving obviously accrues to the producer, unless taken by the intermediaries; but when the articles are to be sold at competitive prices, the consumer is certain to receive a part of the saving. The low Panama Canal rate has opened up coastal markets to producers on the other coast which were not available with transcontinental rail rates. The Panama Canal route has made possible a lowering of consumers' prices on both coasts; probably it has also made possible a raising of producers' profits on both coasts. It requires merely trade experience, not a formal analysis of prices, to make it clear that the saving of freight by the Panama Canal route has usually been divided between producers and consumers according to circumstances.

VIII. CONCLUDING OBSERVATIONS

In our view the relevant evidence indicates that the St. Lawrence seaway and the central inland waterway hold out small promise for the American wheat grower. There is no convincing evidence to suggest that the saving could be over 5 cents a bushel on wheat passing out of the St. Lawrence; the saving would not be greater down the Mississippi. The saving would not apply to the wheat exported during the period of closed navigation in winter, and the weighted saving would be substantially less. We do not believe the farm prices of all wheats would be raised. We are convinced that, whatever saving accrued, it would be divided between producers in this country and consumers abroad.

The case is different in Canada, and the effect of the St. Lawrence and Hudson Bay routes on the farm price of wheat will be much more direct and significant than in the United States. Wheat growers of the United States face a declining use of the projected export waterways; Canadians face an expanding use. In Canada, wheat has great relative importance in the projects of the export waterways, but not in the United States. Instead of comparable effects, it is possible that the export prices of American wheats might be injured as the result of the influence of the St. Lawrence seaway and the Hudson Bay route upon the acreage and prices of Canadian wheat. Under these circumstances, justification of the proposed construction must rest in the United States on other considerations than export of wheat.

We have made no mention of other grains than wheat, but here a provisional word seems called for. The completion of the projected waterways might favor export of oats from Canada and of barley from the upper Mississippi Valley. It could hardly revive export of rye, and a significant influence on export of corn is improbable; it might favor import of flaxseed into the United States. Including all cereals in the group, it is clear that Canada is much more deeply interested than is this country.

The more important issues involved lie outside of cereal agriculture. It is time to recognize that the justification, or extenuation, of the projected waterways is to be found in more comprehensive factors.

The Panama Canal, the system of public highways, and the several waterways are successive steps in a new stage of the industrial revolution. The purpose of these installations has been reduction in costs of distribution. The direct results affect the pre-existing agencies and routes of transportation; the indirect influences on com-

parative advantage and location of industries may be still more far-reaching.

With the completion of the projected waterways,[1] the resultant effect upon transportation represents a profound change. In effect, an inland sea will be created, dividing the country into two parts. In effect, this cleavage will tend to convert the railways into an eastern group running from the Atlantic Ocean to the central valley and a western group running from the Pacific Ocean to the central valley. Freight will be shipped by boat from Atlantic and Pacific ports to ports on lakes and rivers in the central valley for lateral distribution by railway and highway; conversely, freight will be shipped by boat from ports on lakes and rivers in the central valley to Atlantic and Pacific ports for inward distribution by railway and highway. Goods already go from one coast to the other for distribution a considerable distance inland from seaboard. The completion of the connected waterways of the Mississippi Valley and the Great Lakes will have the same effect on traffic from the coasts to the central valley and from the central valley to the coasts. Large areas will thus be opened to water-borne transportation—areas possibly several hundred miles wide, one beside the Pacific Ocean, one beside the Atlantic Ocean, and one lying upon either side of the Mississippi River from New Orleans to the Twin Cities and along the Great Lakes. This development has the effect of creating an inland sea in the Mississippi Valley, in its transportational implications quite comparable with the Great Lakes and St. Lawrence waterway.

Hudson Bay is a natural mediterranean sea of North America; the St. Lawrence seaway would convert the Great Lakes into an artificial mediterranean sea. The waterways of the Mississippi Valley would create, in effect, an inland sea, a transportation change equivalent to a third mediterranean sea. One must not push the analogy too far; but the three waterways would tend to make a north and south cleavage of North America in the transportation sense.

The effect of the successful operation of ocean-bound transportation through Hudson Bay and the Great Lakes will tend to be similar to that sketched for the Mississippi Valley; outbound freight will be drawn from, and inbound freight delivered to, a wide central region. The completion of the St. Lawrence waterway and the corresponding canalization of the connection between the Great Lakes and the Mississippi would permit foreign countries, as well as the parts of Canada and the United States lying adjacent to the coasts, to ship goods to, and draw goods from, central North America without use of rail transportation except for initial assembly and terminal distribution. The transformation thus under way may be stated in exaggerated form as follows. The railways cease to be transcontinental carriers, coast-to-coast carriers. They become assembly carriers for goods to be forwarded by water-borne transportation, and terminal delivery carriers for goods whose major movement has been water-borne. The Panama Canal has had two main effects: it has diverted traffic from transcontinental railways to steamships, and it has favored industries near the coasts at the expense of those in the interior. The projected waterways are designed to restore and stimulate the interior industries. Industries will gradually adjust themselves to these changing influences and opportunities. It is believed that distribution costs will be reduced for the country as a whole. Time will tell just how far and fast this development will extend. For the United States, in our view, the waterways will have a larger meaning for urban industries than for agriculture. And for agriculture, the effect will be more on prices the farmers pay than upon the prices they receive.

[1] The St. Lawrence Treaty was signed on July 18, 1932. It has to be ratified by the Senate of the United States and the Dominion Parliament of Canada, and must then be carried into effect by appropriations by both countries, Canada to receive credit for expenditure on the new Welland Canal.

This study is the work of Alonzo E. Taylor

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