

American Inland Waterways



Herbert Quick







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The Levee at Louisville, Kentucky.

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American Inland Waterways

Their Relation to Railway Transportation and to the
National Welfare; Their Creation, Restoration
and Maintenance

By

Herbert Quick

With 80 Illustrations and a Map

G. P. Putnam's Sons
New York and London
The Knickerbocker Press

1909

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The Knickerbocker Press, New York

Preface

NO critic can be more keenly conscious of the shortcomings of this book than is its author, who will be quite satisfied if it shall be found by the more discriminating to be sound, suggestive, and generally useful.

In the nature of things, a study of American inland waterways, and especially one which considers them in their relations to the national welfare and to railway transportation, and seeks to shed light upon the problems of their creation, restoration, and maintenance, must be a somewhat cursory one if confined to the compass of one volume, and is likely to levy contributions upon more branches of learning and research than one writer is likely to have mastered. Such at least has been the case with the present writer and the present book. He is under obligations to very many writers to whom credit has not been given, and to a large number of engineers and other specialists whose instructions have enlightened him, but who cannot be held to even that slight measure of responsibility, for the contents of the book, which might be implied in definite and personal thanks. Perhaps it will tend

to establish candid relations with the reader, if the statement be made here that, while the writer is not an engineer, every statement of engineering doctrine in the book has been scanned by competent specialists; that, while the author is not a forester or reclamation expert, all his assertions on matters within the peculiar field of such experts have been examined by them; and, lastly, that the author as a writer on public affairs has considered the complex topics related to our water resources as questions to be studied as an interrelated whole by the statesman under instructions from the technical expert, rather than by diverse groups of experts aided by occasional acts of statesmanship. This book seeks to translate the scientific learning of the subject into terms capable of comprehension and enjoyment by the average citizen, to avoid error, and to present national dangers, problems, and opportunities in the light of their moral and political, as well as their technical aspects.

However triumphant spiritual and moral things may be in some other life, their influence over this life depends on the material. Education and religion, art and intellect all depend on soil, production, distribution, transportation, commerce. We are fated to live, and either develop fully, or suffer arrested development, in a huge continent the very extent of which presents a tremendous barrier to human intercourse. Up to this time, we have used land carriage well, but we have

approached the limits of our development by its agency alone. No complete flowering of a modern civilization is possible in the interior of a continent, save by cheaper and easier transportation than railways can possibly afford. The car-shortage of 1906 and 1907 was the first crisis of many which we must suffer, unless our waterways are restored and maintained. It was the first convulsion of a strangling commercial growth.

The disappearance of commerce from our waterways seemed like a striking instance of the death of the unfit in the struggle for commercial existence. The experience of other nations shows that this is not so. Fitness to live for human service is quite another matter from fitness to survive in the contests of the jungle. We fit the earth for use by determining what organisms shall survive. We must so bend the energies of the agencies of land transportation as to allow the waterway to live as a tool of trade, to the benefit of the whole nation, including the railways.

Having found the way by which the railways may be prevented from killing water-borne traffic, we must make our waterways fit for their work. Traffic will follow even the shallow river or canal, if protected from uneconomic competition, but it is wasteful to compel trade to follow the water unless those facilities are provided which are necessary to make water traffic economical.

A first requisite of cheap water transport is depth of water. The great trunk lines of traffic, like the Great Lakes, the Mississippi, the Ohio, the Missouri, the Columbia, and the Tennessee must be given depths in proportion to their functions. The Mississippi must be made a loop of the sea, and given connection with Lake Michigan as our part of the continental back-water of which Canada will build her part, and thus gain the whip-hand over us if we do not build ours. But most of our waterways must in the nature of the case be rather shallow, and our problems with them are to be found in matters of terminals and the types of vessels.

Floods militate against navigation by carrying off in excessive flow the water needed for boats in time of droughts, and must be controlled wherever practicable by systems of reservoirs, out of which the impounded waters may be allowed to flow for the cure of low water. Such reservoirs cannot be safely built in regions denuded of their forests and undergoing rapid erosion, or in danger of it. Therefore, as an integral part of our internal waterway improvement system, our highlands, the birthplaces of our rivers, must be reforested where the trees have been destroyed; and in all cases where forests exist, the public safety demands that they shall be dealt with according to the principles of the best forest practice, rather than for the immediate enrichment of their owners. Posterity may not have done

anything for us, but that fact does not relieve us of our duties to posterity. Racial duty is a thing we owe to ourselves, far more than to those generations who shall succeed us.

Wherever reservoirs are constructed for the impounding of water, either for irrigation or flood-prevention and navigation, water-power is generated. Here the subject of inland waterways brings us into touch with the great problems of power, heat, light, coal resources, and the conservation of those mechanical efficiencies that go so far to account for the difference in our favor between the nations of to-day and those of antiquity. Our water resources are scarcely less important, if at all, as affording a cheap transportation system, than as sources of power which will put off the evil day when, with our fuel supplies exhausted, we shall decay in civilization and wane in power.

All these questions are dealt with in this book as related parts of the great problem of national efficiency and the conservation of the resources of this planet,—resources which we have the power to impair or conserve according to our racial fitness for our trust.

In the course of this review of these matters, the author has at times been obliged to make choice between contending schools of technical thought. The controversy between the civilian engineers and scientists and the army engineers with regard to the improvement of streams by head-waters control and the

co-ordination of the work of the government in the related fields of river improvement, canal construction, and irrigation and forestation is one as to which we are called upon to take sides. Our representatives in Congress will have to do so, surely. Fortunately, as the writer views it, it is not a controversy—momentous as it is—where the intelligent citizen must hopelessly ask himself “Who shall decide, when doctors disagree?” The author of this book, at least, has had no difficulty in coming to a decision in the premises.

Thanks are hereby rendered to all from whose writings or utterances the author has received aid in the preparation of this volume. He desires especially to make mention of the *Preliminary Report of the Inland Waterways Commission*, the excellent *Report to the Chicago Harbor Commission*, published this year, and to the various authors of the papers and addresses mentioned in the text and notes. And, finally, the author wishes to acknowledge the incongruities growing out of the serial form in which many of these pages were first published, and of the fluidity of the subject-matter itself, which changes in status from day to day. For instance, the report of the army engineers on the Lakes-to-the-Gulf Deep Waterway, published during the summer of 1909, was not in existence when the text on that subject was prepared. There is nothing in it, however, which is felt to affect in any way the validity of the conclusions in the book. And

any statement of the subject which might be made is likely to become obsolete in details through the happenings of any year. It is hoped, however, that the basis of the book is to be found in the permanent principles of a subject which must always command the attention of the nation.

H. Q.

MADISON, WISCONSIN, July 1, 1909.

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Inland Waterways

Chapter I

The Grand Strategy of Trade

CONFERENCES and congresses may cry "Peace! Peace!" and philanthropy may endow movements for turning the future into one long Christmas eve of good will, but as a matter of hard fact there is no peace. War is æonian, if not eternal. It used to be prosecuted by good dry knock of fist or rake of claw; then by knife or spear; and through lethal gradations it evolved to thirteen-inch guns, armored trains, barb-wire entanglements, and the Red Cross. To-morrow it may be disarmament; but in any case war will go on. Strong peoples will still hold weak peoples in subjection, if not by arms and armor, then by the arts of trade. Wars of nations will give place to competition for supremacy in carrying to all the earth things to feed, shelter, and clothe mankind—the warfare of the future. Nay, it is the warfare of to-day. The very navies which so tax the nations are said to be necessities of commerce; but in the last analysis the victors must be the people with the most productive soil, the greatest

national energy, the best system of industrial education, the deepest and safest harbors, the best and cheapest transportation, and the wisest conservation of natural resources. As Bacon said: "There be three things which make a nation great and prosperous: a fertile soil, busy workshops, and easy conveyance for men and commodities from one place to another."

We are a nation very well affected toward our own good qualities, and apt to make mention of them at times; and most Americans are secretly loath to admit that any other nation can beat us at anything. There is no reason why we should admit it—except that at many things other nations do beat us. The Germans are out to take the manufacturing headship of the world. Their manufacturers lead us all in the application of science—especially engineering science—to production. In England, in Austria, in the Scandinavian countries, in Italy, much more than here, chemists and savants are working in double harness with men of capital—and their synthetic indigo, artificial nitrates, "wormless" silk, and the like, are revolutionizing whole industries and threatening others. They are threatening ours. But doubtless we shall belatedly wake, one of these days, and learn our various businesses as our competitors are learning them. We have Bacon's fertile soil; we have the busy workshops; but whether we can make the most of the one and keep the other busy must in large measure depend on our answer to the third requirement, the

“easy conveyance for men and commodities from one place to another.”

For transportation is production. We have not actually finished the production of anything until we have placed it in the hands of the consumer. The production of rubber, for instance is not finished with the coming in from the forest of the negro peon with his load, but only when the tire is fitted to the wheel or the head to the pencil. Transportation is a part of production and a charge upon it. Like taxes, it mingles with the cost of goods in every step of their making, from the forest and mine to the retailer's counter. That is why easy conveyance from place to place tends to make a nation great and prosperous and powerful. And that is why the intelligent American now begins to think and act and legislate and plan more and more with reference to transportation.

The air just now is full of the unprecipitated vapor of transportation matters. The relations of the people to the railways have filled more printed space in the past three years than has any other subject. They bid fair to engross our thoughts for a long time in the future. And now arises the related topic of waterways and waterway improvements.

We are actually digging an isthmian canal. This great work we shall carry forward, or incur national disgrace and stultification. But the canal idea seems fruitful, and breeds other canal and waterway ideas.

A president has appointed the Inland Waterways Commission, gone down the Mississippi, and revived the project of a channel from the Gulf to the Lakes. Atlanta, Pittsburg, Kansas City, the people of the Atlantic and Gulf cities—all set up the cry for more waterways and deeper ones. That we are entering upon an era of such improvement seems certain. The congress henceforth will be asked to do more for canals and rivers than heretofore in the history of the nation. It is important, therefore, to know just how much of this is a temporary craze, incited by car-shortages and anti-railway sentiment, and how much is justified by sense and experience. In the language of the street, what is there to this waterways matter? Transportation agencies are mere tools of production. Are n't our present tools as good as we need?

What are our competitors doing in this matter of inland waterways?

They are doing a great deal. Industrially and commercially our competitors are Great Britain, Germany, France, the Low Countries, Austria-Hungary, Norway and Japan, and Canada. Japan and Norway may be left out of this discussion, as their coasts are by nature an almost unbroken succession of waterway terminals, and the sea flows everywhere into the heart of the land. Canada, for very special reasons, deserves separate consideration. What are the others doing as moves in the game?

Canal-building is one of the oldest of engineering



The Harbor at Hamburg, Germany.

From a photograph by Brown Bros., New York.

arts, but outside of China the canals of commerce are principally modern. England and France dug feverishly a hundred years or so ago; and so did we. We made four thousand miles of canals, of which we still use about half, and then we went railway mad, and left our waterways to ruin and neglect. But while we have been doing this France has quadrupled her internal waterway mileage. Since 1814 she has spent seven hundred and fifty million dollars for harbors and waterways, seven hundred million dollars for railways, and six hundred million dollars for wagon roads. A tidy sum to be expended for transportation in a country no larger than Texas, and it makes our five hundred million dollars (which is about what the United States has spent on rivers and harbors during our whole history) look rather small. France is now preparing to lay out one hundred million dollars more.

Ten years ago Belgium, with an area less than that of Massachusetts and Connecticut, had one thousand two hundred and forty-two miles of internal waterways. Her population is the densest, perhaps, in the whole world. On this superb system of canals this midget kingdom has spent and appropriated more than eighty million dollars—probably more than one hundred million dollars. In Belgium and Holland the ocean is brought to every city, and Holland and Belgium are world powers in commerce and manufacturing. A ton of raw materials comes to them a thousand miles for a dollar.

Their transportation tools are the best in the world. Rotterdam has dropped twenty millions of her hard-gripped Dutch dollars into the bettering of her one harbor.¹ The little British Isles have four thousand miles of canals (mostly absurdly shallow), and as many more of improved waterways. They are carrying commerce, regulating freight rates, and the demand is for more and better waterways. One city of England has built the Manchester ship canal at an expense of eighty million dollars to bring the sea only thirty-five miles inland. On the harbors of Newcastle, Glasgow, Liverpool, and Manchester alone three hundred and twenty million to three hundred and fifty million dollars have been spent in our times. Germany has ten thousand miles of internal waterways, including three thousand miles of actual digging, and the German policy seems to be to make a highway of every stream that has water enough to fill a canal. She has expended sixty million dollars on canals alone, and has under way a program of waterway improvement which runs into the expenditure of hundreds of millions. Austria and Hungary have within recent years spent on rivers and canals fully two hundred million dollars.

China, with her population of four hundred millions on an area equal to the Mississippi valley, has so wonderful a system of old-fashioned shallow canals that almost every town can ship by water to the sea. Transportation there is cheap, and this great population is

¹ See note *a* at end of volume.



Navigation on a Small River—between Cheboygan and
Petoskey, Mich.

The German water traffic tends to this tug-and-barge form.

Photo by Detroit Publishing Co.

largely made possible by a system of cheap internal traffic. Even Russia has built canals and improved rivers, until now one may sail from Moscow or St. Petersburg for ports on the Arctic Ocean, the Black Sea, or the Caspian Sea. She has built the Constadt-St. Petersburg Canal at a cost of ten million dollars, and purposes carrying a canal, it is said, over the low Ural hills to the waters of the Obi, bringing the great wheat-raising areas of Siberia into the waterways system she has already established to compete with our farmers who ship by rail. Cast up the amounts I have set down as already invested in the waterway tool of trade by our competitors. In some cases I may have accepted excessive sums as correct, the exact facts being difficult to come at; but that I have found anything like the total expenditures I have no idea. I have not mentioned such harbors as Trieste or Bremerhaven or Hamburg—but I can find seven seaports upon the harbors of which our competitors have spent as much as we have laid out on all our rivers and harbors in all our history.

They are adopting and perfecting the inland waterway, that tool of trade, so long rejected and abandoned by us. Why? Are they chasing rainbows, and literally throwing their money into the water? Do not believe it. They know what they are about. There is no mystery in the matter. In the grand strategy of trade our competitors have acted upon the principle, well known to physics, that it is easier to move an ob-

ject floating in a liquid than to carry it on any wheeled carriage. A recent magazine writer, advocating a canal from Ashtabula to Pittsburg, says that it would do the work of fifteen railroads at the cost of one. On the Sault Ste. Marie Canal a dollar paid out for freight will carry a ton a thousand miles; even on the old Erie Canal it will bear it five hundred and twenty-six miles; on the new Erie it is estimated that the dollar will take the ton nineteen hundred miles; while, on the average, a dollar's worth of freight on the American railway is only about one hundred and thirty-three ton-miles. Our competitors are simply using, in that part of production consisting of transportation, a tool that does the work at from one-fifteenth to one-fourth the expense of the tool we mostly use. Can we stay in the fight under such a handicap?

Sir E. Leader Williams, the great English engineer, writing of the Manchester Canal, said long ago: "The saving of the cost of carriage, amounting to seven hundred thousands of pounds a year, assists manufacturers to meet the competition of foreign opponents who have the advantage of low rates on improved waterways."¹ The British manufacturer is pitted against the competition of the world, and must have the best tools or go to the wall; so he spends eighty million dollars for a thirty-five-mile canal. We are in no better position to compete with foreign manufacturers than is England, if as good, unless we make

¹ See note *b* at end of volume.

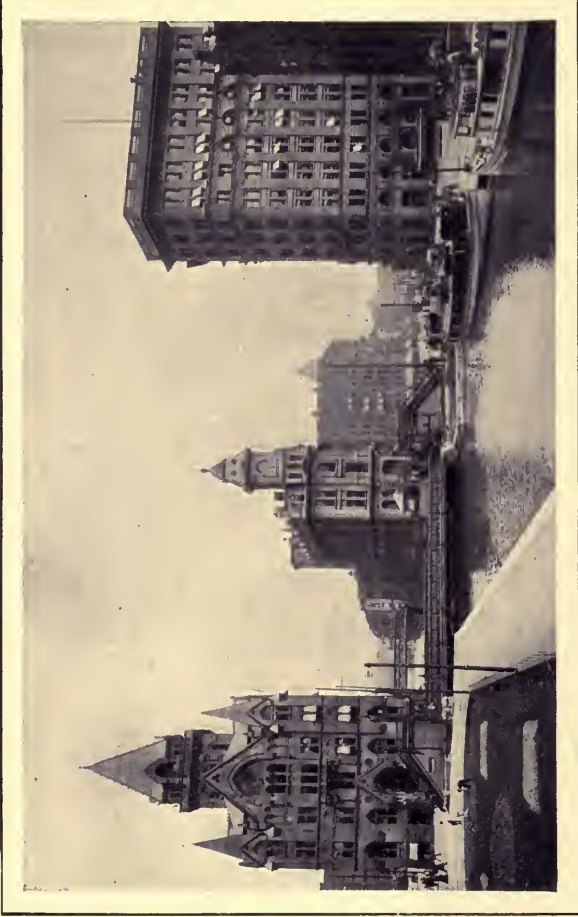
the most of every advantage. Yet in this one tool, and no agency is more important, they are from four to fifteen times as well equipped as are our manufacturers who have not the benefits of waterways.

Our farmers are no better off. It has been stated that the improvement of the Erie Canal will put us on an equality, merely, with the Argentine farmer in marketing wheat; but in getting to the Erie Canal our freight passes over stream after stream which in Austria or Russia would be a place for emptying cars and loading boats. As long ago as 1891 Mr. James J. Hill is quoted by Mr. S. A. Thompson, of Duluth, in a congressional hearing, as authority for the statement that, with twenty-seven-hundred-ton steamers, Mr. Hill was moving as much freight on the lakes for one dollar as the best-equipped railway in America could move the same distance for twenty-six dollars, and that with six-thousand-ton boats he could cut *that* in two. That was a long time ago, and railways can now do better than then; but so can boats. Water-borne freights have progressively decreased, falling between 1868 and 1885 from twenty-five and three-tenths cents per bushel of wheat for the trip *via* the lakes and the Erie Canal to four and fifty-three hundredths cents. And against nations having this tool at command, we are pitted in the tense war of competition—we who have the best system of internal waterways in the world, if we would only develop them!

To the American who thinks it a matter of no con-

sequence that our European competitors are able to come into market with goods shipped by water and made from water-borne materials, it is suggested that if he were in competition with a firm possessing such an advantage in the next town he could not sleep of nights until he had put himself upon an equality with his antagonist. True, the competitors mentioned are across the sea; but so is the trade sought. To him who can not visualize the effect upon himself of his European opponent, or his economic loss from using inferior appliances in production, let us point out a competitor nearer home—Canada.

When the United States lay east of the Alleghanies, only one waterway concerned our thoughts—the Atlantic. But even then Canada was in the field for the control of the interior by its lakes and rivers. She had, and still has, the great St. Lawrence roadway between the Atlantic and the continent's heart. Her explorers, evangelists, traders, and soldiers pressed on along the easy water-lines to the very ends of the Great Lakes, and over to that other great artery of communication, the Mississippi. In Wisconsin, in Illinois, in Indiana, Ohio, and Pennsylvania were easy narrow portages from headwaters to headwaters, and over these the French poured, made treaties with the Indians, called them to the true religion, and built forts. Never were two such systems of interior navigation so easy of connection. England held the coast, but French Canada controlled the hinterland.



The Erie Canal as it Passes Through Syracuse.

Then we pushed our boundary to the Mississippi. Still Canada held the St. Lawrence, and now France, now Spain the mouth of the Mississippi. The pioneers flowed over the mountains, and when they began production on Mississippi waters their paramount issue became the free navigation of the Mississippi. They could ship to the sea at New Orleans, there to be subjected to French and Spanish requirements, and to burdens intolerable. War and sedition simmered through the West; and Burr-conspiracies vied with Jackson-invasions to fill the popular mind. Down the lakes Canada still held the sea. Down the Mississippi the way out was barred by France or Spain. Why rehearse history? Simply because history is rehearsing itself. The same issue again rises to paramountcy. The two openings to the sea by the St. Lawrence and the Mississippi are again exercising their power over commerce; and again Canada occupies the centre of the stage.

The St. Lawrence question was postponed by DeWitt Clinton and the Erie Canal, and New York held her western trade. The Erie Canal made New York and one of the best systems of interior cities in the world, stretching from Albany to Chicago and Duluth. It was a piece of statesmanship that waxes greater and greater as we contemplate it in the light of its accomplished results.

Canada restored the St. Lawrence outlet by canals and locks. New York had made a ditch for barges;

Canada proposed a waterway for ships. Trade must follow the deepest water. So Our Lady of the Snows made the Welland Canal from Lake Erie to Lake Ontario, added forty-three miles of canal-and-lock engineering on the St. Lawrence, and brought fourteen feet of water down to the sea at Montreal. She deepened her river to twenty-seven and one-half feet from Montreal to the sea, and when through the fine Lachine, Soulanges, Long Sault, Welland, and other canals she had brought the lake ports into communication with the ocean by ships through Canadian territory, she had trumped DeWitt Clinton's ace. Only one thing stood in the way of her complete triumph: When she began her splendid system of improvements a vessel drawing twelve and a half feet of water was a sea-going ship. By the time she had done, an ocean vessel called for twenty feet or more. So, although with a population during the time of these exertions scarcely larger than that of Massachusetts she spent sixty million dollars on canals, Canada stood, still unsatisfied, with the pride of nationality in her eye and her arm bared to fit her waterways to the deeper ships.

The speaker of the Canadian House, in a speech at Kansas City in the summer of 1907, quoted and made his own this statement of a Canadian government publication: "People now alive," said he, "will see the minimum depth [in the lakes-Montreal waterway] twenty-one feet; and when that day arrives, Montreal and Quebec, Halifax and St. John, and

perhaps some quiet harbor that is as yet only dreamed of, will be the busiest ports of the North American continent. Of this great highway Canada holds the door. It is a great national asset, and more than anything else gives Canada a dominating position on this continent.”¹

Little old New York may well sit up and observe these words and the situation to which they apply. She has held her trade by means of the Erie Canal and her railways. Can she continue to hold it with congested railways and the fifteen-hundred-ton barges of the new Erie Canal (as yet unbuilt) against the actual fourteen-foot channel and the prospective passage of twenty-one or more to Montreal? A recent writer has justly described New York as the world's greatest port, and spoken eloquently of the enormous commerce of her four hundred miles of docks. Yet here is a Canadian high official speaking of some Canadian port of the future being “the busiest port of the North American continent.” Are we “seeing things,” or has the commerce of New York been flanked and her “communications” threatened? And if so, what does it signify?

The mere writer has ever before him the temptation to become perfervid and sensational. His statement that the commerce of Manhattan is destined to be drawn off from the rear would carry little weight, perhaps, even though reinforced by the consideration that trade

¹ See note *c* at end of volume.

is cold-blooded and unpatriotic, and goes along the line of least expense. The committee on railways and canals of the Fifty-second Congress, however, had no temptation to overstatement. Listen to what it said: "On the day that it becomes possible to send ships direct from the Great Lakes to the ocean by way of the St. Lawrence River, while they are unable to go by way of the Hudson, the sceptre of commercial supremacy will begin to pass from New York to Montreal, and the merchant marine of the United States, which has had a new birth on the lakes, will receive its death-blow from Canadian competition."

This was in 1892, and the report favored the construction by the United States of a deep-water channel from the lakes to the Hudson. The project was never carried out. New York somehow became imbued with the notion that her interests would be better subserved by a barge canal which would force shipments to unload and reload—"break bulk," as it is termed—on her docks and those of Buffalo; and the new Erie Canal was voted one hundred and one million dollars by the State, Buffalo casting the deciding votes. Canada, however, is proceeding with her flanking movement, and, under the slogan of unbroken bulk from the lakes to the foreign port—or at most, but one transshipment—is moving forward and carrying the war past Manhattan into the very heart of the continent. Not only New York, but Chicago, Duluth, Detroit, Buffalo, Cleveland, Toledo, Milwaukee, and



A Great Wheat Transfer Point. Elevators at Buffalo.

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their sister cities may well ask themselves how they like being placed in the predicament that Cincinnati and Louisville were in when the mouth of the Mississippi was closed. Fort William, Port Arthur, Toronto, and the other Canadian ports must hold the whip-hand when they may successfully call upon their government to give it to them.

Why stop at the Canadian Lake Superior ports? The farmers of the Mississippi valley find their hardest competitors in the Canadian northwest. Winnipeg is the greatest wheat market in the world. The sceptre passed from Chicago to Minneapolis, then to Duluth, and now has gone to the young giant of Manitoba. In 1907 Winnipeg exported twenty per cent. more wheat than West Superior and Duluth combined—and the flood of grain from the new northwest has only begun. One cereal competes with all the others. The grains of the Saskatchewan basin will displace the corn of the Mississippi valley; and when it goes to the sea in ships, while ours, if in American bottoms, must go in barges, shall we not be indebted to Canadian generosity if we stand on an equality with Canadian farmers? Let the Bently congressional report again speak more strongly than I should dare: "When we come to compete," it says, "with men of our own race, with a soil just as productive, and with transportation facilities immeasurably superior, the farmers of . . . our Western States are going to have an agricultural depression such as they never knew before, unless our

2

own nation shall give us a way to the sea so that our ships can go and come as freely as they do on the ocean." It is submitted that a barge canal, such as New York is now building, will not save the situation for either New York or the nation.

The Banquo's ghost which will not down is Canada. In an era of waterway improvement she must take a foremost place among builders. Let her past speak. "In proportion to our population and her population and resources, the expenditures of the Dominion in developing both rail and waterways have been enormously greater than those of the United States. With one-twelfth of our population, in a less favorable climate, and with natural resources far inferior to ours, she has fearlessly grasped her great and difficult transportation problem." So runs the Bently report of 1892. Since then Canada has found her natural resources, and is growing like a mushroom in population. In pride and resolve and sense of dignity—those moral factors so important in this problem—she has greatened still more. In the matter of flanking New York and taking the commerce of the West through the Montreal door, she knows, too, exactly what she is about and what she can do.

With fourteen feet of water to New York and the same to Montreal, the Canadian port has three hundred miles' advantage in distance; and she is preparing to cut off more and more. She will do this in two ways. Observe the system of lakes and rivers cutting On-



Canadian Locks in her Canal Paralleling that of the United States,
Sault Ste. Marie.

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tario across—the Trent, the Severn, Lake Simcoe, and others. Here is the Trent Canal navigation system, now open from Lake Simcoe to the head of Healey's Falls, one hundred and thirty-five miles—but not yet through into Georgian Bay, nor Lake Ontario. Most of the unfinished portion is under contract. It has now a minimum depth of six feet, but its deepening is planned. Forty-six miles of shallows deepened, twenty miles of actual canal dug, and Montreal is some two or three hundred miles nearer Lake Huron. Should this be made a ship canal, a vessel taking it would be at Montreal by the time one of our "new Erie" barges could reach Rochester, if they passed the "Soo" at the same time, speed being equal.

But this, to us, is by no means the worst. The real strategic opening out of Lake Huron eastwardly and seawardly is by the projected Georgian Bay ship canal through the French River and Lake Nipissing—both noble bodies of water of ample volume. From the eastern shore of Nipissing it is a short portage to the Ottawa, a magnificent stream flowing right to Montreal with immense volume. To make this route navigable takes less actual canal construction than Canada has done on the St. Lawrence from Lake Ontario to Montreal—it is given at only twenty-nine miles. Most of the way is broad, open water. There are falls and rapids to pass, to be sure, but so there were in the St. Lawrence. One can see no reason why this route should not be quicker, mile for mile, than the present

way. A ship canal would bring seagoing vessels to every lake port, through British territory, on a line so short that outgoing vessels taking it could be cleared from Montreal and on their way to the open sea before the Erie Canal barge starting at the same time from the same place could reach Cleveland. Montreal is as near Liverpool as is New York. The Canadian route would save all the time and charges of the Erie Canal, the breaking of bulk twice, and, it would seem, could not fail to bring that revolution in favor of Canadian ports which the Bently report predicts. It would seem to be able to put both the Erie Canal and New York out of business so far as the great continental commerce is concerned.¹

To quote that public document again: "It is not a question whether the products of the West and Northwest shall go by way of the Erie Canal, or by rail from Buffalo, or not go at all; but whether the transportation of these products shall be retained in American hands, on American soil, and reach an American port, or whether it shall be surrendered to Canada." Furthermore, "breadstuffs and provisions constitute so large a percentage of our entire exports that vessels carrying these"—and I may add iron, the production of which on the lakes has so greatly increased since the Fifty-second Congress—"that vessels carrying these must necessarily be the ones in which to return our imports." This looks rather convincing, does

¹ See note *d* at end of volume.

it not? New York can take care of herself, it may be assumed. She has chosen a shallow and wide canal for barges, rather than a ship canal. Perhaps she chose wisely. It may be that she could not long compete with the St. Lawrence outlet in any case. Or it may be that the new Erie Canal will meet the competition of Canada's deep water better than is suggested. Anyhow, New York did not care to build a ship canal for Chicago and Duluth—and she has blocked ship-canal construction by way of the Hudson effectively, it would seem. But is the nation at large to neglect its interests along other routes? To do so appears the essence of fatuousness.

No era of canal-building can be expected long to continue and leave uncompleted both the Trent route and the Georgian Bay ship canal. But the possibilities of Canadian competition do not stop there. I have spoken of Winnipeg. Those most competent to judge look upon this young city as a powerful bidder for the headship of Canadian cities. She leads the world in grain shipments. She claims the world's greatest railway yards. She has more than one hundred thousand people, filled with the spirit that built up Chicago, Kansas City, San Francisco, Seattle, and the great young cities of our own West. She is destined to be the Chicago of Canada, while with a ship canal into the lakes, the New York of Canada—that “quiet port as yet only dreamed of” mentioned by the honorable speaker at Kansas City—is quite likely to be at “the

twin cities of Thunder Bay," Fort William, and Port Arthur.

And in this matter of waterways Winnipeg will not always be counted out. She is at the junction of the Assiniboine, now navigated for three hundred miles into the wheat fields, and the Red River of the North, up which steamboats can come to the Minnesota, and which brings the sweep of her influence south to Grand Forks and Fargo. Winnipeg is building locks to give her navigation into Lake Winnipeg, as large as Lake Erie, and thence into the Saskatchewan River system, which is navigated for a thousand miles; and all this among the grain fields with which our farmers must compete. While our producers are paying the tariffs which railways must have if they make anything on the carriage of grain, their Canadian brethren, if awake to their own interests, will have the advantage of water competition, the best-known regulator of rates.

We have been speaking of actualities. But in commerce, as in warfare, we should consider all the moves as actually made which our antagonist can make in the game, and which are to his advantage.

Reasoning thus, what moves are open to Winnipeg? Two important ones: She can go to the sea by way of the Nelson River from Lake Winnipeg to Hudson's Bay, or she can come into Lake Superior with any sort of canal she desires, or—and this is what she will do—she can do both.

Let no one, without consideration, cry down the

importance of Hudson's Bay as a commercial possibility. It is the White Sea of America, and it will sometime have its Archangel—the Russian port which carries on its great trade, with a harbor frozen from September to May. Winnipeg will soon have navigation into Lake Winnipeg; and thence to the sea flows the great Nelson River, deep and swift, vexed with rapids, and four hundred and fifty miles long. For more than half this length it is now navigable. The project of making it a waterway to the sea is one of those which is already discussed, and the practicability and utility of which must give it vitality.

But Winnipeg's waterway system, already reaching from the foothills of the Rocky Mountains on the west, and the back yard of Minneapolis on the south, to the mighty Lake Winnipeg on the north, and, eventually, by ship canal to Hudson's Bay, has another possible outlet—that into Lake Superior. The great feeder of Lake Winnipeg from the east is the Winnipeg River, rising in the Lake of the Woods, on the northern border of Minnesota. It is a great river, and is already navigable for two hundred and eight miles of its length of two hundred and fifty. From the Lake of the Woods extends an uninterrupted series of waterways—Rainy River, Rainy Lake, Nemekan Lake, Loon Lake, Nequokan Lake, and others—a magnificent series of connected stretches of open water fit to carry the commerce of Winnipeg's mighty young empire down to Thunder Bay, on Lake Superior, with

only a few miles of canal. There are some rapids, some falls; but the engineering difficulties are as nothing compared with the objects to be accomplished. The very logic of the earth's surface, the demands of an abounding commercial ambition and the power of abounding wealth must finally demand the making of this great way; and we shall see these beautiful lakes and rivers among the great commercial highways of the world. Here must be the Erie Canal of the new West, or the ship canal to its Chicago. The waterway system of Canada will then have become co-extensive with her productive area, and ships may load from Winnipeg's docks for all parts of the world.

The outlook is one of dazzling splendor—for Canada. Occupying the northern half of the continent, she is ice-bound for a good part of the year—nothing can ever rob us of that advantage over her—but while the season serves she can operate along the short lines as to strategic distances. The short line is an advantage. How many of my readers know that a port on Hudson's Bay will be nearer to Liverpool than is New York? From Fort York, where Winnipeg's commerce may debouch, is only two thousand nine hundred and sixty-six miles to Liverpool, while from New York the British port is three thousand and fifty-two miles. From Montreal to Liverpool is two thousand seven hundred and thirty miles. By the Georgian Bay ship canal, French River on Lake Huron, will be three thousand one hundred and seventy



A Jungle of Cars, Hoists, and Vessels at the Orc Docks of Buffalo.

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miles from Liverpool, or only one hundred and eighteen miles farther than is New York. Winnipeg itself, *via* the Nelson River-Hudson Bay route, would be almost as near Liverpool as is Philadelphia. These are some of the strategic distances which must militate in favor of Canada in the commerce of the future.

To sum up: Europe has built and is building waterways for the purpose of reducing transportation charges that she may control the world's trade. Canada, with fine sagacity, has pursued the policy of striking at New York's trade from the rear in the interests of Montreal and her lake cities. The danger was acute in the minds of American statesmen as long ago as the Fifty-second Congress. The deepening draft of ocean vessels seems to be the great factor enabling New York to hold her western trade as well as she has; and Canada is preparing to deepen her waterways to meet the demands of modern ships. New York has abandoned the idea of a ship channel from the lakes to the Hudson, and has contented herself with a barge canal which makes it necessary to break bulk twice in sea-going shipments. Whether she can thus hold her trade or not against the shorter lines and deeper channels which Canada is preparing is a question for her to meet; but the nation at large is confronted with the old danger of having our great avenues of commerce flow to the sea through foreign territory, and our trade liable to the imposition of such burdens and discriminations as must tend inevitably to the destruc-

tion of our merchant marine and the building up of our neighbor nation's. How to meet this situation will be discussed hereafter.

At a time when the two great branches of the English-speaking race have forgotten animosities and become closer friends than any two separate nations have ever been perhaps in the history of the world, it may seem ungenerous to mention the matter of future strife between the British Empire and this Republic. Yet it belongs to this discussion, and must be considered.

We have no navy on the Great Lakes. Neither has England. We have no way of getting a navy into them. England has. She now has passage for vessels drawing from twelve to fourteen feet, and will be able to get large war-ships through when she carries out her plan for deepening the canals. In case of war, we are absolutely at her mercy. The entire lake seaboard, from our farthest eastern reach on the St. Lawrence, to Chicago and Duluth, lies absolutely at the mercy of the British naval force that rides habitually at Halifax, Quebec, and Montreal. In a week of hostilities the sky-scrapers on Michigan Boulevard and Dearborn Street, the buildings of Milwaukee, Cleveland, Toledo, Buffalo, and all the rest might either crumble under gunfire, or we should sue for peace. We could not help it. We have no way of defending any of these places from a naval attack. We have no way of intercepting a naval attack from the St. Lawrence. Absolutely nothing protects our lake



A Glance at Canada's Waterways and the Routes they Make Possible.

(Map-scale, 360 miles to the inch).

seaboard except our amicable relations with Great Britain. To be sure, Great Britain is forbidden by treaty from maintaining war-ships on the lakes; but treaties may be abrogated. As to the lakes, we have disarmed, while the other party has not. One week of war with Great Britain would bring us national humiliation, if not defeat, and would cost more to our Great Lake cities in dollars than it would take to build a thirty-foot waterway from New Orleans to Chicago. This is a possibility on which the placid "practical" American may well ponder.

Chapter II

Bringing the Sea to the Farms

“**T**HE opening of the Ottawa Navigation,” says a publication issued to promote the Georgian Bay ship canal, “as a through waterway, is not only a commercial necessity, but a measure of national and imperial importance. Of military importance, as the only possible waterway between the Great Lakes and the Atlantic entirely within Canadian territory.” That twenty-one feet of water through this channel means much of prejudice to us in a military way, any one can see. That it imperils all our foreign-bound and much of our domestic trade on the lakes, where most of our merchant marine is to be found, ordinary common-sense must make plain, leaving out of account the deliberate utterances to the same effect of statesmen and publicists on both sides of the line. That the Erie Canal deepened to no more than twelve feet can help the commercial situation much is more than doubtful; and it will do no good whatever from a naval viewpoint. The appeal of some project which will bring really deep-draft communication from salt water to the lakes through our own territory is one addressed

not only to our commercial and industrial needs, but to considerations of patriotism and national honor which should raise us above all questions of mere profit. As a matter of fact, however, nothing could show better prospects in the way of plain, bald money-making. "The sheeted spectre of naval operations on the lakes" may be effectually exorcised, our commercial equality there may be maintained, and the operation made to yield profits.

The country is humming with agitation for waterways. In part this is owing to a conviction that the rest of the world is stealing an industrial march upon us in adopting this cheap transportation agency; but chiefly, I think, it comes from the collapse of the railways under the tremendous traffic of our last three years of flush times. Not for eighty years have Americans thought so much of the improvement of rivers and the digging of canals. We are about to begin building, and we shall not stop until we have duplicated our railway system with a system of waterways. The railways have been built with no comprehensive plan—with no plan at all. No people can afford to make waterways in any such rule-of-thumb, haphazard way. We must have a comprehensive plan. It must be continental in scope. It must make the best possible use of natural waterways, and therefore will overpass national lines, ignore artificial trammels, and regard North America as a unit. The time must come "while water runs" when some of the things I

have been obliged to say as to the control of the lakes will have become happily obsolete. It will come all the sooner if we keep up our end of the work, and set the pace. Is there any natural and dominating artery in the drainage of the continent, the magnitude and extent of which marks it as the inevitable centre of any system we may adopt? The answer of every man with the map of the continent in his mind is that there is such a waterway, and that it is the Mississippi River.

The swirl of the Father of Waters sends up in its roar our true national anthem. This mighty valley is nature's own act of union for the people dwelling in it. The sweep of the great river's watery arms is wonderful. President Roosevelt, in his Memphis speech in the autumn of 1907, referred to its twelve to fifteen thousand miles of navigable channel, adding, "and conditions are so favorable that it will be easy to increase this to almost any required degree by canalization." The extent to which the Mississippi valley is the United States speaks out in the description of its boundaries. Its Red River arm skirts all North Texas, and penetrates New Mexico. Colorado and Wyoming are reached from it by the Arkansas and the branches of the Missouri, while Montana, away up to Helena and Virginia City, is a child of Mississippi-Missouri navigation. North Dakota marks the contact of Mississippi drainage with that of the Saskatchewan, and through the Mouse River hints at

the merger of the Canadian waterways system with that of the Mississippi; while through the Red River of the North and the Minnesota, boats may sometimes pass without a canal from St. Paul to Winnipeg, and thence through many watery ways into the wheat-fields. Minnesota and Michigan, Illinois, Indiana, and Ohio are scored with easy passages for canals from the basin of the Great Lakes to the Mississippi valley; all of them but Michigan are pierced by fine affluents of the great river; and as for Michigan, her ships may now go to Joliet, a Mississippi valley port. The Chautauqua Lake district in New York is in the Mississippi basin, and Pennsylvania and West Virginia send down the Ohio more Mississippi River traffic than any other States. Old Virginia sits with one foot on the Atlantic at Newport News, the other on Mississippi waters in the Clinch. Georgia pours out her historic Chickamauga into the Tennessee which misses her northwestern tip by scarcely more than a stone's throw, and sweeps nobly west across all Alabama—a great avenue of the commerce of the future, in which Georgia must share.

All the States within this splendid circle are scored and gridironed by thousands and thousands of miles of waterways actually or potentially navigable; and of the forty-six States, only sixteen are to be left out of the Mississippi roster. We need not think of sectionalism in speaking of the Mississippi. It is the nation's great asset in inland navigation. It must be

the keystone of the arch of our waterways system, the backbone which must uphold our perfected transportation plan, the aorta of our ideal traffic-circulation.

One looking at its majestic current in normal volume would wonder at the fact that anything needs to be done for its improvement. Yet the great stream is prone to spend its wealth of waters in orgies, and between them pass periods of pitiful poverty. There is plenty of water for the year round—if it flowed uniformly. It tears a great channel for itself at its terrific flood-tide, and wanders about in it, dwarfed to puny shallows at low water, like a diminished giant in his Goliath's clothes. It is a sea in March or April or June, and in August one may wade it contemptuously.

Then there are reaches where the slope is so steep that its very rapidity pulls the current down to shallowness. At such places its energy is so great that it digs into the earth, throws up bars, and splits itself into numerous channels, all too small for profitable navigation. It is not until it gets down to its "hydraulic level," as the engineers call it, at the mouth of the Red, that it moves along tamely, keeps to its channel, and is deep enough for ocean-going ships. All this pother about maintaining a deep channel in the Mississippi comes, not from any lack of water, but from waste of water, from steep slopes, from too great swiftness of current, and from the resulting necessities of domesticating and taming the wild, wasteful,

almost incorrigible stream, keeping it within its banks, confining it to one channel, and perhaps raising it to arbitrary levels and taking out the slope, with locks and dams.

At times and in places the upper river, from St. Paul to St. Louis, naturally goes almost dry. The original design of the government engineers was to improve it so as to afford four and one-half feet at low water. After twenty-eight years the maximum draft available for the six hundred and fifty-eight miles under consideration is just four and one-half feet, at ordinary low water, or an extreme low stage of three feet. The people of the Upper Mississippi Association have scarcely dared to ask for more than six feet at low water; and the canal at the Des Moines Rapids, near Keokuk, is only five feet deep—rather meagre figures for the run-off of a continent.

Below the mouth of the Missouri the river rushes down a very objectionable slope, and originally was diffused through so many channels, and was pulled out so thin by its rapidity, that even after the accession of the Big Muddy it had in many places a natural depth of only three and one-half to four feet at low water. A good deal of work has been done here in the way of confining it to the narrower way of a single channel, contracting this one path as much as possible, dredging the shallows, and the like; but the whole result of the present plans for this part of the stream is to get a minimum depth “at standard low water”—quite

different from extreme low water—of six feet only from the mouth of the Missouri to St. Louis, and eight feet thence to the mouth of the Ohio. And the utmost that present plans of the engineers contemplate for the reach from Cairo to the Gulf is a channel two hundred and fifty feet wide and nine feet deep at all stages of the stream.

No wonder that the old river man is saddened when he remembers the teeming commerce of the past, and looks at its shrunken remnants now. All over the world the waterways have been deepened, until it is a recognized condition of the business that vessels which cannot carry a train-load cannot successfully compete with trains. And yet, the means by which almost any required depth of water may be had the whole length of the Mississippi have been worked out. The upper Mississippi engineers report that the results of their work demonstrate that with "liberal appropriations the low-water channel between St. Paul and the Missouri River can be made sufficiently deep, available, and permanent to satisfy the demands of commerce." And when I asked one of the greatest engineers in the service of the United States if it were practicable to bring thirty feet of water through the Mississippi to St. Louis, he answered, "Entirely practicable. It is only a matter of money."

But the improvement of the Mississippi will not of itself solve the problem of salt-water communication with the Great Lakes. Its valley touches their basin

for thousands of miles, and in some places fine rivers flow close to each other, and then turn, one to the lakes, the other to the Mississippi, as if to suggest the cutting through of the low barrier of separating watershed. From the Fox to the Wisconsin, from the St. Louis to the St. Croix, from the Maumee to the Wabash—in many other places—are these old “portages” across which trade once flowed, and through which it will reflow; but the spot set apart by nature for a great, deep waterway between the two basins is where the great arm of the Illinois River, branching off from the Mississippi just above St. Louis, reaches over to the northeast so far that its headwaters sometimes dribble over into Lake Michigan through the marshes of the Des Plaines, Calumet, and Chicago rivers.

The question has often been asked, “Why did the early trappers and traders fix upon that swampy site for Chicago?” They could not have foreseen its commanding position for commerce. All the magic of the growth and blossoming of the continent was hidden from them—unless they possessed supernatural pre-science. Did they possess it? No. They were simple trappers and traders. All they knew was that here the waters going to the Mississippi came within such distance from the lake that one might carry his canoe across with ease—and sometimes when the waters were high one might paddle straight through, and go from Montreal to New Orleans without a portage. The

low and narrow watershed—if that may be called such which did not “shed,” but only soaked in water—was the wonder of Joliet and his companions, who promptly proposed a canal across it.

It was already a highway. It had once been a waterway. The waters of the lakes flowed down by that path before the cataract business was established at the Niagara gorge, and ages and ages ago had cut out a great, gently sloping channel through which the Illinois still saunters. The continent tipped a little to the eastward, and the water spilled over at Niagara, instead of going down the Illinois—but it left its bed as a low place in the rim of the basin. Up the shrunken Illinois came the Indians and traders, and crossed to the lake—the prophecy and germ of a great commerce following the disembodied ghost of a waterway—these made the tiny frontier post that grew to a world-city, Chicago.

If Joliet, in 1673, so promptly recognized the place as a proper one for a canal, why has it not long ago been established? In a way, it was established. There has been a good deal of ineffective dabbling with canals across this part of Illinois, but on the whole we were railway-mad, and here, as in so many places, when a canal was finished the growing necessity for deep-draft boats rendered it useless. Gradually, however, another matter, entirely aside from transportation, came most curiously into the situation—that of pure water for Chicago. The city’s water-supply was con-

taminated by sewage running down the Chicago River into the lake, and typhoid did what railroad rates could not do—forced the building of the canal. The Chicago River flowed into the lake, carrying sewage. The bold proposal was made to reopen the old channel and let the river become an outlet instead of an affluent of the lake. The effects were various and astounding. The river, which had been the foulest in the world, flowed clear and pure—away from Lake Michigan. St. Louis began suits in equity to prevent Chicago's making a sewer of the Mississippi. Niagara and Buffalo awoke to the possible danger in the fact that every drop of water that went down the Illinois was so much subtracted from Niagara Falls. The lake ports from Buffalo to Racine protested that this new opening would drain the lakes down, and make their harbors shallower. The Canadian government took occasion to suggest that its interest in the level of the lakes and in the waterfall at Niagara was quite as great as ours, and that it had something to say about diverting the outflow to the Mississippi. With lawsuits to right of them, commissions to left of them, typhoid behind them, and a supply of pure water in front of them, the people of Chicago went on, digging the drainage canal, taking the water they needed, placating St. Louis, arguing with the engineers of two nations, and perfecting the business of dredging until their experience has made the Panama Canal possible. And among the compromises, concessions, and adjust-

ments of interests which this long course of judicial, legislative, and diplomatic trouble forced from Chicago was the obligation—which the wise of Chicago were glad to shoulder—of making the drainage ditch a ship canal to be donated to the United States as a part of the deep waterway from the lakes to the Gulf.

And Chicago has done this great work. She has spent fifty-five million dollars in deepening her river and widening it. She has torn out the old tunnels and dredged it to twenty-five feet. She has dug a capacious ship canal—one of the very greatest in the world—thirty-eight miles from the Chicago River to Joliet on the Illinois. She has made it twenty-four feet deep at low water in Lake Michigan, one hundred and sixty feet wide in the rock cut, and from two hundred to three hundred feet wide in the earth excavation. She has convinced St. Louis that the Mississippi will not be contaminated, and has enlisted the Missouri metropolis in the campaign for the St. Louis-Chicago waterway. She had obtained the right to take from Lake Michigan so much water as she imperatively needs to dilute her sewage, and she is planning to the end that she will be accorded more. This one city has expended a third of the money necessary to make the Lakes-to-the-Gulf Deep Waterway. It remains to be seen whether the nation will spend the rest.

All this time there have been men who kept up the agitation for waterways; and among them the Lakes-to-the-Gulf Deep Waterway Association. While gov-

ernment engineers have busied themselves with the important problems of to-day and next year, these men have hitched their wagon to the star of the achievement of bringing the ocean to the farm, and making all the lake ports and all the river towns seaports. They have been scoffed at and condemned as visionaries. Great reservoirs of anti-waterways sewage were emptied by interested parties into the channels of public opinion. Men powerful in the halls of legislation had become imbued with the notion that the transportation of this continent belongs to the present systems of public carriers, and publicly boasted of looking through gimlet-holes too small to allow any glimpse of the necessity of waterways, or of danger or disgrace, present or prospective, in our loss of the equal control of the lakes. While cheerfully voting more than two thirds of our revenues to wars and the rewards of wars, our Senators and Congressmen have shuddered at the suggestion of any increase beyond the niggardly one thirtieth doled out to waterways. But always there were some who felt the need of which the public in general was oblivious. Gradually the movement has gathered way, until it has swelled into a demand, which cannot and will not be resisted, for, not the nine-foot channel now sought to be established by government engineers, but fourteen feet, from Chicago to the Eads jetties at the mouth. And Chicago, wise from her experience and study, joins in the call, but by the mightier force of her example, the eloquent speech of

her fifty-five million dollars, she repeats "Twenty-four feet! Twenty-four feet!"

And Chicago is right. Fourteen feet may do as a timid and tentative proposal, but it will not solve the problem. "No vessel of one thousand tons burden," said James J. Hill at the Rivers and Harbors Congress of 1907, "can compete with a box car. With ten thousand tons the problem is mastered." His voice was for a fifteen-foot channel in the Mississippi, and, said he, "eighteen feet would be twice as good." He knows the subject as no other prominent man in this country knows it; for he is an operator of ships as well as railways. His view of the question is that of a man facing an era of unrestricted competition between the waterway and the railway—something of which we shall say more hereafter; but he also knows that the chief value of the Lakes-to-the-Gulf deep waterway must be in its capacity to accommodate the best type of lake freighter. The lakes will not really be joined to the Gulf commercially or in a naval way unless the deepest vessel that can now ply the lakes, or ever will ply them, is enabled to pass in and out freely, with no transshipment of goods, or transfer or terminal charges. Time was when a fourteen-foot channel might have been called a ship passage, but that time is past—real ships draw more water than that now; and the criterion for the depth of the Lakes-to-the-Gulf waterway is the limitation of depth in the lakes.

There are numerous ships in the lakes trade that

load to eighteen and a half feet—some a few inches deeper. There is nearly or quite a hundred of the five-hundred-foot class with fifty-two feet breadth of beam. That is why the Welland Canal route has been in large measure a failure, with its fourteen feet of depth, and its short locks. And the growth in size goes on. There are some vessels in commission on the lakes that are six hundred feet long, and carry about twelve thousand tons when loaded to eighteen and a half feet. At present the lakes trade will not permit deeper drafts than this, because the American “Soo” has a depth limited to twenty-one feet, the Canadian “Soo” twenty, and the St. Clair Flats, the Ste. Marie River, the St. Clair River, and many harbor entrances about the same. The Georgian Bay ship canal is to have twenty-one feet; and this depth may be accepted as the standard maximum of lake navigation—under present conditions.

But the lake channels and harbors may be deepened in the future. Controlling dams at strategic points would deepen Lake Erie by three feet, it is asserted, and raise the level of Lakes Michigan and Huron a foot or more. A dam across the outlet of Lake Superior might be made so to regulate the outflow of the lake as to not only prevent the artificial outlet from Lake Michigan at Chicago from ever drawing down the waters in the Huron-Michigan harbors, but might actually increase their low-water depth. A similar device would greatly deepen Lake Ontario and the

upper St. Lawrence. Chicago, with her twenty-four feet in the Drainage Canal, is looking to such things as these in the future. If she has erred, it has not been in overestimating the possibilities.

Whenever such depths of water are attained in the lakes, vessels will be enlarged to the maximum, and unless our new waterway to the Gulf will accommodate them, it will fail of its full purpose. The Internal Improvements Commission of Illinois recommend locks where the Drainage Canal falls into the Illinois, of the extraordinary length of nine hundred and sixty feet, as against the two hundred and seventy of the Welland locks. Where such a vast commerce is reckoned with, it is wasteful to build in such a way as to fall short of accommodating every possible demand of the future. When trade has once adjusted itself to inadequate facilities ship-owners become interested in the perpetuation of the original error, and capital fights for its maintenance. If there is water enough in the Mississippi and Illinois, and if the other conditions make such depths possible, this generation will make a terrible mistake if it fails to provide twenty-four, twenty-eight, or even thirty feet of water from New Orleans to Chicago, as the depth-possibilities of the lakes may dictate.

The writer is not oblivious of the fact that there are ship-owners and engineers who declare, and seem to believe, that such great vessels as the best lake freighters will never use the Gulf waterway, and that

ocean-going vessels and warships will not come so far inland. It has been suggested that the six-hundred-footer in the ore-trade would have to have a tug at the stern and one at the bow if she were to thread the channel to the Gulf without going aground. The answer to this is, if the best type of vessel for the new navigation has not been built, that it will be. Nobody would have thought it possible to navigate the shallow rivers now in daily use if the American ship-builders had not invented the river-steamer. If the steering-gear of the craft of the open ocean and lakes is not adequate to the new channel, it will be made adequate. And as for warships, their movement is not a commercial matter, and they may be allowed as many tugs as they require. Moreover, it is not admitted that present ships would not use the channel: there are some great firms of lake ship-owners who confidently reckon upon doing so as soon as it is opened. The idea that thirty feet of water would not be utilized if it existed, on the Mississippi or any other great river, is one of the naïve illusions of "those whose cant is simply can't." The most striking effects of the Suez and Sault Ste. Marie canals have been upon ship-building. Doubtless it will be so with the Lakes-to-the-Gulf deep waterway. It will be but a new occasion to which invention and enterprise will inevitably rise.

To doubt this is to accept the Bernard Shaw valuation of us as "a nation of villagers." Nobody

seems to doubt the utility of the Georgian Bay ship canal, save some Canadian cities which are off the new line. The despised Spanish-Americans of our competing wheat regions are deepening the Uruguay River to twenty-one feet for six hundred miles, have dredged the Parana for one thousand miles, and are spending fifteen million dollars on the docks of Rosario—an interior city, four hundred miles from the sea. The average American “villager” has never heard of Rosario; but our farmers will feel it when wheat goes from her docks to Liverpool free of railway charges. They seem to have no fear as to throwing their money away on rather deep interior waterways in Europe. Mannheim is three hundred miles up the Rhine; but it has almost a square mile of dredged harbor, three miles of docks, and nine of improved shore. There are perhaps twenty harbors from one hundred to three hundred and fifty miles inland in Germany—Frankfort-on-the-Main, Berlin, Duisburg—Krefeld—great, busy harbors. Holland carries thirty-foot depths far inland in the Rhine. All the world has solved these doubts but America.

Is there a sufficient supply of water for the channel here described and demanded? This is the first great query the answer to which must be affirmative, or the work cannot begin. The Father of Waters himself looks promising as a source of water-supply, even though he wastes his volume in riotous spring floods and shrinks to pitiful dimensions in summer. But how

about the water for the Drainage Canal, and the Illinois River?

The canal from Chicago to Joliet has a capacity of fourteen thousand cubic feet of flow per second, twenty-five per cent. of the normal low-water flow of the Mississippi at St. Louis—but as yet the right to take this amount has not been granted. Enough has been conceded, however, so that eighteen feet can be produced—probably more—from Chicago to St. Louis. This depth, Mr. Hill says, is “twice as good” as fifteen feet. What the engineers have in their minds when they say “probably more” may be a question; but those who know engineers will be apt to suspect that when they say “probably more” they mean that it is a practical certainty that it will be considerably more than eighteen feet. The possible supply of water from Lake Michigan is adequate to produce any depth required, short of a Niagara. The present drain through the canal has been flowing out for several years, and no one can say that it has lowered the level of the lakes at all. This has been a period of excessive rainfall, however, in the basin of the Great Lakes, and although the drain is not yet perceptible, the lakes, even though higher than when the Drainage Canal was opened, must be actually lower than they would have been if no new outlet had been made. The International Waterways Commission, appointed by our government and that of Canada to study this among other questions of mutual concern to the two

nations, accept as correct within one tenth of a foot determinations which seem to show that an outflow at Chicago of ten thousand cubic feet per second, will after the five years required for its full effect to be observable, lower the mean levels of all the lakes except Lake Superior, with all their connecting channels, from four to six inches; and that a discharge of fourteen thousand cubic feet per second would pull down the immense reservoir by from six to eight inches.

This is immensely important, as will appear when scanty rainfall brings lower water. Adequate depths are essential to lake commerce. Six inches less of water means three hundred tons less freight for the big lake freighter, and a loss of thousands of dollars per season for the ship; and the partial undoing of the work of deepening lake harbors and channels which has been so important a factor in developing this immense commerce. It has cost some seventy-five millions of dollars to produce these depths, and as proof that the money has been well expended it is only necessary to mention the fact that the subtraction of six inches of water from them by the Chicago outlet will, at the low stage of the lakes, cost commerce in diminished ability of vessels to move freight, \$1,500,000 per year, or four per cent. interest on \$37,500,000; and that it will cost this government and Canada \$12,000,000 to give back, by deepening, the loss in depths which Chicago's enterprise must be regarded as having already inflicted on this whole system of waterways.

It is a fascinating, an absorbing, a perplexing problem, in which the factors are inland seas, the world's greatest cataract, the aspirations of teeming cities, and the needs of our whole nation. Here lie the five Great Lakes, three of them filling their colossal cup so full that their contents spill over to the St. Lawrence at Niagara, or to the Mississippi at Chicago according to the will of the insect man. At the eastern spillway, stand those who patriotically seek to maintain the grandeur of the awful waterfall, declaring that its thunderous volume shall not further be diminished. And with them as against the claims of the western outlet, stand the foes of the lovers of scenery, the power companies, who dislike the notion of the diminution of Niagara by any agency except theirs. Scattered along the shores of these seas are dozens of cities, and on their bosoms ride hundreds of ships the welfare of which depends on deep water. At the western spillway lies the world's wonder, Chicago, which, in the heart of a continent, has grown to the magnitude of a world-city. Her public health depends on water taken from the lovers of nature and the creators of power at Niagara, and the taking of which must lower the water for all those ships, and in all those harbors, including her own. And down across the prairie lies that northern arm of the Gulf, that intra-continental feeder of the Isthmian Canal, that commercial hope of thirty States, the Mississippi, waiting to be rewedded to his old reservoirs the lakes—a

nuptials necessary to the welfare of the nation, fraught with blessings to the world, but which requires for its consummation the water from Lake Michigan the taking of which will inevitably subtract from Niagara, make shallower the harbors and connections, and bring loss to the lake commerce. It seems the most stupendous puzzle, the most absorbing romance of engineering in all history.

But it is cheering to be assured that, while the problem is puzzling, it is not insoluble, and that the needs of Chicago, the demands of the deep vessels and the havens of the cities, the legitimate wants of the power companies at Niagara, and even the sentimental claims of the advocates of beauty and grandeur as against utility may be so harmonized and satisfied that, if all be not made happy, all should be content. These objects may be accomplished by controlling works to hold back the waters of the lake outlets in the years when they are high, and allow them to run out so as to meet the deficiency in times when they are low.

The Great Lakes are not always the same in depth. Their waters rise and fall like those of other non-oceanic bodies. They are highest in midsummer, and lowest in midwinter; and there is a periodic rise and fall extending over a decade or so, bringing what are known as "high-water" years and "low-water" years. The highest high water ever known in them was in June, 1886, the water-level then being more than three and one half feet higher than in June, the high-water

month of 1896. As the seasonal variation is sometimes two feet, it is apparent that the harbors of the lakes which are twenty feet deep at extreme low water have depths of about twenty-six feet at extreme high water. At such periods the Niagara cataract has more water than is necessary for either maximum grandeur of scenery or adequate power on the turbines, and the Chicago Drainage Canal might take out its fourteen thousand or more cubic feet per second for years without causing a keel to grate the ground in the harbor entrances—for there would be more than the present ships need, also. In short, while the Great Lakes send out a flow that is more regular, perhaps, than the discharge of any other inland waters, it still is so far akin to the variable brooks and rivers by which it is supplied that for years at a time it wastes water in a stream too copious for the demands under consideration, and then dwindles to comparative poverty through years of drought. If the discharge of the high-water seasons and the high-water years could be held back and used for the low-water occasions, the needs of all parties might be satisfied.

A learned board of engineers has stated, as one device for accomplishing this, that a dam across the Niagara River might be built so as to raise the level of Lakes Erie, Huron, and Michigan about one foot—and this level would be arbitrary, and not dependent upon the Chicago outlet. In that case the Chicago people might take out twice their ten thousand cubic feet per

second, and the only effect upon the problems before us would be the diminished flow over the Falls. But the most promising method seems to be that of converting Lake Superior into an enormous reservoir by controlling works across its outlet, the St. Mary's River. If these were installed, the excess of summer high water, and the needless outflow of wet years, could be held back as a water-account to be drawn upon for the keeping up to arbitrary levels of all the lakes and passages below, clear down to Montreal. None of the Great Lakes, save Superior, would ever rise as high as it now sometimes does, and none of them would ever fall as low. The Niagara cataract would never again carry the volume that rushes over it now when the lakes are at their greatest height; but it would never dwindle to the scantiness sometimes seen at low water. And all the time Chicago could be taking out her fourteen thousand or twenty thousand or even twenty-five thousand cubic feet per second with which to dilute her sewage and keep her people free from pestilence, and at the same time supply the Lakes-to-the-Gulf Deep Waterway with water for the greatest inland channel in the world, connecting the lakes and all their ports with the Mississippi and its ports, and opening a passage from the Gulf to match Canada's from the Atlantic. The lake levels are important, and must be preserved. An abundant commerce, both ours and Canada's, requires this, and natural right demands it; but, on the other hand,

Chicago's rights, with her increasing millions of people, must be recognized. Above all these are the needs of the nation for a perfected system of water communication. This is the largest of all projects, and it must control. Water must be diverted through the Drainage Canal to the full extent which other interests will permit, and then if there is not a sufficient supply, resort must be had to locks and dams in the Illinois. That the project of such a channel as we have urged is an engineering possibility from Chicago to St. Louis the best engineers admit.

At St. Louis we reach the Mississippi, with its great volume, increased by the water of the Drainage Canal—an increase which runs the year round,—and we encounter the problems of the steep slope and the tendency of the channel to split up and raise bars, of which we have spoken, and with which our engineers have been so long struggling. And in this the ugliest part of the river, the one hundred and eighty-six miles from St. Louis to Cairo, are the difficulties that establish fourteen feet of depth as the high-water mark of the organized demands, and send the engineers into opposing schools. And yet, the low-water volume will be so helped out by the flow from the lakes through the Drainage Canal that there will be eighteen feet here for more than half the year when the plans of the waterway advocates are carried out.¹ What these plans are might be answered in various ways. Government

¹ See note *e* at end of volume.

engineers have advocated a canal paralleling the river. This would cut the Gordian knot by getting rid of the slope and the necessity of taming a rebellious river; and, while it would be expensive, it would put the matter of depth absolutely under control. Civilian engineers, wishing to avoid locks and cut down expense, advocate control of the channel and dredging. The situation may be summed up to the effect that, by canalizing, any desired depth and width may be obtained in this St. Louis-to-Cairo stretch the year round—if we are willing to pay for it. With less expense, we may get eighteen feet for half the year, fourteen feet for a period in each year longer than the open navigation period of the lakes, and with a moderate fleet of hydraulic dredges, fourteen feet the year round. From Cairo to the mouth of the Red, it is merely a matter of water-regulation or of dredging; and from the Red to the mouth of the Mississippi there is deep-water navigation now.

Not a simple problem, as any one can see; and yet not one from which we need shrink on account of the obstacles, either engineering or financial. Chicago's fifty-five million dollars have already been paid. The plans have already been made for the reach from Joliet to St. Louis, at an estimated cost of thirty-one million five hundred thousand dollars. The canal scheme for the St. Louis-Cairo section is estimated to cost seventy-three million dollars. These estimates are not all made for adequate depths; but without great



Unloading a Fruiter at New Orleans.

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additional cost the water-supply may be so regulated—a matter which will be discussed hereafter—that a depth of water hitherto thought unattainable may be achieved from Cairo to the mouth of the river without any channel improvement. The same policy will add so materially to the depths above Cairo as to hold out great hopes that no canalization will be found necessary; so that we may accept these estimates tentatively, to be added to or diminished as water-regulation may fail or succeed, or as greater or less depths are striven for. Nobody knows just what a work like that will cost. A waterway such as many think adequate can be obtained for about a hundred millions. The highest estimate I have ever seen for a thirty-foot channel from the Gulf to lakes is three hundred and forty-five million dollars; and this must be fully fifty per cent. over the mark. Will it pay? This with many is the sole question. What shall we get for our money if we spend, say, two hundred million dollars to bring the ocean to the farms?

It would be different if we had any option as to spending money; but the people of this nation must lay out some five billion dollars within the next few years for transportation in any case. It will take that sum to equip the railways to carry the normal traffic of good times—and unless they can carry it, times never can be good. Does some one suggest that it is the railways, not the public, that must raise and spend that five billions? Whatever the railways legitimately

spend is as directly and properly a charge upon the public as if the bonds were signed by the Secretary of the Treasury instead of the president of the railway. So there need be no thought that we as a people will be able to evade payment, principal and interest, of the five billion dollars, which Mr. Hill says must be paid out within the next ten years for the rehabilitation and extension of the railways of the United States. What the government pays out for waterways, therefore, to relieve the railway congestion, will be effective in cutting down what we shall certainly have to pay out through railway expenditures. In one case the government, in the other the railways, will keep the books for us.

When we shall have spent the two hundred million dollars for the Lakes-to-the-Gulf deep waterway, the whole question of the need of this five billions by the railways will have been revolutionized. "In view of the inability of the railways to move the heavier classes of freight," says Mr. Hill, "there has been no subject before Congress for twenty years which interests so many people, and will prove so great a benefit to the entire basin of the Mississippi and Missouri rivers, as a deep channel or canal from St. Louis to the Gulf of Mexico."

"That more than half the potential value of the continent," says Lyman E. Cooley, "should be remote from any actual seaboard, and condemned by reason of continental distances to partial blight, which no

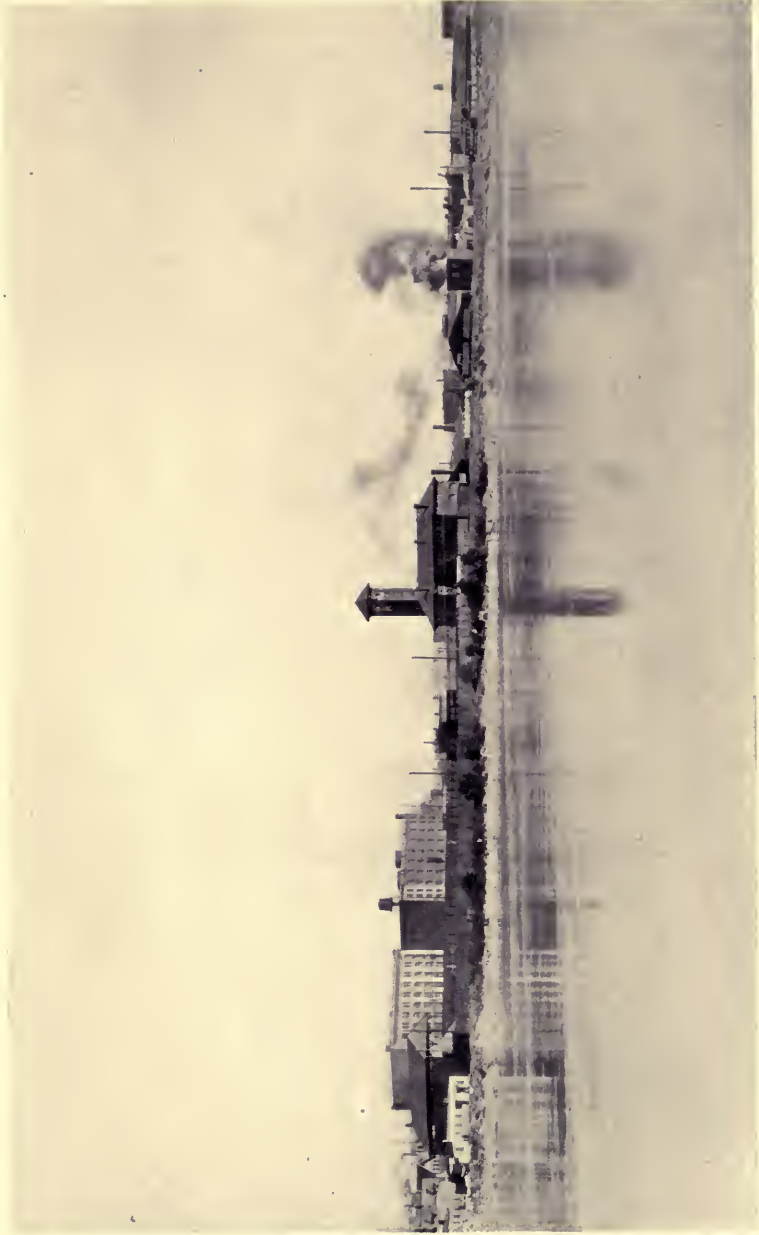
betterment in land conveyance *can hope greatly to mitigate*, is intolerable to the statesmanship of the future." But at one stroke of constructive statecraft and engineering the Lakes-to-the-Gulf waterway would slice the continent through from Quebec to New Orleans with a new seaboard, doing away with the blight of continental distances forever. It would cut through the congested freight-yards like a surgeon's knife through a tumor. It would break the freight-gorge in the region of worst congestion—St. Louis, Chicago, and the teeming isthmus between them. Extending its direct influence to every city from which traffic might be billed up or down the new navigation, it would take off the load of tonnage from the railroads at Duluth, West Superior, Milwaukee, Detroit, Toronto, Buffalo, Cleveland, Toledo, Gary, and a dozen other lake ports, and from those of Memphis, Vicksburg, New Orleans, and Mobile on or near the lower river. The converging branches of the Mississippi, built by nature as if for feeders for the great trunk line, would carry the suction of the north-and-south highway to places as far asunder as Great Falls, Montana, and Pittsburg, Pennsylvania. The busy cities on the Ohio, the galaxy of municipalities on the Missouri would suddenly be freed from the blight of inadequate transportation facilities. The railway equipment set free by the new competition would be enabled to carry with greater speed and more satisfactory profit the volume of high-class business which the

burden assumed by the waterways would leave them free to assume.

The east-and-west commerce would sweep from St. Louis to Chicago through the ship canal, perhaps the busiest canal in the world. St. Louis would be a lake port, Chicago a Mississippi port. The cotton of the South would go by water to a hundred manufacturing cities of the North; Southern lumber would pass to Cleveland or Milwaukee as cheaply as it now goes to Amsterdam; coal from Alabama and the Southwest would compete with coal from Pennsylvania on the docks of Omaha, Sioux City, and St. Paul; and Northern corn and hay and wheat would reach cheaply a hundred Southern cities now suffering for them.

Our great lake ships would pass out into the Gulf, restore to the salt seas our merchant marine, and earn profits during the winters now spent in idleness. The lake ship-builders, with the cheapest coal in the world brought by the most economical handling in the world to the cheapest iron in the world, can compete with the Clyde in creating vessels; when there is an outlet to the seas, they will do this. The best ship-subsidy bill imaginable would be the act for the construction of this great continental back-water navigation. Our marine energies are pent up on the lakes; the waterway will let them out to make us again a world-power in commerce.

Far inland, to the uttermost parts of the continent, the benefits of the work would be felt in better rates,



On the Missouri River Front of Sioux City, Iowa.

Notwithstanding its situation Sioux City's commerce is now carried on by rail exclusively.

and more effective service. The seaboard, instead of being at New York or Galveston, would be at Chicago, St. Louis, or Memphis. The long haul would cease. The South Dakota farmer now pays from his best primary wheat markets four dollars and seventy cents a ton to have his crop hauled to Chicago, seven hundred and seventy-five miles. If the Missouri were developed as a feeder for the great north-and-south waterway, he might ship it to St. Louis or Chicago for the seventy cents and save the four dollars, and his land would be worth more by two dollars or so an acre per year. On the Ohio or Monongahela a ton of freight now goes a thousand miles for seventy-six cents, and between Louisville and New Orleans for even less. A little community just above the Dalles of the Columbia in Oregon is said to have been saved seven million dollars in ten years by the locks around the Cascades. As soon as boats could pass up, merchandise that had been paying six dollars and twenty cents per ton suddenly got a rate of two dollars.

No similar sum ever expended by any one pays better than the investment of the government in the improvement of the channels and harbors of the Great Lakes. Some fifty-one million tons of freight went through the "Soo" canal last year—not to mention the rest of the lake traffic—at about four fifths of a mill per ton-mile. If this had been carried at the average railway charge of three quarters of a cent a

ton-mile it is reckoned that it would have cost two hundred and fifty million dollars more to have paid the freight. If it be thought unfair to compare the average of railway rates with the water rates on the heavy water-borne tonnage—always given a rate lower than the average—then compare wheat rates by rail with wheat rates by water, which is surely fair. Look at the rail rate of four dollars and seventy cents a ton from Eureka, S. D., to Chicago for wheat, and the water rate of forty-one cents a ton from Chicago to Buffalo, a distance greater by one hundred and seventy-five miles. Apply these differences to the "Soo" tonnage, and the result will show a greater saving in that alone than the two hundred and fifty million dollars. We have spent about seventy million dollars on the improvement of the navigation of the lakes. We get benefits in direct savings of twice or three times that yearly.

The Panama Canal, when completed, should be no gratuitous contribution to the commerce of other nations, as now seems to be likely, but merely "another mouth of the Mississippi," through which the shipping of the lakes could sweep to the conquest of the markets of the Pacific. Unless we open the Lakes-to-the-Gulf navigation, the freight from the whole teeming mid-continent must go east by railways or shallow canals to New York or some other Atlantic port, to reach the Isthmian Canal. If it goes out by the Georgian Bay ship canal, the Newfoundland and Nova Scotian capes will become a new Cape Horn to be rounded



An Elevator on the Missouri River at Deapolis, N.D.

A forerunner of what may be.

with delays and perils. In any case, every mile of transportation from Chicago, St. Louis, St. Paul, Minneapolis, or Duluth to the Atlantic is directly away from the Isthmian Canal—distance to be made back after the ocean is reached. The advantage between freight so carried, and freight shipped from European harbors through the Isthmus would be with the latter. But Chicago is five hundred miles nearer to Panama than is New York. St. Louis is nearly a thousand miles nearer. With the deep waterway opened from the lakes to the Gulf we may use the Panama route to advantage. Without it, many of its commercial advantages will be likely to be enjoyed by our competitors exclusively.

The great recent problem of the railways is that of terminals. The water-front of the great harbors is sold by the square inch, and a severe burden of terminal charges is felt at Chicago, at Duluth, at New York, and especially at Buffalo. This problem will also be solved by the new seaboard. The Atlantic coast affords two or three harbors from Maine to Key West; but the Lakes-to-the-Gulf Waterway will be a continuous harbor from Port Eads to Chicago. Every foot of the route will be a terminal, and railways will be enabled here to establish docks on cheap ground for the discharge of freight into the ocean of sea-borne trade.

So, viewed from any angle, our first and greatest national work is the Lakes-to-the-Gulf deep water-

way. As a traffic factor, the "Soo" canal is insignificant compared with it. Its effects would extend over areas that dwarf the radius of action of the Lake Superior waterway. Yet if it should do no more good than the "Soo," it would pay for itself every year if it should cost two hundred million dollars. That sum is a lighter burden to the interests affected than the building of a doorstep is to a householder. Consider the billion acres of the Mississippi Valley and the basin of the Great Lakes! The great north-and-south waterway, which would wipe out the disadvantage of remoteness from the sea under which this great region suffers, could be paid for by a tax of ten cents an acre, and there would be an unexpended balance with which every great affluent of the Mississippi could be made profitably navigable to its source.

This is a part of the great uplifting work of utilization of our natural resources upon which our statesmen of the school of "can" are entering with fine patriotism, handicapped by the older men of the school of "can't." There is much more to the movement than the Lakes-to-the-Gulf deep waterway; but that waterway is singularly central and primary in it. This new and grand conception of the utilization and conservation of our natural resources, and especially of the development of our water resources, is one that must call to its support the big brains and fine souls in our public life. Back of it all, however, if it is to triumph, must be a people determined to



The Northern Terminus of the Great Mississippi Cross, St.
Paul, Minn.

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hold from the clutch of rapacity those things that are of common right; and to *do things*. The work of developing this continent has been carried on splendidly, so far as it could be done by individual effort. The great tasks of the future are national tasks—collective labors which must be taken up in high confidence and carried out in the spirit that disdains defeat or failure. “The Mississippi,” said Roosevelt, in a message to Congress, “should be made a loop of the sea, and work upon it should be begun at the earliest possible moment.”

Chapter III

The Railways and the Waterways

OUR first national impulse to solve the modern transportation problem brought a clash between railways and canals. It was on July the Fourth, 1828, that the fight began: On that day, with imposing ceremony, Charles Carroll of Carrollton, signer of the Declaration of Independence, "laid the corner-stone" of the Baltimore & Ohio Railway at Baltimore—the new road to the West. While he was thus marking an epoch, President John Quincy Adams at Washington was "celebrating" by moving the first earth for the Chesapeake & Ohio Canal. Everything went off smoothly at the railway function; but, ominously enough, when the President—in ruffled shirt and knee-breeches—shoved in his spade it struck a root and spilled. Again he essayed to lift the earth, and again the obstacle balked his design. Then he took off his coat, spat on his hands, it is said, and moved the "dirt."

The two projects went to the mat instanter in a wrestle over right-of-way. Here, as in England, it was war to the knife between railways and canals.

And it was in the canal business always that the spade struck the root. Our first few thousand miles spilled from our shovels under the shock of railway resistance. In such works as those at Suez, Manchester, in the Low Countries, in Germany, and on the Sault Ste. Marie the canal business rallied. Then the Presidency—embodied in Roosevelt—took off its coat, and moistened its hands for the great spadeful at Panama, and is now moving on it is hoped to the Lakes-to-the-Gulf deep waterway job, and to others. But the relations between railway and waterway are not yet settled in the public mind, in the railway mind, or in the legislative mind. Until they are settled, no comprehensive scheme of transportation development is complete.

The most pithy thing said at the Rivers and Harbors Congress of 1907 was a remark of James J. Hill on the relation between depth of channel and ability of waterways to live against railway competition. "No vessel of one thousand tons burden," said he, in effect, "can compete with a box car. With ten thousand tons burden the problem is mastered. A fifteen-foot channel at least is needed" (in the Mississippi), "and eighteen feet would be twice as good." The Georgian Bay ship canal promoters say: "Any waterway which does not admit of steamers passing directly between lake ports and the seaboard is not likely to prove a successful competitor of the railroads; and any material reduction in transportation rates can only be obtained by constructing waterways on which

quick trips can be made and all unnecessary transfer and terminal charges eliminated."

The decline of trade on the Erie Canal, and the failure of the Canadian channel from Lake Erie to Montreal with its fourteen-foot depth and its short locks, indicate that no navigation which cannot accommodate boats like the best type of lake freighter, with its fifty-five-foot beam, its eighteen feet of draft, and its length of six hundred, can take enough freight from the railways in unrestricted competition to modify existing conditions materially—not even by "potential water competition." But it is manifestly impossible to gridiron the continent with canals and waterways twenty feet in depth or even half that. Such dimensions are for trunk lines only, like the Lakes-to-the-Gulf deep waterway. The complete system of waterways which we must eventually have, if we are to compete with the nations which have them, must consist mainly of barge canals and the shallower rivers. Financial and engineering considerations coincide in establishing this limitation. In the main we shall have to use waterways less than ten feet in depth, or we shall be obliged to go without them. If it be true that the railways have it in their power to put out of business any waterway which is too shallow for a vessel of ten thousand tons, what becomes of all the schemes for nine, eight, six, and even less depths? On this hangs the whole situation.

That the railway has in its power to destroy the



Morris and Essex Canal, at Waterloo, New Jersey.

A type of the old-fashioned canal of which a railway has acquired control
in order to put it out of business.

trade of ordinary waterways has been shown wherever they have been permitted to fight the battle out. The unimproved Mississippi, the natural Missouri, the Erie Canal, four thousand miles of other American canals, the British canals, and, indeed, the rivers and canals of every European country except Holland, have shown themselves unable to hold their own unaided against the railways.

The water carries freight more cheaply; but, under normal conditions, the railway delivers it more quickly. The boat is confined to routes where water runs or is made to run; but the railway climbs hills, skirts mountains, tunnels ridges, and goes everywhere. The waterway is passive, lying in readiness to receive freight, but making no effort to get it, sending out no solicitors, pulling no traffic wires; but the railway is active, pervading the business life of the community, looking out for itself, doing favors, cutting to the bone in the waterway's narrower field, and making its losses up on something else. Each boat on the waterway bids against every other boat, and thus the waterway competes with itself as well as with the railway, makes no money, accumulates no war chest, gathers up no surplus, plans no strategy; but the railway does all these things, while it does not compete with itself, or to any great extent with its fellow railway lines. The waterway is a logy animal of almost incalculable strength, but of low organism, and unprovided with brains; the railway is highly organized, efficient in brain, and

knows just how to bring its strength to bear on its antagonist's weaknesses and limitations. The canal or river is the powerful ruminant, carrying great loads, useful, patient, defenceless; the railway is the sharp-toothed wolf-pack that hamstringing and drags it down. The waterway "receives" tonnage merely, to be delivered at the dock; but the railway invades the shippers' private offices and makes it an object to them to enter into exclusive shipping contracts—and in many ways it can penalize the shipper who uses the waterway. For the railways go everywhere, and every shipper to some extent has to use them and is at the railway's mercy. To build waterways and leave them unprotected is merely to throw money away—after the millions and millions already thrown away in the same manner. One might as well turn loose a herd of giraffes in Ohio or Illinois expecting them to breed and fill the land. The waterway is big game, and like other big game it must be protected, or modern high-power guns, such as the railways know so well how to use, will surely exterminate it.

And yet the railways should not desire the extinction of water-borne traffic. All over the world they have extinguished it so far as possible, but there is no basic intelligent reason for their antagonism. Of surface, short-sighted reason there is plenty. Waterways regulate and control rates on competing railways: but at the same time they powerfully promote the prosperity of the very roads with which they compete. Paradox-

ical as this may sound, to railway men especially, the transportation specialist (which the average railway man is not) knows that this is true, and understands the reason.

Competing with American railways are some of the most flourishing lines of water traffic known; but does any one recall a case where the railway has been injured by it, even when the water traffic has increased? Take the New York Central and connecting lines to Chicago, for instance. It has—or at any rate has had—intense water competition all the way, and it has had to build four tracks to take care of its tonnage. It is one of the most prosperous lines in America. The most prosperous railway in New England competes with Long Island Sound, one of our greatest inland waterways. The Atlantic coast lines compete with the Atlantic Ocean. The Illinois Central competes with the Mississippi for a thousand miles; and all over the South, where river navigation really retains importance, almost every navigable stream is paralleled by flourishing railways.

But the most impressive illustrations of the basic harmony between the interests of the railways and those of the waterways are found in the experience of Europe. As a result of the canalization of the Elbe, river traffic increased fivefold, but the competing railways were not ruined. They paid greater dividends than ever—one of them sixteen per cent. The Main River has been canalized to Mayence. There is a railway on each

bank. In ten years the river traffic grew more than tenfold, but the railways were not injured. Their trade on the banks of the same river doubled in the same time. The Northern Railway of France traverses a region where the canals are most numerous. Forty per cent. of the boat capacity of the whole republic is in its trade territory. If canals could hurt a railway, this one would surely feel the injury; but, no matter how much other railways in France have been embarrassed, it has never been anything but prosperous. And America affords similar examples. In 1881 the Great Kanawha carried 9,628,606 tons of freight while the railways on its banks carried 6,631,660 tons. The river was improved, and in 1892, after several years of deeper water, the river traffic had grown to 26,787,888 tons, while the business of the railways had leaped to 30,844,100 tons.

The secret of the seeming paradox will be plain to him who will look at this matter of transportation as a unit, a related whole, a great inseparable job that the public must attend to, of which some parts of the work are profitable, and some burdensome and of doubtful profit; and the doer of which must take the fat with the lean, carry hay as well as silks, wheat as well as wine, coal with cigars, cement along with statues; and cotton, lumber, bricks, and stone as well as coffee and spices. Some of these things have such values that they can stand high rates. The moving of a carload of coffee, spices, cigars, and drugs

may not cost the carrier a cent more than that of a carload of gravel; but the former can and does take a greatly higher rate. The gravel trade is a part of the big job of serving the people as a carrier. If people cannot get gravel and other heavy things they cannot build houses and there will be no demand for hardware and carpets and furniture. Let the hardware, carpets, furniture, and the like pay enough, then, to make up for the unprofitable traffic supplied by the gravel business. Most of the practice of freight classification is concealed in this paragraph. The ore and wheat must be moved from the Duluth shipping district or there can be no population from which to collect freight on tonnage that pays. The breakdown of the railways comes from the fact that they are groaning under the bulky, heavy, cheap freight that under the German or French system would go by water, leaving the high-grade stuff which can pay a high rate to go by rail. The water-borne freight of the lakes is nine tenths grain products, iron ore, lumber, and coal. The railway cars, which in the absence of waterways, would have this to carry, are set free to do business which pays better. The canals of New York carry freight which is one fourth forest products worth about \$11 a ton, one fourth farm products worth \$38 a ton, and only a fraction of one per cent. merchandise, which averages \$300 a ton. The railways which have the blessing of waterway "competition" are relieved of the burden of carrying this cheap freight

which uses so much equipment and pays so little. Many years ago an English railway made an investigation to find out why it was unprosperous. It discovered that the management, in an endeavor to put out of business a competing canal, had been using fifty-eight per cent. of its equipment to move bulky and low-grade commodities which paid only fourteen per cent. of its revenues. Every railway that has no complementary waterway must be in somewhat the same situation.

One of our German Consuls-General, Mr. Mason, says in a report that German statesmanship was the first to foresee that in a fully-developed transportation system, the proper rôle of the railways would be to carry passengers and the higher classes of merchandise manufactured from the raw staples which the waterways had brought to their doors. The French view is identical. M. de Freycinet, when as a member of the French cabinet he had control of transportation affairs, said: "It is conceded that the waterways and railways are destined, not to supplant, but to supplement each other. Between the two, there is a natural division of traffic. To the waterways gravitate the heavy commodities of small value, which can only be transported where freights are low. . . . In procuring for manufactures cheap transportation for coal and raw materials, they create freights whose subsequent transportation gives profit to the railways." It is this "creation" of freights through her mar-

vellous duplicate transportation system that fills Germany with great cities, and her competitors with alarm.¹

This principle by which the less profitable stuff sinks to the waterways and the cream rises to the railways is conceded among statesmen and specialists to be a sound and controlling one; and European governments are acting upon it with vigor and enterprise. They are paralleling their government-owned railways with waterways, because they have found that railway carriage is too expensive for the heavy traffic upon which their industrial prosperity is founded. They feel that they must have waterways if they are to hold their own in the world's markets. They find that their waterways make their railways more profitable. They are acting as does the drayman, who, when he finds his business growing so as to include the moving of safes and structural iron, adds to his plant a team of huge percherons, and leaves the light work for his ponies. The railway's capacity, huge as it is, is as a pony to a draft-horse, compared with that of the waterway.

This division of traffic is a direct benefit to the railways; but there are greater indirect benefits from the double transportation system. All economically-justifiable transportation lines open opportunities and create traffic. The Cape of Good Hope traffic, so far from being crushed by the Suez Canal, is as large as ever.

¹ See note *f* at end of volume.

The Temiskaming & Northern Ontario Railway was built by the Ontario government into a wilderness which seemed quite barren of tonnage; but it is already a paying line, with its string of flourishing towns. Cities make tonnage, and waterways make cities. The great metropolises of the world are built with reference to boats and ships. The Erie Canal made Albany, Rome, Syracuse, Rochester, and Buffalo; and its parallel railway reaps dollars from these water-made cities for every cent it may lose on canal freights, or lowered rates. The Soo Canal made the Duluth district by letting ore find coal by water. The railways could not have done this; but they profit by the enormous tonnage of high-class freight originated by the populations involved—freight which will scarcely ever seek water-transportation. Manchester, England, was a decadent city until her great ship canal brought the sea to her wharves; and the railway suffered from the conditions that caused idle factories, empty warehouses, stagnation. Since the completion of the canal the city has been revived, its population has increased, a building boom has set in, and every railway running to the city has been obliged to enlarge its terminals to accommodate its trade. Railways cannot be prosperous in the absence of an energetic population engaged in productive enterprise; with such a population they can always make money.

The attitude of the railways toward waterways is very important. Just how much of this science of

transportation is understood by the railway men of this country may be a question. So far as yet heard from, they do not seem to see that there is anything for the future to bring forth but the unrestricted competition between the two modes of traffic which has destroyed inland waterways in the past. There is no doubt that many of the greatest railway operators and railway owners in the country are sincerely in favor of some waterways, at least. Mr. Hill, always a leader in thought, has spoken for waterways when such utterances were anathema in railway circles. At Memphis last October Mr. Harahan of the Illinois Central spoke eloquently and with evident sincerity for the Lakes-to-the-Gulf deep waterway which parallels his line from Chicago on the lakes, Dubuque on the Mississippi, and Sioux City on the Missouri, to the Gulf. "A wholesome competition," said he, "whether of rail lines or of rail and water lines, is not destructive, but is productive of good to all, to the public and to the carriers; and the success of one means the success of all."

These things augur well for the new movement for waterways. The first question to be settled is as to the economic correctness of the new policy. After that it is a matter of public opinion. When the people favor waterway expenditures as sincerely as they now believe in pensions and naval glory, Congress will make the appropriations. The railways are powerful moulders of public opinion; and any project or policy supported

by them will have its chances of seeing the heaven of legislative passage greatly improved by their approval. Therefore it is much to be hoped that the powerful men who control the railways of the United States may cling to their loyalty to the principle of the wholesomeness of water-competition through the thick as well as the thin of their own affairs.

This remark is elicited by the thought that the present attitude of the railway leaders may in part arise merely from the fact that the railway situation in this country has reached an abnormal and anomalous state. The transportation facilities furnished by the railways have stimulated a volume of production which furnishes more tonnage in prosperous times than the railways can carry. The situation, one of the utmost gravity, calls for some five billion dollars to be used in extensions and betterments, and if we may believe those best informed, the railways have no idea how they can raise such sums. Their capitalization has been expanded until their credit has become impaired. The question of new terminals has become vital through the increase in the land values of the large cities. This one item alone seems to forbid the building of many new trunk lines; while the intimate connection between the great money-lenders and the present lines works to the same end. Extensions are scarcely to be thought of, as was forcibly stated to the writer by the president of a great railway recently, and proven by the declaration that his system was at that time

carrying six millions in short-time notes at high interest, because the market would have none of its bonds. Yet extensions are sorely needed. The best railway description of the situation is that we have been trying to force a three-inch stream of commerce through a two-inch pipe of railways; that we need from 75,000 to 120,000 miles of new track, and so many new cars and engines that, on the whole, there is not iron enough in the country to meet these needs, not labor enough to make and install the new equipment and track, and not money enough to pay for the transactions.

The outlook is made the more interesting, not to say more ominous, by the tendency of business to grow to the limit of any increase in railway facilities. The new capacity is swamped by the traffic it stimulates. In the ten years preceding 1905, railway mileage increased by one fifth while tonnage doubled. In the years between 1890 and 1906 the value of the agricultural products of the United States increased by 225 per cent. Allowing for higher prices, the increase in tonnage must have been immense. The only tonnage that seems likely to fall off in the future is that in lumber, and it will be replaced by the heavier building materials of brick, stone, and cement. When we have found and borrowed and spent the five billions necessary to put the railways in condition to handle such a volume of trade as that of 1906, the problem will not have been solved. The tonnage will in all

probability have doubled in the ten years of rehabilitation. Good agriculture in the Mississippi valley would break the railways' backs with freight. North Dakota, for instance, grows only half as much wheat per acre as Connecticut, while she should produce twice as much. Coal and iron are almost certain to double in mile-tons. Building materials are sure to be heavier. The nation's business, yielding seventy-nine billion mile-tons in 1890, one hundred and forty-one billions in 1900, and one hundred and eighty-seven billions in 1905, will, unless retarded by industrial depression, call for the carrying of three hundred and fifty to four hundred billions of mile-tons in 1916.

While their credit has been impaired as their need of it has intensified, the difficulties of the railways are increased by the rising prices of the things they have to buy. In 1895 the Southern Railway carried a little more than a billion mile-tons of freight. In 1906 it carried four billions and a half. To provide for this increasing task it claims to have spent \$100,000,000. It now faces a situation requiring new construction on a large scale, with bridge timber doubled in price, ties fifty per cent. higher, steel advanced from \$17.50 to \$28 per ton, and labor from \$1621 per mile to \$2874. Protesting against the enactment of "reciprocal demurrage" bills, President Finley of the Southern said: "Inasmuch as adequate facilities are not in existence, penalties for failure to furnish cars will do no good. They will not build railroad tracks, sup-

ply equipment, nor enlarge and amplify terminals." Nothing can show more eloquently than this statement the despair of the railways at the Old Man of the Sea which industrial progress has hung about their necks—who has the inconvenient power of doubling in weight while the railway Sindbad adds twenty per cent. to his strength.

Recent railway history teems with proof of the increasing pressure on trackage, car-supply, and motive-power. Like most machines, when the railway mechanism is crowded too hard, it not only does not do its best work, but it fails to work at all. The frightful situation at the time of the historic "car-shortage" of 1907 indicates that we were then approaching that stage. The paralyzed mechanism slowed down until freight-cars went only twenty miles a day. Equipment was concentrated on main lines, and remote branches were "served" by only a train or two a week. Farm products rotted at stations for lack of transportation. Coal was piled in mountains on the docks, while in fireless homes on the prairies frontier settlers froze and died. Cars were doled out to shippers like allowances of food and water in a famine. The desperation told on the personnel of the railways, and on whole systems of roads such things as time-tables and schedules were lost sight of. In despairing efforts to move traffic, trains were thrown together in a multitude of terrible accidents that filled the world with horror. As a disease which manifests itself at the

point of weakness, the trouble showed sometimes as lack of cars, sometimes as lack of trackage, sometimes as lack of motive power. It suddenly came to the industrial world as a shocking surprise that business had expanded until it had reached an absolute limit in railway prostration. "It will require the best thought and best effort of this generation," wrote Mr. Hill to Governor Johnson of Minnesota, "to avert the evil that now casts its shadow upon the farmer, manufacturer, and merchant, to arrest the progress of the paralysis that is laying its grip upon the heart of commerce, and to restore the wholesome circulation without which there cannot be life and growth in either individual or the commonwealth." If at this time the situation be any better than when the above words were penned, it is only because a temporary financial depression has cured the car-shortage by stopping business. While the railways are given this breathing-spell, these striking words of the genius of the Great Northern should be considered. They may well have a place over the desk beside the "Do it Now" sign.

The way out of the difficulty is plain. The waterways of the continent must be developed so as to enable them to perform their proper economic share of the work. It is a great task, but it is quite within our power; and the waterways can do the work, which the railways never can. The natural expense of land carriage is high, and the capacity of railways is strictly limited. The capacity of a waterway like the

new Erie is equal to a dozen railways. A very judicious writer has recently said that the proposed ship canal from Lake Erie to Pittsburg would do the work of fifteen railways at the expense of one. The capacity of a deep waterway down the Mississippi is almost incalculable; but it is entirely safe to say that no conceivable tonnage derived from the Mississippi valley and Lake basin could tax its carrying power. The promoters of the improvement of the Missouri state that with twelve feet of water in that stream it could do the work of six hundred railways. A good waterway is practically incapable of being overloaded with traffic. In efficiency the waterways leave nothing to be desired as a remedy for our transportation ills.

On the score of economy, the result is equally favorable to the waterways. We must treat all railway investments as public investments, because they become a charge on the nation through freight and passenger rates. Every dollar put into waterways will save many by diminishing the demand for railway betterments and extensions. The Lakes-to-the-Gulf deep waterway could be put in condition to carry ten times the traffic of all the north-and-south railways of the country, for \$100,000 a mile.

The State of New York has undertaken the rehabilitation of the Erie Canal by making it over into the "Erie Barge Canal" at an expense of \$101,000,000—an enormous work, and one that reflects credit on the citizenship willing to assume the tremendous bur-

dens incident to its carrying forward. If doubt mingles with the admiration accorded, it is not of the inherent merits of the project, but of the prospects for that wise and progressive legislation which is necessary to protect the new channel from uneconomic railway competition and to provide it with adequately equipped and publicly owned docks, wharves, and terminals at its extremities and along its entire course. If the exultation which every American must feel in contemplation of such daring enterprise in an American State is at all tempered with regret, it is not at the expense incurred or the burdens assumed, but at the thought that the Empire State and the nation are not co-operating in constructing on this line, made historic by the statesmanship of DeWitt Clinton, a ship canal, deep enough to accommodate the largest lake boats, and to make possible the entrance of our navy into the lakes, as England's will soon be potentially admitted by the Georgian Bay ship canal. But aside from all doubts and regrets, the work is a splendid one. A canal four hundred and forty miles long, it will be twelve feet deep, and provided with locks forty-five feet wide and three hundred and twenty-eight feet long. Barges carrying two thousand tons may be towed from any point on the lakes, through such a canal to tide-water on the Hudson at New York or Jersey City. Add to the amount authorized for its rehabilitation the \$38,000,000 which the State has already invested in the old Erie Canal, and the new



A Lake Port that may Become Great by the Erie Barge Canal,
Oswego, N. Y.

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channel will have cost at completion, if the estimates are not exceeded, more than \$300,000 a mile—a sum which we may be sure the statesmanship of the future will not see go to waste for lack of adequate legal protection or free terminals. The Barge Canal will be there for all time, with a capacity for carrying freight far greater than that of the railways which could be built from New York to Buffalo, with a branch to Oswego, for \$300,000 a mile.

It must be admitted, however, that this is a case which, from the view-point of investment, may be regarded by intelligent and honest minds as doubtful. Fortunately, it is, among all our inland channels, the strongest citable instance in the brief against the waterways. The next strongest is perhaps the Missouri, unless we except the Lakes-to-the-Gulf deep waterway, dealt with elsewhere. The Missouri is scarcely second in potential importance, however, to any water highway in the world, notwithstanding the fact that it has been practically abandoned by the government. For the astonishing distance of two thousand two hundred and eighty-five miles, to Fort Benton, Montana, it has been navigated, not only in fact, but with much profit to its navigators, and to the upbuilding of great industrial communities. Its upper branches are capable of improvement for some hundreds of miles above Great Falls, itself about forty miles above Fort Benton. Flowing with a low-water volume unequalled by either the Ohio or the upper

Mississippi, and a regimen which it adequately maintains quite to its source, in the richness of its valley and the extent of its potential highway mileage it is unequalled. The Missouri proper is five hundred miles longer than the St. Lawrence with the Lakes, nearly a thousand miles longer than the Rio Grande, five hundred miles longer than the La Plata, nearly twice as long as the Orinoco, three times as long as the Rhine, almost twice the length of the Danube, two hundred miles longer than the Niger, more than twice the length of the Columbia, longer than the Amur or the Hoang Ho, twice as long as the Ganges, and more than a third longer than the Volga. It is surpassed in all the world in this respect by the Amazon and the Nile only. With the Mississippi—and if the length of the Missouri is to be compared with other rivers it must be followed to the sea—it is the longest river in the world.

For four thousand four hundred miles this mighty current rolls uninterruptedly from the heart of the Rocky Mountains at a point only a few miles from the spot where under proper improvement the head of navigation will be found in the Columbia, and finally falls through many mouths into the Gulf. As in length it surpasses all rivers, in richness of drainage basin it is equally pre-eminent. The United States army engineer now in charge of the perfunctory operations on this great river, to which the meagre appropriations of the government confine him, has said



Alfalfa on the "Great Plains" of Montana.

Where this grows freight accumulates in live stock products.

Courtesy Van Norden Magazine.

in a report: "When we consider the great natural fertility and the enormous production of the territory bordering on this river, it is not extravagant to say that the region surpasses any other on the globe, and this is especially true of that portion from Sioux City to its mouth. The production of grain, live stock, and meat products almost staggers the imagination."

Once this stream was the sole highway for its valley. Fifty years ago, more steamers were leaving St. Louis for Missouri River points than for both the upper and lower Mississippi. Steamers wintered at Fort Benton, four thousand miles inland by river, and on coming down in the spring, passed a swarm of vessels going up. Wafted on these pioneer boats, civilization was carried far beyond the frontiers, and the warwhoops of the Indians mingled with the bellowings of the buffaloes and the howling of the wolves in the warm summer airs that crept to the ears of the passengers on the *Emelie* and her sister steamers in the day when the miners of Montana were transported to the mountains *via* the Missouri, and fed by the commerce on the same great highway which also carried away their gold, or took them, disappointed, "back east." Moreover, these boats made better time going up-stream than a freight car ordinarily makes on an American railway, and travelled three times as rapidly on the down-stream voyage as does the car.

Now, notwithstanding the recent vast extension of railway mileage in the valley of the Missouri, no por-

tion of the nation is more sorely in need of transportation facilities. Captain Schulz speaks truly of the wonderful richness of the valley from Sioux City down; but the upper valley needs but the touch of the wand of cheap freight rates to pour out a tonnage equally great, if not greater per mile of channel. The spaces in Montana and North Dakota which, as Mr. W. A. Campbell says, "are tired of growing buffalo grass and want to grow wheat," are almost illimitable. New processes of agriculture seem to make it quite possible to grow grain on lands which have been considered too arid for culture, and crops of from twenty-five to sixty bushels of wheat produced by "dry farming" are not uncommon. If a quarter of the land suitable to such tillage in the upper valley of the Missouri were to produce half the yield mentioned, half this product would rot on the farms because too far from market to be worth hauling, and the balance would break the railways' backs when it came to moving it. The live stock and meat products of such a land furnish immense volumes of tonnage. Montana is the greatest state in wool-growing, clipping thirty-five million pounds per year. In addition to these and many more heavy agricultural products, and the ordinary freight necessary to sustain the teeming population which will some day produce them, the upper valley is rich in lignite coal which must one day make it a great manufacturing and industrial region—always assuming that it gets what it must have if it develops,



No. 1. The Missouri Approaches a Farmer's Cottage.



No. 2. Twenty Minutes Later—the Cottage Undermined.

cheap transportation by water. The entire tonnage of the valley of the Missouri proper amounted in 1907 to fifty-five million tons, worth \$1,000,000,000, of which twenty-five million tons, worth about \$500,000,000, originated within fifty miles of the banks of the stream. In an era of such development as is even now ready to take place, this tonnage would be multiplied over and over again in a few years. The lignite coals are quite as good as anthracite or bituminous for use in the production of power by the producer-gas type of internal-combustion engines, which bids fair to drive the coal-burning steam-engine to a large extent out of use. Montana and North Dakota have room for a dozen Pittsburgs before their coal measures are exhausted—if they can have cheap water transportation.

Moreover, the Missouri has the potentialities of a great through trunk line east and west, and north and south. It taps the mining and mineral mountain region, with its demand for heavy machinery and its yield of heavy ores and metals, and it runs to a connection with Gulf ports on the south, and with the Pittsburg district on the east. The stupendous traffic of the Ohio is ready to take possession of the Missouri in an era of revived waterway commerce. The Mississippi from Cairo to St. Louis, in such a time, will be at the crossing of the greatest inland waterway commerce in the world. The upper Mississippi, the Ohio, the lower Mississippi, all centre here, and the Missouri comes in but a short distance above, forming

the junction of the great waterways cross, the four arms of which are, respectively, at Fort Benton, Pittsburg, St. Paul and Minneapolis, and New Orleans—a cross of water highways into which flow other streams actually or potentially navigable, thousands and thousands of miles in length, and supplying arteries for commerce for half the richest continent in the world, abounding in population and wealth, certain to be as populous as China at some time—always assuming that it receives its prime necessity, cheap water transportation. And this is not the whole story of the great cross of waterways. Coming down from Chicago the ship canal is assured as a connection between the Mississippi and the St. Lawrence system, now bearing the greatest volume of fresh-water commerce in the world. The great waterways cross will be double-tracked in its eastern arm, one track tapping the Pittsburg district, the other, spreading out into the five Great Lakes, forking down to the sea at Montreal by way of the St. Lawrence and the Georgian Bay ship canal, and by another mouth reaching New York through the Erie Barge Canal. From Minneapolis and St. Paul, the present northern terminus of the upper Mississippi, the north-and-south beam of the cross pleads for extension through the easy route of the Minnesota and the Red River of the North, to Winnipeg, to Lake Winnipeg, and by the Saskatchewan system to the far wheat-fields of the Canadian Northwest. Of this stupendous plexus of actual and



No. 3. The Undermined Wing Falls into the Stream.



No. 4. Leaving Main Part of Cottage on the Brink.

feasible waterways, the Missouri, reaching out to a short portage for Pacific coast trade from the Columbia, is the longest, and not the least important arm.

And yet the Missouri is neglected. Year by year, its commerce has been allowed to be murdered, and, although it is now as good a stream as in the days of the *Emelie* and Captain La Barge, it is unfitted for the use of such boats as those spoken of by Mr. Hill. It is the *bête noire* of rivers: eating always at its banks, throwing up bars in new places day by day, defying pilotage to keep pace with its swift changes; frightening cities and railway systems by threats of cutting across country and leaving million-dollar bridges riverless, and railway connection destroyed; delving beneath forests or farms and making a wild waste of yellow waves to-day of what was yesterday mile-long rows of corn that astonished the beholder by its height and greenness; spreading broadly across its wide valley in the April and June rises, but leaving bare in September a half-mile channel of drifting sand. It is the despair, the sorrow, and the menace of a valley deserving of a better stream.

Seemingly, the Missouri is the worst of our rivers—too incorrigible for improvement, even where improvement both for commerce and for bank protection is so sorely needed. And yet, as is sometimes the case with the wild and wayward youth who becomes the most useful of men when his misdirected strength is turned into the regular channels of steady effort, the

Missouri is, not the worst of our streams from the view-point of navigation, but probably the very best of them. Its great volume of water, even at its lowest, renders it immune from the necessity of locks, dams, or head-waters reservoirs. Its soft bed is one in which the water itself digs a channel amply deep for navigation, when once it is persuaded to stay in one place and flow, instead of spreading out over the sand-bars and wandering. The whole problem is that of so persuading it. The matter seems most hopeless, perhaps, to the man best acquainted with the stream, but unacquainted with the engineering methods applied to it. And yet, the means for making a deep navigable waterway of the Missouri are as well worked out as those for the improvement of any river in the world. According to these plans the banks are to be revetted, willow mattresses are to be woven and sunk so as to make a dike, the river is to be led, not forced, along the line of least resistance, and, when so coaxed into civilized ways, it is to make its own depths, and, without a fall or a rapids, to run from Fort Benton to the Mississippi, a channel fitted to carry on its bosom the illimitable commerce of even this wonderful continent, a better stream than the Mississippi below Cairo, than the upper Mississippi, than the Ohio even after the nine-foot channel has been made by slack-watering.

For the reformed Missouri might be made to carry depths of twelve feet along almost its entire course.



No. 5. Next Morning—the Remainder of the House
Falls in.



No. 6. And is Swept away by the Big Muddy.

There is no longer any engineering doubt of this. Between 1891 and 1901 fifty miles of the worst part of this river were given the sort of improvement mentioned, with the result that, even though the bank improvements have deteriorated from neglect, and are in some measure destroyed, this reach of the stream is still five feet deep at low water over the "crossings" or shallow places, and in most places no less than from fifteen to twenty-five feet in depth. That it is not, over every foot of the reach, twelve feet deep at low water is due, not to the failure of the improvements, but to their neglect. The plans were worked out to success. They are adapted to almost the entire river. Applied to its whole course, they would make of the Missouri a ship channel with a depth of twelve feet and no rapids, locks, or other obstructions. The problem of low freight rates for this richest portion of the continent so sorely in need of them, would yield at once to the simple device of legislation compelling the railways to co-operate with the boats instead of fighting them—if any such compulsion were needed in the era of more intelligent railroading into which we seem to be entering.

The investment required, though large, is far below that of New York in the Erie Barge Canal, length considered. From Kansas City to the mouth of the Missouri, the depth could be made twelve feet the year round for \$51,000 a mile; from Kansas City to Sioux City the same great depth could be attained for \$53,000

a mile; and there seems to be no reason why every mile of the river cannot be civilized, improved, rendered harmless, and made into a fine waterway for like sums per unit of distance. The whole project may be estimated as costing \$100,000,000. A great sum, but not a very great proportion of the \$5,000,000,000 which we are under the imperative necessity of investing in highways. A great sum, but not beyond the power of a Hill or a Harriman to raise for a great transcontinental railway. Fifty thousand dollars for a mile of river seems rather large; but we are paying interest on much more than that sum for every mile of railway in the country, and for every mile of new track made necessary by the impending freight congestion and car-shortage we shall have to pay interest on far more than \$50,000. When the railways are built we shall not own them, and their future increment of values will be an additional burden on us, while the Missouri, the Ohio, the Mississippi—all the waterways—we shall own as free highways for all shippers.

These are the most expensive of projected improvements. The reader will at once think of vast stretches of waterway capable of being made highly useful for trifling fractions of these expenditures. The government has already made plans whereby thousands of miles of our most important rivers may be improved by means which will more than pay for themselves. These plans will be discussed hereafter. For present



No. 7. Last Glimpse of the Lost House. The Rank
Corn on the Bank will soon Follow.



No. 8. The Homeless Family.

purposes, it is enough to show that for the \$5,000,000,000 which, unless we are to cease growing nationally, must be put into railway construction as soon as it is physically possible, every economically justifiable canal which has ever been advocated in the United States could be dug, and every river for which navigation has ever been thought a possibility could be given depths sufficient for every demand of commerce. The car-shortage would then be a thing of the past forever; railway rates would be automatically regulated; and, by natural selection, the freight going to the railways would be raised in classification until it would, even at the lowered rates, pay adequate returns to railway capital. The congestion of business at the limited deep-water frontage of harbors, with its growing burden of wharf dues arising from excessive land values, and the increasing incubus of terminal values in even inland cities, would be at once mitigated if not completely relieved by the creation of available terminals along thousands of miles of new water-frontage. The railways themselves would in many cases welcome this as a relief from intolerable burdens.

The state of blessedness outlined is enchanting. What stands in the way of its accomplishment. Nothing, except the obstacle of Things-as-They-Are. If the railways are in such a state as described, will they not welcome the era of waterways? Yes, and no. They will each welcome the waterway which will relieve its particular burden, just as each private citizen

will do the same. Commercial revolutions, the turnings of trade to adopt new channels, always affect private interests and stir antagonisms. The policy to be adopted must be one based on considerations superior to the claims of comparatively small interests, as against great ones, or of selfish and private interests as against public rights and benefits. In other words, this one phase of our development opens the door and creates the imperative demand for great and constructive statesmanship.

The waterways must be built with every modern appliance for carrying on trade. The era of the mule and the towpath can never return. Neither will commerce seek channels unprovided with the best machinery for handling and housing freight. The rivers and canals must have the best of harbors, the best of docks, the best of transshipment appliances, and the best means of haulage for barges. To patronize such a highway is not going back to the old, but forward to the new.

And most important, the railways must be protected against their own tendency to exterminate waterway traffic¹; for it must be remembered that waterways, in the end, promote railway dividends. And the public must be protected from the tendency of one of their utilities to destroy the other—both of them being sorely needed. Can the railways not be relied upon to pursue the course that will in the end be best

¹ See note *g* at end of volume.



No. 9. Farm Still Falling In.

From photograph by Leonard B. Robinson, Esq., of Sioux City, Iowa.

for them? Strange to say, they cannot. The experience of the world shows that.¹ Railways are run by men who are anxious to make reputations. They are after tonnage for this year's report. The German Government cannot trust the management of its own government-owned railways to allow its own government-promoted waterways their proper share of the traffic. So everywhere in the great industrial countries of Europe the waterways are protected against the uneconomic competition of the railways—not to destroy railway prosperity, but to increase it.

How is this done? In various ways, but principally by prohibiting the railways from making quite as low rates as those of the boats. "It is to the advantage of all parties," say these statesmen, "that the heavy loads be hauled in the dray, and the packages in the express-wagon; that the freight which is cheap and heavy should go by water, and the tonnage that can pay higher rates by rail." So they give to the waterways the right to underbid the railways. It has been found that almost anything will go by rail, unless the rail rate is more than twenty per cent. above the water rate. Therefore they forbid the railways to make a rate of less than 120% of the water rate.² Of course this does not give the waterway all the business. It merely gives it the business which prefers to go by water for a dollar rather than pay a dollar and

¹ See note *h* at end of volume.

² See note *i* at end of volume.

twenty cents to follow the rail route. The high-class "package freight," all that which must have the advantage of speed, and all that in the carriage of which the freight is small as compared with the value, tends to go by rail—and that to inland points must do so. That which under such a rate regulation seeks water carriage is of the sort which it is wasteful to carry by land. Then they look out for it that the railway traffic man does not go to the shipper who uses both rail and water and say: "My dear sir, you cannot ship all your product by water, for there are many inland destinations. Why not give it all to the railway?" Or say to the shipper who argues that where the waterway does run it is cheaper to use it: "Your competitor has given us all his freight. If you still patronize the boats, we are afraid that he will have prompter car-service than you, and such superior facilities generally that you will feel his competition sorely!" As surely as human nature is human, traffic men will do these things if they are allowed to do them—and they will destroy the trade of any except the largest and deepest and best-placed waterways. They will do it in spite of the real interests of the railways themselves.

To President Roosevelt's trip down the Mississippi and the speeches delivered by him and the other very able men who made the event the occasion of discussion of waterways, much of the present impulse toward actual work for a duplicate transportation system is



Loading Ore at Escanaba.

The railway engine like a toy above the boat.

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due. More than any man who preceded him in the presidential chair, Mr. Roosevelt made real to himself our great material needs, wastes, and national tasks. Some of the most notable addresses ever delivered on such a subject were made during that trip by men like Lyman E. Cooley, Mr. Harahan, Colonel Vance, and others. Mr. Burton of Ohio, however, is the only one who touched upon the chief thought of this chapter. "What is another thing that has got to come?" said he. "Co-operation between the railroads and the rivers. Stop fighting each other. Supersede an era of competition by one of co-operation."

This is the key to the problem. We have many waterways now, bearing much traffic. We should begin the era of co-operation, and end the era of destruction in the relations of the highways now in existence—and "do it now." A study of the laws of foreign nations will disclose just and reasonable methods by which men who have capital for investment in boats may be protected against loss by un-economic competition. The assurance such regulations would give would do more to restore our shipping to river and canal than anything imaginable except deep water; and deep water alone cannot win against unrestricted competition. The idea of waterways-protection may be new to most American readers; but it is set down in the full assurance that unless it is received into the thought of America as it has been into that of Europe, the agitation for most of the water-

way projects that claim consideration might just as well stop now. They are meritorious undertakings—under proper conditions. Those conditions, being matters of law, must be created. That they will be created when their necessity is recognized, no one with faith in his country's capacity and destiny can doubt.



A Steamer Carrying a Railway Train.

The merger of water and railway freight-carrying across Mackinac Strait.

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Chapter IV

Terminals a Vital but Neglected Matter

A VOYAGE by water, whether it be by ferry across a river, or by liner from continent to continent, is obviously a means, and not an end. It involves contact at two places at least with the land. If it be a coastwise or interior voyage, it is likely to mean many landings. We speak of the "free navigation" of our waterways; but whether or not they are really free depends on the conditions governing their terminals.

Given a private monopoly of terminals, and water transport is as easily controlled for private profit as any. Nay, the monopoly need not be that of the whole shore. It need take in no more frontage than abuts on the deepest water, and deep-water harbors are rare. The ship drawing thirty feet of water can put out of business the vessel drawing only twenty, because, with only a slightly augmented expense, it can carry a load of more than thrice the tonnage. The owner of dock facilities with forty feet of water may charge in wharfage the difference per ton in freight between the earnings

of the larger ship and the smaller, and the latter will be crowded off to poorer docks, or to shallower harbors. This advantage in site will be capitalized in the values of water-front lands, and will constitute a fixed charge on commerce. The value of increased efficiency in vessels will go to the owners of terminals rather than to the world at large in lowered rates.

More than this, those who control the dock sites at which alone modern vessels can discharge and load, will see the opening offered to the control of the carrying trade itself,¹ and will force combinations manipulated by themselves; and at last gather into their own hands the whole business of water-borne traffic, charging what the traffic can bear rather than what it should bear. These increased profits constantly become capitalized in the values of the favored sites, and the piling up of charges goes on with no check save the prudential avoidance by owners of the wiping out of the difference in economy between the best terminals accommodating the best vessels and the poorer facilities frequented by the shallower bottoms: except of course the tendency of trade to escape monopoly by creating other terminals in the making of new harbors or the deepening of old ones, and the competition of public docks either in the same harbors or competing ones. But given complete monopoly of the deep-water terminals of the world's ports, and the monopolization of water-borne trade follows, with the

¹ See note *j* at end of volume.

concomitant raising of freights to the mere living-point for boat-owners, or the consolidation of the ownership of all vessels in the hands of the dock-owners.

This principle is one which has been worked out by the private owners of docks in many of our ocean, lake, and river ports, as well as in foreign harbors. Instances in plenty will be cited. The complete accomplishment of such a monopoly is suggested for the purpose of calling attention to the most neglected phase of the waterway problem, the matter of terminals. We are prone to speak of the building up of a great system of waterways complementary to our present system of railways as if all we have to do is to dig the ditches, and commerce must flow along them. Nothing could be more erroneous. Waterways without terminals would be as useless as electric wires without contacts. Before taking up the consideration of this question in relation to our inland waterways, a brief glance at the European practice in the premises may be worth while.

Liverpool docks (including those of Birkenhead) are administered by a board, six sevenths of whom are elected by the local ship-owners and merchants who pay taxes on ships or goods of the amount of \$125 a year, and the remainder by the general government. All members serve without pay. By this plan it is made certain that the port will be administered in the interests of owners of ships and goods—of commerce,

in brief—rather than for profits in docks. Handicapped by a situation on an estuary in which there is a difference of thirty-one feet between high and low tide, and by shifting bars of sand and silt at its mouth, yet this port has been built up by its own unaided efforts, and without a dollar from taxation either imperial or local, into one of the greatest in the world, the home port of the *Mauretania* and the *Lusitania*, and the *entrepôt* of a teeming commerce. Since 1859 it has spent the astonishing sum of \$150,000,000 on its harbor. It does all its own dredging, lighting, buoying, warehousing, and transshipment, and in all matters relating to terminals is a law unto itself.

The port of Manchester was created by the great ship canal, built by a semi-public corporation—a corporation private in form, but created for purely public purpose. After it had spent \$50,000,000 on the canal, it borrowed \$25,000,000 from the city of Manchester, and is governed by a board, a majority of which is appointed by the city. The success of this great project is historical, and undisputed.

The ports of Newcastle, Gateshead, Tynemouth, South Shields, and Jarrow show what a group of cities with common interests in waterways can do by combining. Fifty-eight years ago they formed a "Tyne Improvement Commission" governed by a board of thirty members half of whom are elected by the cities, and half by the coal-owners, ship-owners, and traders, with authority over twenty miles of river and estuary.



The Thames River at London, England.

From a photograph by Brown Bros., New York.



It has spent \$85,000,000 on the channels, and is now spending \$2,000,000 more per year.

At Bristol the water terminals constitute a city monopoly, controlling not only the docks of Bristol proper, but those of Avonmouth, several miles down toward the sea, where the deep ships dock. Since 1848 this city, about the size of Milwaukee, has borrowed \$25,000,000 to be expended in harbor improvement.

The harbor of Glasgow is administered by a board of trustees elected in part by the city, in part by trades guilds and chambers of commerce, and in part by seven smaller municipalities interested in the navigation; but the whole plan is that of administration for public purposes. It has spent \$44,000,000 on the harbor, and has made of Glasgow a great port.

London, still the greatest port in Great Britain, has fallen behind New York, Antwerp, and Hamburg in the list of world's ports, and her complicated and out-of-date port administration is often, and with much reason, charged with the blame of her slowing down. She is asking to reorganize her port administration on the Liverpool model, and a valuation has been made of her docks which shows the burden thrown on commerce when these great increments of value are allowed to accumulate in private hands. The commerce of London will, it seems, have to pay interest on \$200,000,000 of this in future, while that of Liverpool all goes to the common good, as is the case wherever the water-front is publicly owned.

For eighteen years the city of Havre, France,—now the fifth port of Europe, I believe—earnestly strove for freedom from the control of the general government, and authority to go about her own harbor improvements in her own way, as the best British ports have done. In 1900 she succeeded, and set about her great task with a success no less than astonishing. The present rapid growth of Havre as a world's port begins with the year 1900. Plans under way contemplate the expenditure by this city of \$17,000,000 in addition to the \$42,000,000 heretofore spent in making a harbor in an estuary with a tidal range of twenty-five feet and a bottom of shifting sand; and within a few years, the deepest ship in the world will be enabled to dock at Havre at any stage of the water.

The greatest port in Europe is Antwerp, Belgium, and in all the world, only New York surpasses it. Yet the city has fewer inhabitants than San Francisco and only a few more than New Orleans. Her wonderful volume of business has been won by her daring spirit, impelled by which she has already enabled the port authorities to spend \$45,000,000 in harbor improvements, and to undertake the building of new docks to cost \$55,000,000 more. She has an average of two hundred and fifty seagoing vessels in port all the time, and has adopted the definite policy of building on broader and broader foundations for a still more impressive structure of commercial development.



The Harbor and Docks at Havre, France.

From a photograph by Brown Bros., New York.

Antwerp asks no odds of any general government, but only seeks to be let alone. The state has some water-front lands, but the wharves, in the main as to ownership, and completely as to administration, are a city affair, save as to certain minor matters. The mayor is the highest authority in dock and harbor concerns, being the head of a council of thirty-nine on whose sagacity and efficiency the welfare of the city commerce depends. Her warehouses, sheds, cranes, railway tracks, and transshipment facilities are the mechanism which makes Antwerp a commercial magnet drawing to her wharves the deep ships of the world.

Rotterdam, Holland, is another of the self-confident European cities which, copying the harbor administration of the best-conducted British ports, and improving upon them, have won success. As London and Hamburg are tied for third and fourth places among Europe's seaports, so Rotterdam and Liverpool are struggling for fifth and sixth. Ten years ago, Rotterdam had forged ahead of the city on the Mersey; but Liverpool has now repassed her. Both are fine examples of what may be done by a city wisely and energetically addressing itself to the task of coping with silt, sand, and tidal variations for the sake of trade. In 1873 this old Dutch town made over her harbor management to a company like that of Liverpool, which after spending \$6,000,000 gave up the struggle and turned the work over to the city. The

growth of the commerce since that time is the best proof of the wisdom of making a municipal monopoly of a thing which is strictly a city affair. Over \$30,000,000 has been spent on this harbor and its communications. Not a dollar has been contributed by the general government of Holland.

Hamburg's commerce is so very little greater than London's that they may be considered as tied in the race, but after Antwerp and New York, Hamburg's commerce is growing faster than any other, and, therefore, London may expect to fall behind the German port from year to year. Here we have one of the finest examples in the world of a city finding herself. Sixty miles up the Elbe from the sea, with mud and silt and tide-rip to fight, Hamburg has made her water terminals atone for the necessity which the deeper ships are under of awaiting the tide to pass the bars, and has won her pre-eminence among the seaports of Germany. The German general government undertakes the deepening of the river-channel—which greatly needs deepening—but the creation, care, and maintenance of the great harbor, together with the auxiliary harbor at Cuxhaven, are a municipal monopoly of the old free city, which has expended on them more than \$100,000,000. This huge sum is only half, however, of what the commerce of London will have to carry if the London docks are made over to the public.

Bremen, another of the old Hanse towns, also has



The Harbor at Rotterdam, Holland.

From a photograph by Brown Bros., New York.

public ownership of her wharves, but for reasons not necessary to be discussed has not grown as have her sister towns of Havre, Rotterdam, Antwerp, and Hamburg. In the first seven of European ports, she was seventh in 1870, and she is seventh to-day, lagging back just ahead of the American ports of Boston and Philadelphia. Her growth has been steadier than theirs, and she leads them more than she did then, but she does not show the vast superiority over the American ports which one who has looked the field over comes to expect of those of Europe.

Such is the condition as to ownership of terminals of these great European marts—the commercial centres from which we must wrest trade for our seagoing commerce if we get it. In all of them, save London, the precious water frontage is recognized as a public asset, and one out of which no private interest is to be allowed to make profits—and the conditions in London are difficult to be understood, and are unsatisfactory. In every one of them the principle seems to be recognized that the owner of the land where ships must dock owns the profits of the ships if he cares to take them. This principle must be recognized and acted upon in preparing for the great new development which is anticipated in the revival of waterway traffic in America, or disappointment will be met, and anticipations will fail.

The three great outlets toward Europe on the Atlantic coast of the United States might have been

expected to be Boston, New York, and Philadelphia. All of them are important, but the commerce of New York is so much greater than that of both the others, that they may be called insignificant in comparison. Many causes have conspired to give New York her pre-eminence; but it may well be doubted if she could have taken advantage of them if she had not emancipated herself from the private ownership of terminals under which they struggle. New York owning all the water-front of Manhattan Island—partly, perhaps through questionable management—feels cramped for room for her amazing commerce; and one of her problems is to find new frontage for public docks. But look at Philadelphia: she has more than twenty city docks, it is true, but most of them have less than nine feet of water for boats, and while in theory all docks are open to the public, in fact her commerce is absolutely under the thumb of private ownership or control of water terminals. Most of them are controlled by railways. There is no pier from which a newly-established line of steamers could of right clear, and the thirty-foot channel that the government is making in the Delaware will bring no commerce except such as the dock-owners are willing to admit on their own terms. Quoting Ward W. Pierson with reference to this port, "At every point the interests of the city have been sacrificed to private or corporate interests." Is it any wonder that Philadelphia lags behind ports with far inferior natural advantages?



South Street Docks, New York City.

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Boston owns practically none of her water-front. She has several small public landings scattered about where they have little commercial importance, but that is all. At Detroit nearly all the docks are private property. The disgraceful water-front of Washington is owned by the federal government, but most of it is leased to private parties. The wharves of Providence, R. I., a city well situated for commerce, and about the size of Hamburg, are all privately owned. The city of Duluth owns only a few commercially unimportant ferry landings. Buffalo has the largest artificial harbor in the world, with an area of sixteen hundred acres (nine hundred of which have depths of eighteen feet or more), the frontage of which is owned by private parties, and the expense of making which, therefore, is as distinctly a matter of private profit as is a doorstep to a private house; while her inner harbor is all controlled by the private ownership of the docks except the ends of streets abutting on it. Chicago has no public docks worth mentioning, and no publicly owned water-front upon which to construct them, save some twenty-five hundred feet improved by the authorities of the sanitary district on the south branch of the Chicago River, in a place difficult of access by large craft, and fifty miles of water-front on the drainage canal, ample for a great port, but cut off from the open water by bad passages through the tortuous river, and remote from the present centre of business. New Orleans has twenty miles of water-

front, of which only five miles are publicly owned. These five miles, however, are highly improved, and, under an enlightened port administration, city-owned railway tracks and fine transfer facilities promise benefits which will bring a growth of traffic sufficient to outgrow the public docks and bring the Crescent City face to face with New York's problem—a commerce forced to private wharves by lack of space.

The difference between the enlightened practice of the foreign ports and that of most of ours is well illustrated by these examples. Obviously, no general rule can justly be deduced from the facts given, and no conclusion is to be drawn that private ownership of docks is incompatible with the development of an immense commerce. The case of Duluth alone would disprove that. The point is made, however, that wherever a great commerce is accommodated at privately owned wharves, it is at the mercy of the owners of the terminals, that such a commerce is likely to be carried on in ships owned by or selected by the terminal-owners, that the development of port accommodations of the sort to which alone a general commerce will resort is likely to be arrested by the demands of private profit—in short, that private property cannot be expected to be administered for public purposes. Beyond this, it is axiomatic that the immense values attaching to the limited area on which docks may be built will be of benefit to commerce only as diverted to its improvement, as in the European ports cited,



Terminal Machinery at New Orleans.

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rather than left in the hands of individuals or private dock companies.

The importance of these principles to inland waterways is controlling and obvious. A voyage by river or canal is always taken for the purpose of touching land somewhere. The owners of river-frontage and canal-frontage in cities and towns can control the commerce by water to and from such inland ports. Where they are owned by railways, the development of waterborne traffic is in their hands, and the improvement of the streams will either produce no commerce, or will result in the making of water feeders only for the railways by their own boat lines, and highways for low-grade freight for the railways' own convenience, on a free channel maintained at public expense.¹

In an official report to the Chicago Harbor Commission, Mr. George C. Sikes says that the city government has in recent years spent almost nothing on harbor improvement, that it is almost impossible for a new boat line to secure dock accommodations, and that those more recently established are paying one fifth of their gross freight receipts for unsatisfactory terminals—and Chicago imagines she has ambitions to become a port! The largest boats on the Lakes cannot get into the Chicago River at all. The railways require boats to which they transfer freight at Chicago to pay for unloading the car. So inadequate have become the facilities for handling freight in this poten-

¹ See note *k* at end of volume.

tially the greatest of lake harbors, that one great Chicago firm, with frontage on the river, ships its freight by rail to Milwaukee (another port with privately owned docks) and there loads it into boats, rather than use the passages to the lake at Chicago; while it is not uncommon for boats with freight consigned to Chicago to dock at Milwaukee and ship to destination by rail. This situation is not so much wrong, as merely silly. The railways which control the docks cannot be expected to administer them for the benefit of commerce in which they have no part. They are doing their duty by their stockholders. But with the terminals at Chicago and Buffalo owned by the railways, how can the water-borne freight between the two ports be carried at rates unsatisfactory to the railways? And with the water terminals at Duluth, Detroit, Cleveland, and the other Lake ports similarly monopolized, the bald fact dawns upon the nation that, however effective the great inland waterway of the Lakes has been in the past as a regulator of rates, its usefulness in that respect is now being diminished by monopoly of docks at the only places where commerce can be landed; and that the Lakes themselves have become, through this cause alone in large measure, mere freight highways for railway use. The \$75,000,000 which the government has spent in the improvement of Lake harbors and channels has made a great highway; but whether or not it shall continue a public highway in the true sense of the word depends on the



Where Coal is Unloaded from Boats, Duluth.

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action of the cities, States, and government in the matter of docks.¹

A former member of the New York Commerce Commission, in a letter to the writer, says:

“Strangely, the matter of terminals is rarely mentioned, but the omission to consider it in my judgment spells the real cause of the comparative inefficiency of waterways. Any such canal as that at the ‘Soo,’ where traffic does not originate, but which merely connects great bodies of deep and free water, does not require terminals. Any canal large enough to accommodate the vessels using it without the necessity of breaking bulk does not require terminals except for traffic originating on the canal. . . . In this State [New York] the Erie Canal has degenerated into its present inefficiency not because it is too narrow or too small, but because it has lacked the essential terminals that are provided by the competing and successful railroads. When its enlargement now under way is completed, if lacking terminals as now, its increased commerce will in my judgment be inappreciable.”

This interesting communication refers under the name of terminals not only to docks and wharves, but to transshipment facilities, warehouses, and all the appliances that make for the efficient handling of freight in the ordinary railway terminal: things to be considered hereafter. But if the \$101,000,000 now being spent results in a canal which can be approached only

¹ See note 1 at end of volume.

from monopolized docks, its construction will result either in no commerce, or commerce carried on for the benefit, primarily, of the owners of its banks at points where they intersect cities. And if these owners happen to be railway companies—as in a surprisingly large number of cities they will turn out to be—then the \$101,000,000 will have been spent for a low-grade freight highway, the use of which will be in the railways' hands, and it will carry little tonnage except that which it will not pay the railways to carry on land. The Hennepin Canal in Illinois was meant to furnish a waterway from the Mississippi to the Lakes from a point near Davenport, Iowa. While inadequate in width and capacity of locks for the highest usefulness, it is seven feet deep and might carry a good deal of commerce between the busy industrial territory in which it originates and Mississippi River points. Mr. Sikes believes that its limited use is owing to lack of terminals, and suggests that it will never have much commerce until extended to a water connection with Chicago. But an extension to Chicago can give it no commerce of a general nature unless it is provided with terminals open to all boats.

The controlling effect of terminals on water-borne commerce is well illustrated by the condition of that important trade, the Chicago-Buffalo business. The so-called "package" freight—by which is meant all miscellaneous business—is in the hands of boat lines owned by the railways. They are the only ones that



The Tortuous and Obstructed Channel of the Chicago River.

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can engage in it. If the independent boat could find a place to dock in Chicago, she would be denied a landing at Buffalo, where the railways own all the frontage and keep most of it out of use. Some force—probably connected with dock facilities at Buffalo—has forced or induced the formation of a boatmen's union on the Erie Canal, which ties up with the railways the remnant of trade on that historic ditch. Under such conditions it is not surprising, the railways being in the hands of good business men, that Chicago-Buffalo water rates are more and more inclined to rise and fall according to the interests of the railways, that water rates have increased lately from twice to three times as fast as railway rates, that the movement for higher rates comes at the time when the control of terminals by railways has been perfected, that the water rates rise and fall in sympathy with rail rates, and the water route has come to mean little if anything to Chicago merchants in the way of lowering rates, but is of value principally as it increases the capacity of the railways to handle business.

Aside from the package freight, the principal tonnage of this route is grain eastward and coal westward. Up to this time a good deal of freedom has existed in the matter of independent boats' bidding for this low-grade tonnage. But within the past year the railways have exerted their power on the movement of freight so as to diminish water-and-rail tonnage in comparison with all-rail tonnage. That they

have the matter under perfect control through their terminals cannot be doubted.

If the traffic from Chicago to Buffalo, and from Duluth to Cleveland can be controlled by the ownership of terminals, so can it from Des Moines to Keokuk, when the Des Moines River is improved, or from Indianapolis to Ohio River points when the White is canalized, or on any other river or canal. I have spoken freely of railway control of docks and wharves, because railways have very naturally come to own or hold under lease much of the more valuable harbor frontage of the country. But railway control is no more inimical to the growth of water-borne commerce than other private ownership, where it amounts to a monopoly. In any private hands the site-value of the water-front will grow not only as fast as the commerce, but according to the law of anticipated increase will grow faster, and becoming capitalized into a body of values entitled to returns, will become an incubus upon trade. Moreover, such ownership will make possible combinations among transportation lines; being, indeed, perhaps the only thing that can make such combinations possible, if alliances with railway lines be eliminated by law.

The matter is one of the utmost importance, not only to the people of such cities as are ambitious to become ports, on ocean, lake, river, or canal, or to enlarge the trade which they now possess, but to the whole people. President Taft has suggested the ad-



Elevators on the Chicago River, Chicago.

This narrow river is the heart of Chicago's future prosperity.

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visability of bond issues for such great inland waterways as the Mississippi and the Ohio. When this course is once entered upon, it will be followed to its logical end—the making of a vast system of waterways complementary to our railway system. There is good reason to contend that the federal government should insist upon an adjustment of the matter of terminals all along every such waterway before spending the people's money upon it; for a waterway with monopolized banks at the ports is a gift to the owners of the water-front. The time to acquire rights for the public is before the highway is completed. To wait is, first to make a road for trade, and then pay for it over again to the owners of abutting land. The right of the railways to handle their terminal business to the destruction of waterway trade may well be considered; and, in a general way, the effects of terminals on water transportation should be worked out while there is yet time.

The controlling importance of the ownership of water terminals is manifest in practice and clear in reason; but the value of the factor of mechanical equipment—in which term is included warehouses, docks, wharves, and the like—while not so apparent in its deeper implications, is a thing to which the American people must address themselves as they solve the terminal problem, if the waterways are to be accepted by commerce and win in the inevitable struggle of the new with the old.

Shippers are wont to have offered them all the accommodations which an era of competition taught the railways to install. When the merchant or farmer of any city or town served by a railway takes his goods to the railway terminals, he finds there an agent to aid him, an expert to tell him the thing he needs to know, a warehouse to receive his freight and keep it safeguarded, trucks and other appliances to move it, a smooth floor on which to shift it, cars with capacious doors set on convenient tracks, and of just the height to receive the packages or bales from the wagon, elevators with hoisting machinery for grain, stockyards with convenient loading chutes, if the consignment be live stock, cars with troughs and mangers, arrangements for unloading animals and feeding them, telephones at the terminal with an agent to answer and give information, trains run on rather regular schedules and at frequent intervals—and above all, back of all this, a corporation of unquestionable solvency which practically insures the goods against all loss or damage while in transit.

No system of transportation can win in competition with railways unless equipped in large measure with similar agencies and appliances. The American shipper is a man impatient of delays and imbued with the notion—quite a just one on the whole—that the method which is inconvenient is wasteful. As a matter of fact, the most important shipping waste in our whole industrial system is in the getting of goods from

the farms and other localities of primary production to the railways and waterways. It costs on the average twenty-five cents a ton per mile to haul produce in wagons. Thus the farmer who hauls four miles to the station has his income lessened by the task to an extent which would pay for loading it on the cars and carrying it one hundred and fifty miles, or put it on a boat and take it a thousand miles. This shows the importance of the country road—but it is not the point directly under consideration; it is mentioned as the greatest single waste, perhaps, in order to lead up to the next greatest expense in transportation, the handling of goods at the terminals before the voyage or actual haul begins, and after it ends—getting the goods on the cars and boats, and unloading them. This is called the terminal charge as distinguished from the carrying charge. And it is to augment this charge that all inconveniences and lacks in equipment of wharves directly and powerfully contribute, while every improved appliance cuts it down.

Nobody seems to know exactly what this terminal charge on the average is. The railway rate-makers are quite ignorant, it seems, of the proportions in cost to the road of loading and unloading to actual haulage; and so far as I know, no one has made any determinations which are satisfactory. A few years ago, however, Mr. Lyman E. Cooley, on behalf of the commercial interests of the city of Chicago, spent a

year of time assisted by a corps of clerks in an investigation of the problem, a research which, unhappily, was never completed, but which is still, it is thought, the most enlightening ever made in this country. Its findings were never made up, nor its incomplete data published, but enough was learned to point to the conclusion that the terminal expense in this country on the average railway shipment is equal to two hundred and fifty miles of haulage, and that on the average water shipment the terminal charge, if separated, would be about equivalent to twenty-five hundred miles of carriage. These calculations are not to be relied upon as exact; but that they are approximately correct is believed, it is thought, by most freight experts.

The significance of these facts is startling. The country roads and the water terminals are within the control of the local authorities. No action of Congress is needed in order that the highways, haulage on which absorbs for the producer as much or almost as much of his produce as his railway transportation, may be put in such condition that the expense will fall to half of what it now is. Good macadamized country roads would work as much benefit to farmers living five miles or over from market as a fifty per cent. cut in railway freight rates—and this boon to the producer he can, by local action, give himself.

On the other hand, the appliances and conditions prevailing in the freight-houses of railways and at the docks and wharves of water terminals are in many



The Levee at Cincinnati.

Carrying freight up and down such places is a heavy expense.

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cases more important than the character of the cars or ships into which the goods are loaded. It is less than a thousand miles from Chicago to Buffalo. The terminal charge for the water shipment is equal to twenty-five hundred miles of actual water carriage. The freight charges as a whole, therefore, are earned in thirds: one third for loading at Chicago, one third for steaming from Chicago to Buffalo, and one third for unloading at Buffalo. The two thirds expended at the terminals constitute a factor in freight charge which may be cut down by good transshipment facilities, the instalment of which is a matter quite within local control where the water-front is publicly owned, and quite within the control of the owners in any case. So far as good freight-handling appliances tend to cut down the cost of carriage, it may be cut down without act of Congress. Ports, on ocean, river, or lake, are, in this matter, respectfully reminded that Heaven helps those that help themselves.

If water transportation from any progressive city to the sea could be cut in half by the opening of a new railway, or the deepening of a channel, its people would besiege the functionaries on whose action hung the granting of such a tremendous benefit, dinning in their ears the needs of the city until the civic effort should end in glorious victory or crushing defeat. But the installation of good handling appliances and the building of good docks has in many instances much more than cut in half the transportation charges of

a thousand miles. It has done this in the ore, coal, and wheat trades of our own Great Lakes, where some of the most efficient handling mechanism in the world has been installed. On the voyage from Duluth to Cleveland, the terminal charge on miscellaneous freight is believed to be about twice the carrying charge. But with the wonderful coal and ore tipples, and the surprisingly efficient methods of transshipping grain, which special needs have developed, the terminal charge is thought to be reduced to a point where it does not exceed the actual carriage; and this in a trade in which economical methods of transshipment, compared with those prevailing on our inland waterways in general, have always been in vogue.

If in the case of an ordinary railway shipment of five hundred miles, or an average water shipment of twenty-five hundred miles, half the freight is absorbed by terminal expenses, how much more is the proportion in the average river shipment, where the goods are dumped on the bank, covered by tarpaulins or left uncovered, and carried package by package by roustabouts into the hold or piled on the deck? If half the expense of carrying coal from Cleveland to Duluth is in the terminal expense, with loading mechanism which is so effective that the entire cost of shipment is sometimes as low as thirty cents a ton, how much more must be the loading charge at ports where the coal is carried on board in bags by negroes, as is still frequently done!



The Empty Hold of a Lake Freighter.

River Steamers must open upwards like this if they are to be economical carriers. Observe the man in the distance.

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If the river boat could be transported between the termini of many of these shipments by some magic which would require no waterway, and involve no expense—like the magic carpet of the Arabian Nights,—it would still be more economical to ship by rail than to haul freight down a steep bank, laboriously unload it by hand, roll it to the edge of a muddy levee, watch it until the steamboat should arrive, roll it down a gang-plank or carry it down piece by piece, stow it under the towering superstructure of an American river steamer—and reverse the process at the other end.

Under such conditions no great waterway traffic can be built up. The terminal expense alone is more than the average railway charge. The depth of the channel and the capacity of the boat make little difference, when the work of getting goods to and from the dock more than wipes out the difference between water and land carriage.

In the preliminary report of the Inland Waterways Commission, there is a careful study of the relation of water transportation to railroad rates in which the effects of the physical condition and equipment of water terminals are incidentally noted. The following quotations are significant:

“Boat lines as a rule make lower rates than those made by rail carriers; but this is sometimes necessary on account of the cost of marine insurance, and charges for drayage, and for loading and unloading. Insurance is less necessary on rail shipments because of the

common-law liability of the rail carrier. Where goods are shipped from or delivered at a warehouse on a railroad switch, freight cars can be loaded or unloaded directly by the shipper, while boat freight has to be carried to and from the landing. On the other hand the boat lines sometimes have the advantage of location in receiving and delivering freight from warehouses on the river banks."

"Mr. Robert E. Lee, general manager of the Lee Line steamers (on the Ohio) says: 'We try to get as near railroad rates as possible, allowing for expense of insurance and expense for drayage when shipments originate from shippers who have tracks alongside their stores or factories, and a small differential for hauling to and from the river on account of the steep grades of the levees, for which the transfer companies charge extra.'" The effect of these conditions on waterway commerce is plain. The expense of handling goods at the badly equipped terminal must be borne by the shipper or the boat-owner. In the one case it drives shippers toward the railways, in the other it repels capital from investment in boats. In either it militates against water commerce. If to these disadvantages under which the waterways labor be added those of an unlimited legal right on the part of the railway to meet water competition in rate-making, and extensive railway control of water terminals, the wonder at the disappearance of our river traffic quite ceases.



Loading Ore at Mesabi Docks, Duluth. Train Loads of Ore far
above the Vessels.

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Speaking of the rates on the Mississippi, this excellent report says: "The Mississippi is paralleled on both sides by railroads operating long trains over easy grades at the least possible cost. River steamers can still underbid railroads to some extent on local traffic, but they are at a disadvantage in loading or terminal expenses, and in insurance or risk, as well as on account of the rise and fall of water in the river." The methods by which rise and fall of water is dealt with at good terminals will be mentioned hereafter.

Where waterways are effectively used, here and abroad, the proper physical equipment of the terminals is taken for granted as an essential element in the business. The handling devices for the grain, ore, and coal trades on the Great Lakes are among the commercial wonders of the world; especially the splendid achievement in freight-handling by which ore is brought about a thousand miles from Duluth to Pittsburg,—loaded on ships, carried to a terminal on Lake Erie, transshipped to cars, and unloaded at the furnaces at a cost that makes it possible for our steel producers to command the markets of the world. But we have signally failed to solve the problem of handling miscellaneous and package freight on rivers and canals. Water traffic has been decadent because of the hopelessness of its contest with unregulated railway competition; and a decadent industry is apt to give up at all points. But in the new era which we hope for, the commercial interests must adjust them-

selves to waterway methods of to-day at the best American and European ports, and not to those of the days when Mark Twain piloted the floating palaces on the Mississippi—floating palaces built for passengers and show, and not for the cutting off of the last fraction of a mill in the cost of taking a ton of freight from the bank, carrying it to its destination, and discharging it.

In a recent consular report occurs this passage with reference to the port of Antwerp: "The Antwerp Chamber of Commerce induced the government to enter into negotiation with the Dutch government for the better lighting of the River Scheldt, to enable large ships to navigate the river at night. It also persuaded the city authorities to install the fifty-ton electric crane at the south quays, which has greatly facilitated the manipulation of cargoes." This is a typical dual transaction in the fine administration of the European ports—channel improvement along with up-to-date, economical, efficient freight-handling devices. Everywhere in Germany, Belgium, Holland, France, and Austria-Hungary, the landings bristle with steam and electric cranes, derricks, and winches. At Hamburg "the warehouse barges represent an interesting method by which managers of barge lines overcome the difficulty in river navigation caused by changes in water level. A huge terminal barge is anchored in the harbor, and, of course, rises and falls with the level of the stream, as effected either by tides



Monongahela Wharves at Pittsburgh. The Old-fashioned Steamer
and the Old-fashioned Dock.

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or the changing volume of water at different seasons. In other cases, warehouses are constructed with elevators and cranes, so that whatever the level of the stream the freight may be taken directly from the barge and stored."

We have seen how daring is the enterprise of the great foreign ports in the matter of investments in docks, harbor improvements, dredging operations, and the like, and how independent the cities are of the general governments. It is quite as instructive to observe how complete is their realization of the necessity for efficient physical equipment for freight-handling. Our river cities may well copy these merits. With few exceptions our interior towns that importune the government for the deepening of channels seem destitute of any ideas as to the duties resting on themselves. If the Ohio River towns had done as much for themselves as the government has done for them, every village would have its public dock, every dock would have its warehouse, and every warehouse would have its machinery for transshipment, loading, and unloading. The harbor manager would be a greater man than the mayor. The finances of the town would be to the extent of the taxing power at the service of the port. Money would be poured out for better boats than the antiquated craft now plying the river. Every hull would be capable of being thrown open from the top, and cranes capable of doing the work of the uncertain gangs of roustabouts at a fraction of the present

expense would handle freight more cheaply than it is handled in the average railway freight house. The railway tracks would be taken out over the water on aerial structures where necessary, and the expensive draying up and down steep levees would be eliminated. At the more important points specialized appliances would be installed, and the town with ambitions toward real cityhood would retain the best engineers for the designing of terminals, to be its proudest achievement, and its greatest municipal undertaking.

Along all our rivers, lakes, and canals the best brains in the technical world must in the future be engaged on the problems of saving this half or two thirds of the expense of transportation which is involved in handling and rehandling of freight. The changing channels of such streams as the Missouri and the lower Mississippi must be anchored to the waterfront by revetment work, and from the public docks the huge packages will be swung by great cranes from the open holds of boats to the cars, and from cars to boats. As an example of the devices sometimes adopted to save time and the breaking of bulk, the methods of sending American meats into London may be cited. They are unloaded from the ships directly into delivery wagons at Southampton, the loaded delivery wagons are carried on cars to London, ready for the horses which haul them to the butchers' shops. In many places trains of cars are carried on boats across rivers and straits, and long distances by water.



Electric Hoist Unloading Ore, Buffalo.

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There seems to be no reason why grain, live-stock, cotton, and much heavy freight which is costly to unload, and which must make a part of its trip to market by rail, should not be carried on boats in the cars—the original shipping packages. Neither does there seem any reason why huge boxes each containing a carload should not be made capable of being swung from the boat to the flat-car to which it might be fitted, and back to the boat again when necessary. The cranes capable of doing the work are already invented, and in use.

No one, of course, can foresee the mechanical development of the great new public works the need of which is so clear, it would seem, that it needs but to be mentioned to be admitted. It was a matter of frequent assertion in Roosevelt's utterances on inland waterways that localities should bear their fair share of the burden of instituting a complementary system of highways. Doubtless he had in mind contributions to such matters as levees for the regulation of channels and concomitant protection of property, in which cases the property reclaimed or insured against flood and erosion should pay its share of the expense. But in the acquisition of water-fronts and the building and equipping of water terminals also is a burden which localities must assume or water commerce will not succeed.

Unless it is cheaper than railway transportation it cannot and ought not to succeed. The demand will

soon arise for regulation by law of the railways in their relation with waterways. They will be required to pro-rate with waterways. They will be forced to route freight as asked by the shipper to the nearest water terminal for transshipment to boats. They will be required to co-operate in the building up of that water commerce which will benefit the railways by relieving them of the burdens of bearing the heavy, low-grade tonnage. But so long as our river-fronts and canal-banks are the bare landings that now skirt our waterways, such a policy on the part of the railways cannot be required, and would not be endured by shippers if voluntarily put in force. The terminal not properly equipped will make the river voyage on the average more expensive than that by rail; while the harbor or levee provided with the best handling machinery will go far to make profitable even the small vessel plying the shallow waterway.



Unloading Cotton at Memphis.

Note how freight must be stowed under over-hanging decks.

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Chapter V

The Rivers and the "Conservation Movement"

THIS study of Inland Waterways now runs into the work of a group of men of whose labors in the service of the government we should all be proud—the scientific group. They deal with the applications of science to the conservation and utilization of our national resources; and no one who has had a glimpse of their fine patriotism, their unselfish devotion to duty, their consecration to the ideal of our trusteeship for posterity can fail to be thrilled by it. Such men as Pinchot the Forester, Leighton the Hydrographer, Newell the Reclaimer, and Davis the Irrigation Engineer have the claim to greatness that the doing of great works in a lofty spirit entitles men to. Every one of them, in these times when great engineers and organizers are worth money in the business world, works for the government at a sacrifice; but I am glad to bear witness that they are men of the sort to be enthralled by the great, alluring, and unselfish labor of adding millions of acres to our useful area, reclothing with trees our devastated forest lands, gauging our

rivers, laying plans for a better America leading out far beyond the possible duration of their own lives. The honesty and efficiency of science react upon the discredited methods of the Government Circumlocution Office too. These men cut red tape. They build the greatest and finest engineering works more cheaply than private enterprise does it. They are the vanguard of a reform in governmental methods of which they themselves of all men have the least conception—true soldiers of the common good.

In James Wilson, our greatest Secretary of Agriculture, there came into our national life a man kindred to them in spirit. He, too, has vision, and all the rugged honesty of science. And at the very psychological moment, came into power the active and many-sided Roosevelt, whose mind is peculiarly open to the truths in which such men deal. The conjunction of these men in the political sky was the opportunity of the scientific group, and has brought to the nation the chance which knowledge gives of beginning the end of the chaos of national waste and destruction which marks us as the spendthrift and waster among nations.

The original Inland Waterways Commission was appointed by President Roosevelt to begin the work of the "Conservation Movement." Its name relates it to the subject-matter of this volume, as does the presence on the Commission of Congressman (later Senator) Burton of Ohio, Senators Warner of Missouri and Bankhead of Alabama—all recognized ex-



Power-house at Dam Site, Salt River Project, Arizona.



perts in rivers and harbors legislation,—and especially Senator Newlands of Nevada, whose statesmanship delights to deal with national needs beyond the scope of platforms and campaign books. General Mackenzie of the army, too, was at the head of the service having control of waterway engineering; but the other members of the Commission brought with them the new light rather than the old. They were Dr. W J McGee, a soil expert and repository of universal knowledge, who may be regarded as the *alter ego*, on the Commission, of Secretary Wilson; Frederick H. Newell, Chief of the Reclamation Service, whose great work in Western irrigation has added to the arable territory of the nation an acreage equal to an average state; Gifford Pinchot, who, through the profession of forestry which he created in America, has become recognized as one of the most potent men for good now living; and Herbert Knox Smith, Chief of the Bureau of Corporations.

So far does Congressional action lag behind the best thought of the nation, that there was no law under which this Commission could be appointed. It was purely unofficial. Its members were not paid for their services—in fact, one of the employees of the Commission was in large part paid by a member of the Commission out of his private funds. To labors already great and engrossing, these men added this new service, from a sense of duty and a love of a work at once alluring and altruistic. This work was to be

nothing less than that of bringing into co-ordination the unrelated activities of the government, so that all things done, and many new things to be undertaken, having to do, directly or indirectly, with our streams, may be grouped, systematized, and organized into a magnificent scheme for the betterment of a continent—"the conservation movement." The utmost to be hoped of the new official National Waterways Commission is that it may in some degree equal the old in energy, in wisdom, and in desire to serve the nation.

Out of this comes the plan of Mr. Marshall O. Leighton, Chief Hydrographer, for improving our rivers by head-waters control, rather than by dependence on the methods of the past, which consist of puttering with banks and channels—a plan regarded as revolutionary by the custom-bound, but which, if a layman may dare to express an opinion, must win eventual adoption. It applies to most of the navigable rivers of the country. It is especially important to the upper Mississippi, and to those rivers of the South, Southwest, and West which have periods of low water, alternating with floods; but because it has been better worked out for the Appalachian region, and because of the immense importance of those mountains, I shall pay most attention to that watershed, which so largely determines the character of most of the large rivers east of the Mississippi, and dominates the Mississippi itself below the mouth of the Ohio.

The Mississippi is the central feature of our water-

way system. The Appalachian group of mountain ranges is equally primary in importance as a region where navigable streams have birth. Every inland waterway falling into the Atlantic from the Penobscot to the Savannah is fed from Appalachian slopes, and most of them have actual rise in the mountains. So do all the main streams falling into Mobile Bay, the Chattahoochee, and the chief affluents of the Ohio, including such great arteries of water-borne commerce as the Monongahela, the Great Kanawha, the Tennessee, and the Cumberland. Mr. Leighton proposes to do more for these rivers—or at least the more important of them—than any project ever advanced has contemplated. His plan solves the deep-water question for the Ohio, for the Tennessee, for the lower Mississippi. He proffers the Lakes-to-the-Gulf Deep Waterway Association more aid than any other man. He should be an honorary president of the Atlantic Deeper Waterways League, for he offers hundreds of miles of really deep channels to its coastal system of waterways, of which I suspect they have no knowledge. He should be recognized by the Upper Mississippi Improvement Association as the man who can show them how to get nine or ten feet in their channel for the six they ask for. He solves their problems for the people of the Ohio River Improvement Association; he offers the Missouri River Congress a clear fairway from Cairo to the Gulf, thus narrowing its field of effort; and he gives the National Rivers and Harbors

Congress a single project which covers more of its objects than any plan which has ever been placed before it. This policy, adopted as a part of the conservation programme of the Geological Survey, the Reclamation Service, and the Forest Service—if not formally by the Inland Waterways Commission itself,—seems, in economic and material importance, and especially in importance to our inland waterways, the most noteworthy matter now before the people of America. It is a far-reaching system of plans, one feature of which is that of holding back the waters of the freshets in great reservoirs, and liberating them during low-water periods, so as to keep the rivers always in gentle flood. The policy of the past has been to dredge, lock, and dam streams in order to maintain depths in spite of low water; the policy of the future seems sure to be that of never having low water, and of resorting to canalization and levees in those cases only where the plan of head-waters control is incapable of overcoming the obstacles of rapids or inevitable floods.

Mr. Leighton's plans are a part of the general conservation movement, and really grow out of the forest projects of Mr. Pinchot. Superficially the scheme for reforesting the White Mountains and the Southern Appalachian watershed seem unconnected with waterway improvement. Basically, however, the chief factor in the future of our navigable streams east of the Mississippi is their impending destruction by mud and



At Work on Roosevelt Dam, Salt River Project, Arizona.

silt, now on its downward course to fill them up and end their commercial usefulness. The whole Appalachian highland, including the White Mountain region, is rapidly advancing to sterility and ruin—the condition of a washed-off desert; and the spoiling of the streams is only one phase of this decadence of a once useful and beautiful region.

Appeals to the wrath to come are likely to fall upon deaf ears; but the evils already here may be supposed to be more compelling. Forest-destruction has already brought its punishment. We are entering upon a long purgatory of wood-famine, if not, indeed, upon sufferings more enduring still. The hardwood supply nears exhaustion; and within a few years, comparatively speaking, industries depending upon it, all over the land, must close down and go out of business, unless something is done to conserve our hardwood forests. There is no economically available place for these forests save in the Appalachians; and the Forest Service has told the nation how on these slopes may be grown a hardwood supply reasonably adequate to the nation's needs. This involves the establishment of a great national forest to take in the White Mountains, and all the most rugged highlands from central Pennsylvania southward to northern Alabama. The Forest Service knows whereof it speaks. It already has charge of government property worth a billion and a half of dollars, and controls a forest estate as large as all the Atlantic

States from Maine to Virginia, with a part of North Carolina thrown in. It is a model service as to business methods, is self-supporting, and will turn in two or three millions as profit on its operations this year. It is essentially the creation of Gifford Pinchot, who has followed the example of the European nations, who know so much more about some things than we do. The growing of forests will never be done on a great scale by individuals. It is as much a collective duty as the levying of taxes or the maintenance of waterways.

The Forest Service saw the necessity of extending its work to the Appalachian region, and some years ago recommended the establishment of a Southern Appalachian Park to comprise 70,000 square miles of land; but the difficulty of impressing upon Congress the advisability of doing anything at once so new and so big has led to a paring down of the proposition, until now it includes only the acquisition of some 600,000 acres in the White Mountains, in which rise the Connecticut, the Androscoggin, the Saco, and the Merrimac, and about 5,000,000 acres in the Southern Appalachian region, taking in the higher watersheds of the Potomac, James, Roanoke, Yadkin, Catawba, Broad, Saluda, Savannah, Chattahoochee, Coosa, Tennessee, New, Cumberland, Kentucky, and Monongahela rivers. On this land it is proposed to establish a great national forest, or series of forests. That the advantages of the plan might be fully understood, the



Cherry Orchard, near Kiona, Kiona Canal, Ledbetter Scheme,
Washington.

Geological Survey seven or more years ago instituted a series of admirable studies of the water resources of the region, and its capacity for storage reservoirs, and it is now able to point out a way for the establishment of ample reservoirs; for the saving of hundreds of millions of dollars yearly, perhaps, in flood damages; for the furnishing of ample depths of water to thousands of miles of our most important waterways; for the yearly saving of many thousands of dollars, if not millions, in dredging and other channel improvements; for saving the whole Appalachian and White Mountain regions from ruin by erosion; for the saving of many of our navigable streams from commercial destruction by the mud washed down from the bare mountains; for the establishment of a great national forest, to become to the United States what the Black Forest is to Germany; and all this, not only at no ultimate expense to the people, but with the prospect of an ultimate profit.

If the project fails, it will not be for lack of attractive features in the plan itself, nor for the absence of necessity impelling us to it. For we must buy this land and establish this forest if we are to be true to our collective duties. Unless we do so, this vast region, charming in scenery and rich in historic interest, is doomed to lose its utility, and to become an unsightly and mischievous desert. The destruction of its forests has set in motion the advancing ruin.

The White and Appalachian mountains are great

lumps of earth mingled with stones. The rains and snows wear them away as spray from a garden hose would wear away a lump of potter's clay. Until man destroyed it, the forest was spread over them, breaking the dash of the rain, carrying it in runnels down the trunks of the trees, or letting it drip harmlessly from the boughs. Thickly covering the ground was a warp and woof of dead leaves, twigs, boughs, humus, and a mat of small green things sheltered by the great trees. The very spirit of the woods is one of shade and moisture and mosses and the slow outflow of cool springs. This spirit has been changed by the destruction of the forests. The mountains have begun to dissolve and wash down upon the lowlands. The streams are commencing to silt up with mud. The nap of nature's protecting towel was the large trees. These were taken by the lumber companies. The pulp mills followed and sheared to the ground; and then came the farmer, digging up the soil on the lower slopes with plough and harrow, so that a few years of beating rain and rushing freshets of snow-water could not fail to take away the very soil itself; and where the farmer fails to go, runs the fire, destroying more than man has destroyed, burning up the very humus of the soil, killing the little plants, baring the earth to all the forces of erosion. The inevitable result is a desert.

Any one who has observed the melancholy, ruined "old fields" of the Southern Appalachian slopes must



Hillside Erosion in Abandoned Fields, Catawba County, N. C.

From a photograph by U. S. Forest Service.



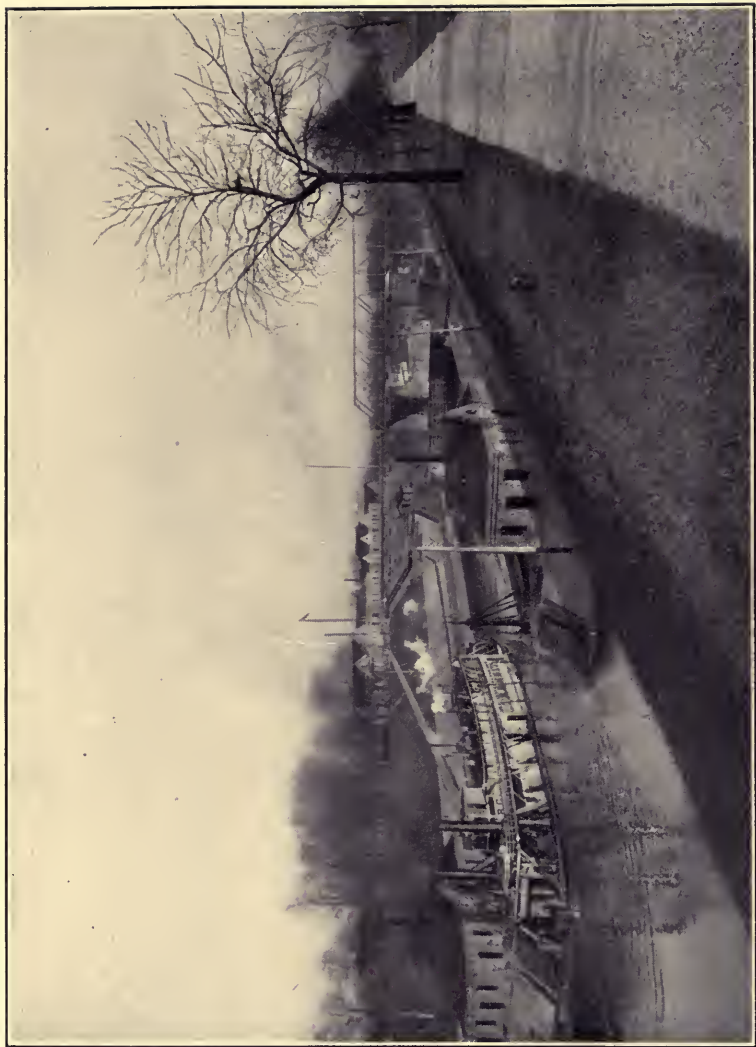
have noted the washed-off sterility of their gullied slopes, their utterly ruinous condition. Professor Shaler—a conservative scientist, who weighed his words—stated in 1896 that three thousand square miles of the highlands south of Pennsylvania had then been destroyed for human use, and its very soil carried down to the lowlands and the sea, and that arable and forestable lands were then being lost at the rate of a hundred square miles a year. Every year since then this leprosy of destruction has spread more and more rapidly. In passing to the lowlands the soil covers up the rich bottoms with sterile detritus, and in reaching the sea it has to be rolled along the beds of navigable rivers, destroying their navigability. With no forest to hold back the waters, every year the floods grow worse. This world is as large as it ever will be. We cannot make it one inch larger, but we can destroy its usefulness by abuse. Civilized people should be ashamed to do this, and yet we, who call ourselves civilized, are here wasting this planet on which we live, at the rate of perhaps two hundred square miles annually—land which our children may so bitterly need.

The Forest Service knows how to reclothe with trees all these slopes not irretrievably ruined, and to stop the devastation where it is; and to make the operation pay, as a transaction in forestry. Saxony takes out of her forests nearly a hundred cubic feet of timber per acre annually. A fraction of this output would pay interest on the price we should be

obliged to pay for the White Mountains and the Southern Appalachians. Mr. Pinchot's Service would be quite sure to show a good balance-sheet in a few years from this alone. But Mr. Leighton shows us how the new national forest might be made to pay for the whole transaction over and over again, through the most stupendous development of water-power ever contemplated, perhaps, in one project. By a partial survey of the proposed national forest, he has laid out reservoirs with capacity to hold back the floodwaters of thousands of miles of streams, by dams creating power which, if sold at ordinary commercial rates, would create a sinking fund ample in amount to relieve the people, not only of all the burdens of sustaining the forest itself, but to build every commercial waterway for which there is any expressed need in the nation.

This is a very startling statement; but it is based on data seemingly incontrovertible. Let us dismiss the idea of forestry, and look at the matter from the angle of flood prevention and benefits to navigation. And first, let us consider these things as related to the Ohio River, a stream which, judged by the amount of commerce carried, is the most important river in the United States.

The Ohio brings to its valley the worst floods of any American river. One of these, within the past five years, did damage estimated at \$100,000,000, a tithe of which was incurred by the city of Pittsburg



A Piece of Necessary Canalizing on the Ohio, at Louisville, Ky.

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and its environs. There is water and to spare, then, for the greatest ships that float, and a stranger looking at the swollen river would be startled to know that the utmost efforts of the government engineers can maintain but six feet for vessels at low water, and that they have fixed upon nine feet as the ultimate, after spending millions for dams and locks which will cut the channel into short reaches of different levels—a series of millponds from Pittsburg to Cairo. Of course these dams and locks are vexatious to commerce, consume time in passing, and are expensive both to the boat-owners and the government; but they are the best the engineers can do—so far as they have worked their plans out. But in the proposed national forest, Mr. Leighton has located sites for reservoirs to hold back the floods of the Monongahela, the Great Kanawha, and some small tributaries, the contents of which, liberated as needed during low-water periods, would give to the Ohio a clear channel certainly nine and perhaps twelve feet deep the year round, without channel improvement. His survey is not yet complete except at some of the steeper places in the river. He has not included in it such Ohio streams as the Kentucky and the Big Sandy. With these he might be able to give fourteen feet or more. It would pay to build these reservoirs just to keep down the floods by this vast volume of water; but as an aid to navigation, this reservoir plan would give to the States bordering on the Ohio a better river than is the Mississippi below

St. Louis—a far better river than they ever dreamed of having.

The Monongahela has a system of locks and dams which has cost the government six millions of dollars—or, at least, the river has done so. It is a most important waterway, the navigation of which is much impeded by a slack-watering system like that now building on the Ohio. The water from the projected reservoirs in the new forest would give it water a foot deeper than it now has, with no locks and dams. The Kanawha is being improved to a depth of six feet. Leighton's reservoirs would give it seven feet through the driest summer, with no channel works.

We think of the Niagara water-power as the greatest thing of its kind in the world—and it is, of course, stupendous. The utmost permissible realization of power at the great cataract, if its beauty is to be retained, is nearly 600,000 horse-power. These reservoirs on the tributaries of the upper Ohio, in addition to giving the navigation benefits mentioned, would put at the disposal of the government, in the greatest industrial district of America, more than 400,000 horse-power, counting only the minimum of the lowest two weeks. The Chicago Drainage Canal people reckon their power to be worth \$25 per horse-power per year. At this rate, as a by-product in the operation of partially redeeming the Ohio valley from floods, making the Monongahela and Kanawha really navigable, and giving the Ohio nine to fourteen feet of water all



A Few Miles of the Tennessee from Lookout Mountain.
Proper headwaters' control would make this a great waterway.

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the time, the government by building and operating power-plants might realize from the sale of power \$10,000,000 per year, and create a property of the value of \$200,000,000. I do not know how the thing can be more strongly put.

Let us go to the Tennessee. This should be one of our greatest commercial highways. It flows through a region rich in fertility and full of mineral and forest wealth. But it empties itself in floods which roar down the valley sixty feet deep; and then it drops so low that the government engineers can promise nothing better than the pitiful and all-but-useless shallows of three feet above Chattanooga, and five or six on the lower reaches. The proposed reservoirs in the national forest would make the river thirteen feet deep for a drought of 117 days each year from Knoxville to Chattanooga, and below Chattanooga they would furnish the water for a depth of fifteen feet for 150 low-water days a year; and all this without any channel improvement below Riverton. And between that port and Knoxville a flow would be provided which would greatly reduce the necessity for canalization. The Tennessee would be a big-boat river clear to Knoxville, a better stream than the Mississippi is at St. Louis; and the largest steamers plying between Memphis and New Orleans could go to Chattanooga any month in the year. As a waterway improvement, this would pay if charged with the whole expense of the project. But in addition to this, and as a by-

product, the dams to hold back this water would develop a minimum of 973,600 horse-power, or sixty per cent. more than it is contemplated ever realizing from Niagara. This is on the basis of the two weeks of lowest water. By installing machinery to work while the water is higher than the minimum, as all hydraulic engineers do, the upper Tennessee and its tributaries would furnish 1,584,400 horse-power. A million horse-power at \$25 per year is worth \$25,000,000 annually, and the property yielding it would pay interest on \$500,000,000.

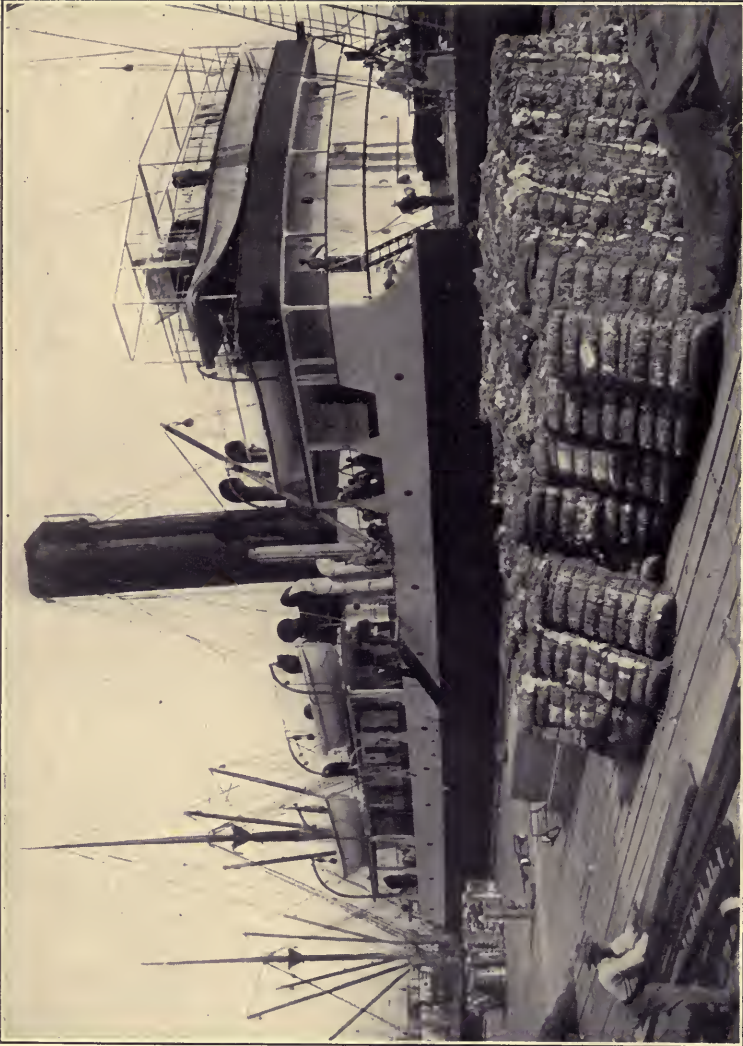
The water poured out to redeem the Tennessee and the Ohio would not cease to be useful on reaching the Mississippi at Cairo. The whole country is humming with demands for deep water in the Mississippi. Even the East, and the States west of the mountains, see in the renewed commerce of the Father of Waters a relief from the car shortage and railway prostration which must recur with good times. The Memphis Convention, attended by the President and so many Governors, adopted the slogan of "Fourteen Feet through the Valley." Well, gentlemen, here's your fourteen feet from Cairo to the Gulf. Computations which are perfectly reliable show that the water which would make of the Tennessee and the Ohio really deep waterways would solve the problem for the lower Mississippi.

If this statement works out for the worst place in the river and for the driest season ever known, it

may be accepted as proven, may it not? The worst place in the river is the Point Pleasant crossing, where a fleet of government dredges are kept ready to begin digging whenever the depth in the channel falls below nine feet. The worst year ever known for low water was the fall of 1904, when six dredges put in more than four thousand hours of work at this place. To have kept the river nine feet deep without dredging would have required something less than 400,000,000,000 cubic feet of water. Leighton's reservoirs on the Monongahela and Kanawha alone would have furnished 402,300,000,000 cubic feet. The projected reservoirs on the headwaters of the Tennessee would have poured out 850,000,000,000 cubic feet more. This is more than three times the amount necessary to enable us to dispense with dredging, and more than is needed to give the river fourteen feet—at the worst place in the river during the longest period of low water. Thus, by this simple though immense project of equalization of flow, coupled, of course, with a certain amount of channel improvement, we should make two great deep waterways—from Knoxville to the Gulf on the one hand, and from Pittsburg to the Gulf on the other,—make a new basing line for freight for two thousand miles, and relieve a hundred congested freight-yards.

But this is not the whole story of this magnificent project, as to either waterways or power. It is not yet completely embodied in figures, and not all of what

has been worked out can be stated here; but enough may be mentioned to show the wide-spread blessings to be derived from it. In South Carolina, for instance, the Santee, the Wateree, and the Congaree rivers are the controlling waterways, and some important reservoir sites are located on their head-waters. The Santee through its entire length affords to vessels a low-water depth of four feet. The outflow of the reservoirs would keep it always above eight feet. The Wateree as far up as Camden, and the Congaree to Columbia, fall as low as three and one half feet. The reservoirs would always keep the Wateree at least seven and a half feet deep; and I suppose that as reservoirs are projected on the Broad and Saluda above Columbia, the Congaree would be benefited in like measure. These cities would thus be assured of better navigation than Pittsburg now possesses; boats of a thousand tons' burden could come to their docks from the ocean; and a shipping revolution would be inaugurated for them. The Great Pedee, also in the Palmetto State, is now eight feet deep to Smith's Mills, 52 miles, and three and one half feet thence to Cheraw, 167 miles. The national forest reservoirs would increase these depths to fourteen feet to Smith's Mills and nine and one half to Cheraw. South Carolina would at once have three great, deep, dependable waterways striking far into her interior. North Carolina in the Roanoke has a waterway which is three feet shallow to Weldon, 129 miles. The Leighton reservoirs



A Cotton Steamer at New Orleans.

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would make it ten feet deep the year round, unless the drought extended over a period of more than 122 days. The Potomac, the James, the Chattahoochee, the Coosa, the Black Warrior, the Cumberland, the Big Sandy, and many others are likely to show equal improvement when their cases have been worked out; but the data now at hand show that every State from Pennsylvania south in the circle made by the Ohio, the Mississippi, the Gulf, and the Atlantic, save Mississippi and Florida, would find themselves pierced at once by waterways more valuable as commercial arteries than any they now have the slightest expectation of ever securing; that the States on the north bank of the Ohio and the west of the lower Mississippi would receive benefits almost equally great and unexpected; that there would spring up about the great power plants in the heart of the national forest great industrial cities created by cheap power. The forest, instead of becoming a deserted place, would grow in population. Its agricultural lands and mines, being exempted from the Forest Reserve, according to the universal rule of that service, would increase in value; and the prosperity of this group of States would be greatly promoted.

The Leighton reservoirs in the projected forest would prevent the overflow of the Mississippi levees, if we assume that no flood capable of topping them can arise without the aid of the Ohio. And the reservoir system is not to be confined to the projected

forest—it bids for adoption as the accepted system of river control. There are reservoirs already on the upper Mississippi, and there are sites for more. At the sources of the Missouri, Mr. Newell is busy taking out the waters and holding back floods for irrigation purposes. Altogether, the reservoir system in Montana, in Minnesota and Wisconsin, and the Southern Appalachians, promises, in connection with the maintenance of the present levees, more in safety for the lower Mississippi flood-sufferers than was promised by the Seddon plan of throwing the St. Francis Basin to the river as a sop. At the same time, the Leighton plan will begin its benefits at the very head of navigation, and Minneapolis and St. Paul will rejoice with Pittsburg, Louisville, Chattanooga, Knoxville, and a hundred other cities in better water for navigation than they now dream of. Every one of these reservoirs will develop, as a by-product, power enough to pay for itself. The Connecticut, the Saco, and the Androscoggin will be improved for navigation, and new power be made available for New England wheels and spindles.

We are entering the age of water-power as a substitute for coal. The time must come when we shall be forced to limit its burning to those purposes to which water-power cannot be applied. In each successive decade we have used as much coal as in all the previous history of the nation. This is a terrific acceleration. If it continues, we shall have used the last



An Eroded Slope in Western North Carolina.

A hillside which should have been left protected by forest. Now it is not only worthless, but it threatens the streams and bottoms below.

From a photograph by U. S. Forest Service.

of our coal in another century; and our grandchildren will be plunged into the distresses of a coalless world—distresses of which we can scarcely conceive, so bitter and terrible they must be. As a plain question of collective living and a square deal to posterity, ought we to burn coal if we can use water-power to accomplish the same ends? Or if this query be too advanced for offhand answer, ought we to waste our water-power recklessly, or should we allow the power-sites in the public domain to be filched from the people? For they *are* being so filched almost daily. The great financiers of the land know the value of water-power better than most of us know it, and are devoting themselves to its monopolization, by fair means and foul.¹

The government, let it be admitted, has made the way of the power-forestaller easy. We have been wasteful in many things, but in nothing, perhaps, have we scattered treasures to the winds so lavishly as in water-power. An indicated minimum of 2,800,000 horse-power is wasting down the rivers of the Southern Appalachians at this moment; but for this the general government is not to blame. The case is quite different, however, as to the power given away, and wasting over the dams we have actually built. Based on the two weeks of lowest water, these dams develop a minimum of 1,600,000 horse-power. By putting in wheels to be turned whenever there is work to run them for four to six months in the year, they would yield

¹ See note *m* at end of volume.

no less than 4,000,000 horse-power, worth every cent of \$100,000,000 a year. This is twice as much yearly as the Rivers and Harbors Congress asks for the great work of waterway improvement. In five years it would replace in the treasury every cent this nation has ever spent in waterways work. It is running off like precious wine from an open faucet, at the rate of three hundred thousand dollars a day.

Senator Teller of Colorado rose in his place in the Senate, not long ago, and stated impressively that under the Constitution the United States Government has no right to receive one cent of revenue from the water-power created by the dams built with the people's money. Many private interests engaged in cornering water-powers ardently agree with him—in Colorado and elsewhere. At the Des Moines Rapids of the Mississippi the power given away since 1896 amounts to 185,000 horse-power; at Sauk Rapids, Minn., 7100; at Le Claire, Iowa, 9800; above Sauk Rapids, Minn., 8900; on the Tennessee at Chattanooga, 114,000; on the Missouri in western Montana, 14,000; at Helena, Mont., 16,300; at Vandruff's Island, 5800; at divers points on the upper Mississippi, 11,200. I could mention twenty-five others, among them the splendid power at Rainy Lake, Minn., with a head of thirty-seven feet. All along the slopes of the Sierra Nevadas and Cascades, all among the cañons of the Rockies, the engineers of great corporations and capitalists are at work gauging the run-off and measuring the head, and the sites



Work on Laguna Dam, Yuma Irrigation Project, Arizona and California.

are being filed on. The Reclamation Service is in terror of these big private interests. Whenever its engineers begin operations to lay out a reservoir site to bless some desert with water, they fear the onslaught of the power-site monopolist. The reclaimer is driven off by the forestaller, and in the Senate we hear the solemn assurance that we may waste our water resources or give them away, but we cannot hold them on just terms for the people's use.

The meagre documents now in print relating to the water-power of the proposed White Mountain and Southern Appalachian forest, show something of the immensity of these water resources; but every quantity has been so pared down by engineering conservatism as to give much less than the truth as to the real business "proposition" involved. Secretary Wilson's Report, following that of Mr. Leighton, gives the indicated minimum, or theoretical horse-power, of these rivers at 2,740,000, the commercially available amount of which is estimated at fifty per cent., because not all of the indicated horse-power of a stream can be realized by damming. This is over-conservative, as any specialist engaged in commercial installations will say. A hydraulic engineer—perhaps the greatest in this country—writes me: "Of course all the indicated horse-power of a stream is not available. Sometimes ninety per cent. can be developed, sometimes less. So, when you use the entire indicated horse-power for an estimate, you are probably giving more than it is worth, while

the report, when it uses fifty per cent., is so conservative as to do poor justice to the situation."

I am trying to get at the value of one of the greatest neglected assets of the nation, and I crave the reader's indulgence while I do so. Let us assume that of this 2,740,000 horse-power, 2,000,000 is the minimum physically available. This minimum is derivable from wheels which would turn all the year round, even at dead low water. But by installing additional machinery to utilize the flow during higher water, this minimum may be trebled, and 6,000,000 horse-power realized. The report estimates this to be worth \$20 per horse-power per year; but, as I have said, the Illinois authorities reckon theirs at \$25, and it is not likely to go lower as coal and wood become scarcer. On this basis the Leighton reservoir system would develop power worth \$150,000,000 per year, and from it could be created a sinking fund for the financing of a complete waterway system for the whole nation, even if we should at once undertake the construction of a complete continental system of canals.

Nothing has been said here, except in general terms, of the 892,382 horse-power of the Mississippi head-waters, which may be doubled as a commercial proposition; nor of the magnificent power-sites of the mountainous West, which we are losing day by day into private hands. No mention has been made of the capabilities of the rivers of the Northern Appalachian region. The fact that these figures may be increased



Looking Upstream through Dam Site, Rio Grande Irrigation
Project, New Mexico.

from three to thirty fold by proper storage has also been passed over, lest the statements be thought incredible. It is not believed that all this power could at once be sold at the rates named; but there would seem to be no doubt that it could be done approximately as fast as the reservoirs could be completed, that it would relieve our coal supply of a part of the drain upon it, reduce the price of fuel, open the way for the statesmanship of the future to conserve the coal in the earth, and place the strain of our industrial power-generation in part upon a source of supply that is renewed from day to day without cost. The total horse-power derived from coal in the United States is about 12,000,000. Every pound of this could be generated by the streams of the White-Mountain-Appalachian forest. As a by-product in the operation of reforesting this region, and of improving these rivers, we should develop enough power to do all the industrial work of the nation if every steam-driven wheel were stopped.

The forest scheme is essential to the redemption of the streams by the reservoir system, for, unless the forests are protected and restored, the reservoirs would be destroyed by silting up as the mountain slopes were washed down. The welfare of the inland waterways seems to be bound up with the success of the plans of the Forest Service. This most interesting system of projects would seem to stand or fall as a whole. If it could be isolated from the tangle of selfish interests

hiding behind constitutional quibbles, and regarded as a matter of business, leaving out of view as Utopian visions the farther peaks of national duty, it would surely win. It would pay in prevention of flood damage; it would pay in the salvation of rivers from mud and silt; it would pay over and over again in benefits to navigation; it would pay in the preservation of a hardwood supply, and in actual returns from forestry. The highlands included in the project could be bought for \$25,000,000, and the reservoir system could be installed for \$75,000,000 more. It would pay a private corporation, as a mere matter of money-making, to buy the whole system of tracts, reforest the slopes, build the reservoirs, redeem the valleys from floods, give the rivers the depth made possible by the impounding of the waters, and take its pay in the horse-power developed. Such a project would soon be paying cent per cent. on the investment; but if allowed it would be the most gigantic piece of graft ever perpetrated or permitted. The masses of the people are unaware of the extent to which these things of their birthright are being taken from them and wasted, are ignorant of the value of these treasures. Their representatives in Congress, however, have the facts before them. On them is the responsibility of action.

Chapter VI

The Long Look Forward in Transportation

THIS is the day of the long look forward in matters of material resources. A basic change of attitude is being assumed by the world's thought, or we should not be taking serious account of such things as the exhaustion of the coal supply, the dwindling forests, the sapped fertility of the soil. I think it was Lord Kelvin who once made some determinations as to the using up of the guano and nitrates, and found that the world faced starvation within calculable time. The scientists, in the very nick of time, found a way to take nitrogen from the air, and are now selling it in competition with the older commercial fertilizers. Lord Kelvin's evil prophecy is thus averted—or at least deferred until the air itself shall be depleted of nitrogen. These racial ultimates ought to bring us into sympathy with the Martians, who, if Percival Lowell speaks by the card, are forced to carry water from the poles to the equator for irrigation. With them, water itself has become scarce. The problems which confront us they must have met and solved long, long ago.

This long-look forward is not for the theorist only, but for the statesman. Presidential messages deal with it, and Congress wrestles with its dilemmas. The Newlands bill, still in the limbo of good measures of which Congress is not yet worthy, for instance, must greatly mystify members who see in Congressional duties two-year periods of jockeying for advantage in the campaign for another two-year period, and nothing else. It provides, not only for the appointment of an official Inland Waterways Commission, with large powers, but authorizes examinations and surveys for a complete continental system of waterways, including every river in the United States, and every important lake. This in itself is a great new project; but the bill extends to surveys and plans for connecting these rivers by canals—waterways where there are now “portages” between river-systems,—and by coastal canals connecting tidal lakes, bays, sounds, and river-mouths, creating quiet backwaters, like the one proposed for navigation from Boston to Florida, and from Florida to Texan ports.

All this is to be done to promote transportation on inland waterways “by vessels of a standard draft”; and “to consider and co-ordinate the questions of irrigation, swamp-land reclamation, clarification of streams, utilization of water-power, prevention of soil waste, protection of forests, regulation of flow, control of floods,” and of transfer and transshipment facilities for waterways, so that people shipping by water may not

be deprived of such utilities as stations, freight-houses, platforms, and attendants.

This is not the project of a dreamer. It is a measure introduced by a practical statesman. He disclaims any intention to speak for any one but himself; but it is an open secret that the Newlands Bill in large measure represents the plans of the Forest Service headed by Gifford Pinchot, of the water resources branch of the Geological Survey represented by Marshall O. Leighton, of the Reclamation Service in the person of Director Newell, of Dr. McGee the erosion expert, of Secretary Wilson, and, formerly, of President Roosevelt himself.

The Newlands bill, like the Appalachian Forest measure, may not pass; but there lies back of each of them such an array of arguments pointing to an imperative national duty, that it seems impossible for either of them wholly to fail. Their passage would mean the enthronement of science and the dethronement of the smaller and meaner politics of many Washington services. It would mean a sort of revolution—and even the most beneficent revolution never has things all its own way.

A look at what we have done as to waterway improvement, and our manner of doing it, will illustrate this. In the fully-developed waterway systems of France, Germany, and the Low Countries—our competitors in the world's markets—there is a mile of waterway for every twenty-three square miles of area.

Such an extension of shipping facilities requires the canalization of every river capable of being made navigable. Of this sort of work we have done practically nothing in this country, except in the Pittsburg shipping district—the entire task of making highways of such streams as the Wabash, the Sacramento, the Des Moines, the upper waters of the Connecticut, and a hundred other rivers lies before us. The Mississippi Valley alone has tens of thousands of miles of such streams. Business will one day demand their improvement and they must be improved.

We have spent some \$500,000,000 on rivers, lakes, and harbors, but its impression on the problem of strictly inland waterways has been small. Leaving out of account the harbor entrances, and oceanic creeks which make no considerable reach inland, one wonders at the small results of river improvement.

The Penobscot has a depth of eleven to fourteen feet to Bangor, 27 miles; but it had this as long ago as 1870, except for slight obstructions. The Kennebec affords seven feet 44 miles to Augusta, and seventeen feet to Gardiner. And this is the tale of inland waterways for Maine—work on which was begun as early as 1827. Vermont, since 1836, has benefited to the extent of a ten-foot channel from the foot of Lake Champlain to Whitehall. New Hampshire has only 13 miles of navigable river in the Cocheco. Vessels only stick their noses into the Merrimac; and the longest navigable stream in Massachusetts is the Taun-



Unloading a Fruiter at Baltimore.

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ton, twelve feet deep for 30 miles, but very narrow. There is a prospect that the Connecticut may some time be improved: something like navigation sometimes takes place as far up as Holyoke—but it is not a real waterway. Connecticut has a fourteen-foot channel in the Thames to Norwich, 15 miles only, and 50 miles of ten-foot water in the Connecticut as a result of seventy years of improvement. Rhode Island's rivers are all bays—and this tells the story for New England.

The United States have given to New York eight miles of fifteen-foot channel in the Harlem, and of inland waterways this is all, unless one include the twenty-six-foot passage in the East River, and the making of an eighteen-foot channel from Lake Erie to Tonawanda on the Niagara. In the matter of rivers and canals the Empire State has led the way, and stood on her own foundation.

New Jersey has the ten-foot-deep Raritan for 12 miles, and both she and Delaware have benefited by the deepening of the Delaware to twenty-five feet as far north as Philadelphia, and hope for the projected thirty feet to Trenton. Aside from the Ohio and affluents, Pennsylvania has only the Delaware. The Susquehanna, the Schuylkill, "the blue Juniata"—all these are practically unnavigable. Maryland has navigation in the mouths of the Patapsco and the Susquehanna, but not far inland except by the bay.

The Potomac affords twenty-four feet to Washington, 113 miles, and one wonders why Washington

is not a greater commercial city. Virginia brings us into that belt of Southern States where steamers are run—in river parlance—“on a heavy dew” (or “wherever it is damp,” as Admiral Farragut expressed it); and the government has spent much money on brooks which may be waded. The State has some really good rivers, however, striking quite well inland—the York twenty-one feet deep to West Point, 45 miles, the Rappahannock which has nine feet for 106 miles, and the James with its 100 miles of seventeen-foot channel to Richmond. The Mattaponi, the Pamunkey, and the Nansemond are under improvement by the government.

As showing the sort of navigation on which the money of the people is being expended—with good reason, I have no doubt—the “projects” in these South Atlantic States are interesting. The government project on the Roanoke in North Carolina is to secure five feet to Weldon, 129 miles; but this is deep for a Southern river. The Tar has three feet for 22 miles, and thence is “shallow, except in high water.” The Neuse and Trent are “navigable,” to Smithfield, 150 miles; and it is expected that the nation’s engineers will deepen the stream to three feet for nine months in the year! It is proposed to canalize the Cape Fear River, and to make it eight feet deep to Fayetteville, 115 miles; but in the meantime it is called “navigable” with two feet of water. Into some of these rivers Mr. Leighton proposes to turn the redeeming flood of his Appalachian Forest reservoir system.



Where Sails Still Carry Goods.
Lumber schooners at Savannah, Ga.

Photo by Detroit Publishing Co.

These rivers of the Atlantic slope are all of one class, in that they run fairly deep for about fifty miles and then afford a stretch of "heavy-dew" navigation for fifty miles farther—two to three feet; and that they are navigated at high water far above their low-water heads of navigation. South Carolina has the Waccamaw and the Little Pedee which are of this sort; and the Santee, with its two heads, the Congaree and Wateree, and the Great Pedee, all of which the Appalachian Forest reservoir system would make navigable for huge river steamers, though they are now not much better than the others. Work on these streams has been in progress for from twenty to thirty years.

The Savannah has now only three feet of available depth to Augusta, 202 miles, and the project contemplates only five. The Altamaha affords only thirty inches over its entire length, and the project is to make it three feet. The Oconee is in practically the same condition, while the Ocmulgee has the exceptional depth of five feet to Macon, 200 miles. This is the result for Georgia to date, except a few miles of shallows in the Flint, and a three-foot navigation in the Chattahoochee.

In Florida we reach a region of changed physical geography, and in the St. John's this State has a noble waterway navigable 276 miles to Lake Washington, and thirteen feet deep to Palatka. Peninsular Florida has the possibilities of a Holland in its network of streams, the Oklawaha, the Kissimmee, the

Caloosahatchee, the Suwanee, the Withlacoochee—names the romance and music of which make them worth mention. And across the western spur of the State runs the Apalachicola, six feet deep for its entire length, and leading up into the Georgia shallows of the Chattahoochee and Flint.

There was once a project for making the Escambia, a Pensacola Bay stream, five feet deep for nearly three hundred miles, but the work already done seems to have been lost through failure of appropriations. Such losses are common.

In Alabama we come to a very important system of waterways—a sheaf of rivers falling into Mobile Bay, of which Mobile is the commercial port. The Mobile River and a network of deep bayous carry ocean shipping depths 50 miles inland to the mouth of the Alabama, which, with its affluents, constitutes an inland waterway 815 miles in length, and in the Coosa sweeps near enough to the Tennessee to create demand for a canal linking the Ohio system with that of Mobile Bay. Emptying into the Mobile only a few miles from the Alabama's mouth is the Tombigbee, which, with the Black Warrior and other affluents, forms a part of the same system—some fifteen hundred miles of navigation. These are great rivers; yet the government project aims at only four-foot depths on the lower Alabama, and less on the branches; and a six-foot channel to Mobile from a point on the Black Warrior about twenty-five miles from Birmingham.



Loading Lumber at Gulfport, Miss.

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The importance of these projects grows out of the richness of the cotton country and the immense tonnage of the Birmingham coal and iron district. The Black Warrior-Tombigbee-Mobile waterway has every prospect of duplicating, some day, the traffic of the Monongahela and Ohio to and from Pittsburg—in kind, if not in volume. But while the Ohio-Monongahela water traffic is enormous, that on the Alabama streams is yet so small as to make little impression on freight rates. There are six costly locks and dams to be completed. This is one of our progressive bits of waterway work.

Of the rivers of southern Mississippi the Pascagoula and its branches, the Pearl, the Wolf, and the Jordan, are under improvement—and need it. They are of local importance, but the prospect for available depths very far inland must depend upon the force of the “waterway movement.” Over on the other side of the State are the Yazoo, the Tallahatchie, Coldwater, and Big Sunflower, upon which we have spent money, but which are able to carry boats of from twenty-four to thirty inches draft only. Government work on these Mississippi streams began some thirty years ago.

Louisiana is the American Low Countries. In the mouths of the Mississippi it possesses a system of internal waterways naturally far superior to that controlled by Holland and Belgium in the delta of the Rhine and Meuse. The main stream carries ocean depths for shipping from its mouth to its junction

with the Red River, offering terminals for transshipment from river to ocean carriage for hundreds of miles. Branching off to the westward is the great bayou system of quiet, deep streams flowing from river to Gulf through plantations of sugar-cane, rice, and cotton, to which the steamer is the usual mode of carriage and for which there is no question of freight rates or of waterways. Some of these streams are so clear of obstructions, such ideal channels, that they have never bothered the government for appropriations. But the Bayou Lafourche, the Bayou Plaquemine, the Grand River and Lake, the Pigeon Bayou and Bayou Teche, the Mermentau, the Calcasieu, and others, besides similar streams on the right bank of the Mississippi, are receiving appropriations. These waterways have all sorts of depths and widths, but run much deeper than those of the Atlantic slope.

The water-front of Texas, like everything Texan, is immense and complex. There is a twenty-three-foot canal, now taken over by the government, from the Gulf to Port Arthur, and a considerable waterway basin on the Sabine and Neches rivers tributary to it. Galveston, with her thirty-foot harbor, has prospective six-foot navigation by the Trinity several hundred miles to Dallas, well to the north border of the State; and easy canalizing would make a great waterway of it. There is another great river, the Brazos, whose mouth is reached from Galveston by an inland waterway, mostly natural, which affords some hundreds of

miles of shallow navigation at least as high as Waco. Like the Trinity, the Brazos is easy of improvement, and must some day carry a great traffic. In the farther rivers of Texas, we reach the class of streams for which as yet there seem to be no plans. The Guadalupe has had some improvement, but the Colorado, the San Antonio, the Nueces, and the Rio Grande, like the Platte, the Republican, and the Dakota, come out of a dry country, and have not as yet tempted the Rivers and Harbors Committee. They may have been only waiting. With her projected coastal waterway from the mouth of the Rio Grande to the Mississippi at Donaldsonville, the Galveston-Houston shipping district, already of immense importance, would be united with every river system of Texas, and with that of the Mississippi. Three ports are bidding for the headship of the Gulf coast. New Orleans, the favorite in the betting, has the Mississippi behind her. The Galveston-Houston district has the great Texan river system. Mobile, an ambitious third, is the port of the Birmingham district and looks for greatness to cheap tide-water coal and iron by the Tombigbee waterway, and the cheap cement and timber of the Alabama system. All of these ports wait breathlessly for the opening of the Isthmian Canal.

Cypress Bayou, Sulphur River—these are among the unknown streams which make for the manufacture of jokes when the biennial fight is on over Rivers and Harbors. They run into the Red River and are of

some present and much prospective value. They would be great rivers in New England. The Red, flowing into the Mississippi about midway of its Louisiana course, has two outlets to the Gulf for shipping—the regular Mississippi way and the anomalous Atchafalaya route, which flows out of the Red at Alexandria, and cuts through to Atchafalaya Bayou, an arm of the Gulf, in quite an independent way. General Banks found the Red River navigation very bad during the war—and it is not much better now. Boats hardly ever go above Fulton, Arkansas; but sometimes they venture up as far as Denison, Texas, where the government project stops though the river goes on for hundreds of miles.

In Arkansas, Mississippi, Louisiana, and even a part of Missouri, the characteristics of a delta are still preserved from the time when the land was laid down by the Mississippi River's deposit of mud. Here are veritable Low Countries, with a truly Dutch capacity for waterways. The Black and Washita of Louisiana are to be improved from near the Red, where the Black empties, to Arkadelphia, Ark., four hundred miles, by nine locks and dams, and other works. The depth to Camden, 360 miles, is to be six and one half feet, or six inches deeper than the project for the Ohio, and the work is to cost over \$2,000,000. In addition to the costly improvement of these little-known rivers, seven of their tributaries are under improvement, and one is led to think that the government has under-

taken the construction of an extensive system of waterways for Louisiana and Arkansas, which pretty well covers the country to the mouth of the Arkansas River.

This great stream affords less than five hundred miles of navigation—very uncertain—to a point near Muscogee, Oklahoma. In good years three feet may be depended upon to this head of navigation. The government's plans are, vaguely, that the river be "improved." There would seem to be room for this. The White River of Arkansas is really a better stream than the Arkansas for about two hundred miles, but is imperilled by silt from above. There is a project for improving the upper reaches of this river, eighty-nine miles, now unnavigable, by ten dams and locks, to cost \$1,600,000. The locks are to be only four feet in depth, and are to unite the navigation of the lower stream with that of 204 miles of head-waters with only eight to ten inches of water on the shoals. There would seem to be precedent in this for the artificialization of some rather shallow waterways in some rather sparsely settled communities. On the Cache River, which parallels the White, \$9000 has been spent on ninety-five miles of eight- and ten-inch "navigation." Current River and Black River, not much better than the Cache, are also under improvement for nearly three hundred miles, but no great depth is contemplated. The St. Francis and L'Anguille, both bayou-like streams of the low country, are on the list of Arkansas

waterways for which the government has adopted a policy of improvement.

Although the Missouri has been navigated since 1819, has developed more territory from savagery to civilization than has any other waterway, though it is navigable to Fort Benton, 2285 miles, though there are considerable stretches of navigable water in it above Great Falls, though its valley contains perhaps the richest portion of the continent, and that which most needs better transportation—despite all these things the government has abandoned the improvement of its navigation. It is in a class by itself, and is now mentioned as the controlling feature, with the Mississippi, of the waterway system of Missouri. As a waterway, it is receiving less attention than the Gasconade and the Osage, other streams of the State. On 107 miles of the Gasconade, we have spent \$100,000 and expect to lay out an indefinite sum to complete it. It is used mainly for floating railway ties out of the Ozarks. The Osage is another shallow river coming in from Oklahoma, 175 miles, and under improvement with an undefined project.

Over in Tennessee, the Obion, the North Fork, and South Fork are receiving appropriations, but have nothing more than heavy-dew navigation, and that for only a part of the year. The Cumberland is navigable for 518 miles, in three States. An expensive lock-and-dam system is projected for it; but boats can go up to Nashville during no more than six or eight months



Boats and Barges on the Missouri River at Washburn, N. D.

A remnant of a once great commerce.

Photo by W. H. Degraff. Courtesy *Van Norden Magazine*.

in the year. Its Caney Fork is on the government list, too.

The Tennessee River system has been mentioned as one of the great waterways possible of establishment by Mr. Leighton's reservoir project, with nine feet of water the year round to Riverton, and possibilities of quite adequate depths by artificialization as far as Knoxville. With its tributaries it now affords more than thirteen hundred miles of navigation. All the government project contemplates above Chattanooga is a three-foot channel, and depths of five and six feet on different reaches from that city to the Ohio. The French Broad, the Little Pigeon, the Clinch, Hiwassee, and Holston, all are under improvement.

The Ohio itself carries the most important strictly river-commerce in America, and is in process of being slack-watered to a depth of six feet throughout its length. The reservoir plan of the Appalachian Forest would give it twelve feet the year round with few dams and only short reaches of canalization. The Monongahela, in Pennsylvania, has already been slack-watered, and carries an enormous commerce. The Alleghany has semi-navigation, and is entering upon the slack-watering process. The Little Kanawha has been canalized for a part of its length, and is under further improvement. The Great Kanawha carries a large traffic and receives a large appropriation. To give the Muskingum in Ohio six feet of water for eighty-four miles, \$1,500,000 has been spent. There is a project

for a lock-and-dam system for the Big Sandy, in Kentucky, but it has not been carried far enough to produce results. There is an ineffective slack-water system in the Kentucky River, but it is recommended that the deepening be carried upwards to the coal lands, where tonnage can be produced.

Besides her interest in the Ohio, Indiana receives a federal appropriation for the Wabash and the White. Nobody seems to have a definite plan for the development of either stream. In an era of waterway improvement, both will no doubt become important.

Forming a little system of their own in western Kentucky are the Green, Big Barren, and Rough rivers, all sufficiently promising to receive national appropriations, but not important waterways. They are in a region well provided with railways. Many of the absurdly shallow streams of the South on which money is spent are the sole highways of remote communities, and therefore possess strong moral claims on the national purse.

The Great Lakes are really seas, and while in a certain sense inland waterways, they are not so from the standpoint of improvement except in the strait-and-harbor sense. The work of improving their harbors and channels is going on all the time, and has been mentioned in previous articles. The waterways emptying into the Lakes are very few, except for short estuaries like the Chicago River. Grand Rapids has the ambition to make of herself a lake port by Man-



On the Upper Mississippi.

A raft passing through a drawbridge.

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chester's device. In the Michigan case it will mean the deepening of the Grand River, which now has depths of four and five feet. There is a government project involving a depth of ten feet. Saginaw has a similar scheme, for a twenty-two-mile entrance through the Saginaw River, which is now ten feet deep. The improvements in the lake channels—the "Soo," the Ste. Marie River, the St. Clair lake, river, and "flats," the Detroit River, and many other passages, to depths of from twenty to twenty-four feet—are not included in this examination, because of their exceptional character, and for the reason that they have been considered in other connections. The Illinois-Chicago River waterway is a part of the Lakes-to-the-Gulf channel; and with that exception we have mentioned all the government projects leading out from the lakes.

All the States lying west of the Mississippi, except those already mentioned, have been left out of the plans of the past, save those on the Pacific Slope, and a few projects in the Upper Mississippi system. Draw a line from Pembina on the Red River of the North, to Sabine Pass on the Gulf, and it will accurately separate the East from the West—and the States now receiving waterway benefits from those whose interests have lain more in the direction of irrigation. On this line is the Red River of the North itself, which carries our only contribution to the waters of the Hudson Bay Basin. It was a steamer route until the railways came

in, and is still clinging to its place on the governmental pay-roll, with its two-foot depths below Grand Forks, and its eighteen inches to Moorhead and Fargo. It rises in Lake Traverse and flows north. Mingling with Lake Traverse through reedy sloughs is Big Stone Lake, out of which flows the Minnesota down to the Mississippi at St. Paul. This shallow channel is partly navigable for from forty to eighty miles above St. Paul, and gets an appropriation. But for a great artificial waterway from St. Paul up the Minnesota, through the two lakes and down the Red, to make the Canadian waterway system a part of ours, and to offer the Canadian wheat-growers cheap transportation to the mills and elevators of Minneapolis—for this there is as yet no project. But there will be, if we go into the waterway business scientifically. With the projected two-foot channel in some sixty miles of the St. Croix, the tale of eastern waterway projects ends—unless I have overlooked some of them. The Upper Mississippi itself, a great natural waterway, has a five-foot project, six-foot ambitions, nine-foot possibilities, a great history, and a dwindled commerce. It should be a match for the Ohio—and will be, at some future time.

Skipping the prairie States, the mountain States, and the Great Basin we reach the Coast, and a wet climate. Here, with a few more improvement projects, the tale ends.

The great topographical feature of California is



Unloading Lumber at Saginaw.

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its wonderful central valley, the drainage of which is brought from the north by the Sacramento, from the south by the San Joaquin, and emptied into San Francisco Bay—promising on the map a great system of inland navigation running down to a great harbor. The promise is not made good by the facts, though there is seven-foot navigation on the Sacramento to the city of the same name, and a shallower channel in the San Joaquin to Stockton—some hundred miles in each case. These streams are silting up—the story of the Appalachians, again, with their deforested sides washed down by rains. On the Sacramento this process has been hastened by the millions of tons of earth from the hills washed down by hydraulic mining. These, with the Mokelumne River, navigable for thirty-four miles, and the Feather, famed since the days of the Argonauts, make up the list of projects for the Sacramento-San Joaquin system. Napa River and Petaluma Creek are tidal arms of the Bay.

One of the great river-systems of the world finds the ocean in the Columbia; its port is Portland. The Columbia and the Snake have 2500 miles of channel; their tributaries have thousands of miles more. They strike deep into mountainous regions, hard to reach by other means, rich in both present development and future possibilities. In one thing most of these rivers excel—the volume and steadiness of their current. They have many rapids and falls, and their development, while necessary, is difficult. Portland is far

inland, at the head of ship navigation in the days of smaller ships; and, like many other ports, she has had to dig her way to the commerce of deepening draft. She has more or less certain depths of twenty-five feet down the Willamette and Columbia to the sea—and needs thirty-five. The government has the work in hand. The Willamette for a hundred miles or so above Portland is on the improvement map, and carries commerce. Its main tributary, the Yamhill, has a government lock and dam, and some local commerce. The Columbia itself is navigable without improvement for some distance above the mouth of the Willamette, but in breaking through the Cascade Mountains, and at many points above, the great stream tumbles over steep slopes, is squeezed between cliffs of basalt and otherwise contorted and thrown about so as to make continuous navigation out of the question. Here the government has done a beneficent work in making a highway under difficulties. The canal around the Cascades is nearly five miles long, and has locks eight feet deep, 460 feet long and 92 feet wide. A similar work over eight miles in length will open the way around the Dalles and Celilo Falls, and the Columbia will have begun to find itself as a waterway. There is an undefined project for 124 miles of the Columbia above Celilo, and for 216 miles of the Snake, but nothing very promising except as earnest of more to follow. In fact, the work done as yet on these rivers, important and creditable as it is, must be regarded as



A Scaport and Riverport, Portland, Oregon. On the Willamette River.

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a beginning only. The Cowlitz, the Clatskanie, and the Lewis (not the great Lewis or Snake) have appropriations, but are not very important.

Far up in Washington, there is an eighty-mile reach of the Columbia under improvement, between Wenatchee and Bridgeport, and projects for improving stretches of the Okanogan and the Pend Oreille rivers—small beginnings upon a great work. The Spokane—through which the city of Spokane may sometime hope to reach the sea—and long stretches of the Columbia and Snake await the verdict of the country as to an adequate waterway system.

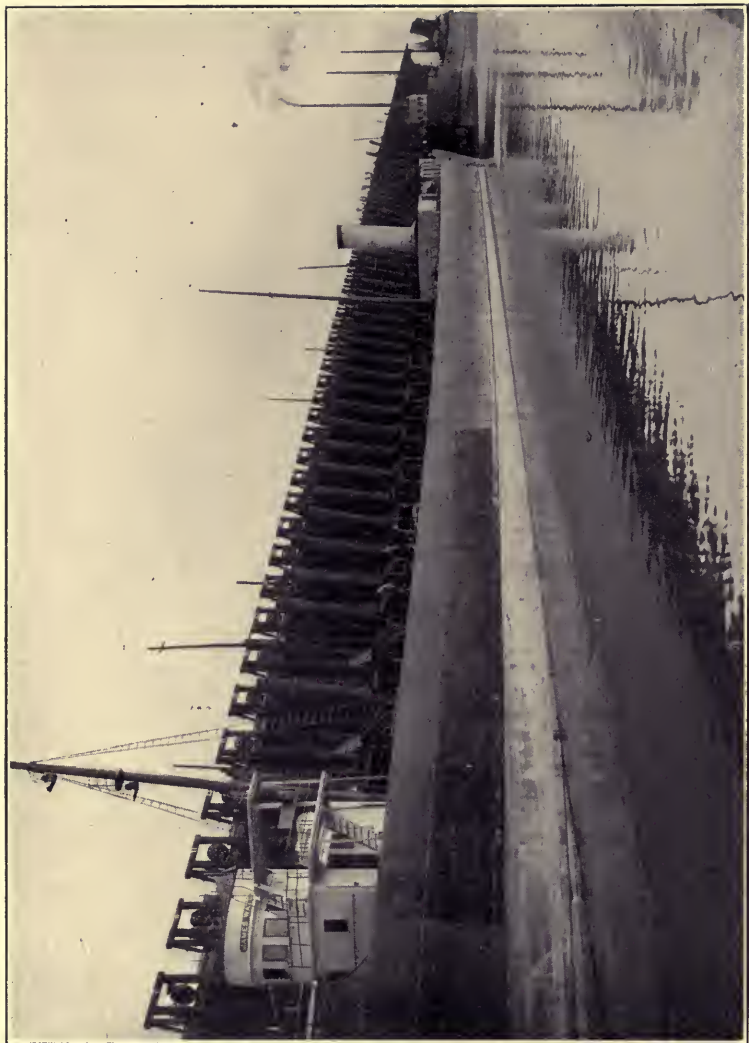
Puget Sound, with its wilderness of fine firths and fjords, its deep harbors and splendid cities, is a great system of inland waterways in itself; but it does not come within the scope of this enumeration, already too long, and perhaps, notwithstanding its aqueous character, too dry—like some of the streams mentioned in it.

Such are the waterway improvements upon which the federal government is now engaged; and such the results upon our streams of the five hundred millions already expended on rivers and harbors. Much experience has been gained; and experience, like everything else of value, has to be bought. Much good work has been done; the benefits to commerce from the improvements of the Great Lakes and their channels alone are enough to pay a fifty per cent. dividend on all past expenditures every year. But on reviewing the whole

subject one is impressed with the condition of things as an illustration of the manner in which the excellences and shortcomings of the popular thought are reflected in the work of a popular government. The popular thought on the subject of water transportation and waterway improvement has been vague and lacking in co-ordination. So it has been with our waterway improvement. Nobody is to blame, perhaps.

The idea of there being a possibility of a water transportation *system*, with vessels of a standard draft, and with standard depths and widths of channel to correspond, never seems to have occurred until recently to any person in authority; and we have something the same situation in our waterways that we should have had in our railway affairs, if all the railways had been built by guess, of varying gauges, and with rails made for different and incompatible types of wheels. Barges for inland waterways should be capable of being billed anywhere, upon a continental system of waterways, just as are railway cars on our continental system of railways.

All the depths given in this chapter are the low-water depths. There are probably very few of the streams mentioned as too shallow for successful navigation which would not have ample depths if the flood-waters were held back by a reservoir system. We have not yet developed any plan for reservoirs except in mountainous or hilly countries; and Mr. Leighton's interesting suggestions may not be applicable to the more level



Steamers at the South Shore Railway Docks at Marquette, Mich.

The ore is hauled upon the superstructure in railway cars, and slides into the ship by gravity.

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catchment areas; but it cannot be doubted that such a system is capable of vast extension beyond what his published observations show; and it must be remembered that these plans carry the three benefits of flood-prevention, depths for navigation, and water-power development.

The Newlands bill provides for an official Inland Waterways Commission, vested with power and endowed with funds for doing the co-ordinating and systematizing work which all can see must be needful. In the meantime, the unofficial Inland Waterways Commission has done what lay in its power in the desired direction. To this end, it has already divided the inland waterways into four systems—corresponding with the four distinct and physically separated sections of our country—and laid out its work for the official National Waterways Commission which succeeded it.

The Atlantic Interior System takes in all the territory east of the Rocky Mountains; and its two greatest projects are the Lakes-to-the-Gulf Deep Waterway, and the continuous passage from New England to Florida. This runs from Boston across the Cape Cod peninsula, by Long Island Sound and New York harbor-passages to the Raritan, across New Jersey, down the Delaware, over the peninsula to the Chesapeake, southward to Norfolk, across the Dismal Swamp and into the North Carolina sounds, and thence by waterways partly dug, partly projected, to the Florida river system. Added to these are plans for the im-

provement of virtually every river falling into the Atlantic and the Gulf from Maine to Texas, and for the entire Mississippi system, not omitting such neglected streams as the Des Moines, the Missouri, the Arkansas, the upper Mississippi, and the Platte. A Western Inner Passage is projected from the Rio Grande to the Mississippi, and an Eastern Inner Passage from the Mississippi to a connection with the Atlantic Inner Passage in Florida. There are projects for canals connecting the Lakes with the upper Mississippi, and with the Ohio—such as the cutting of the narrow portages in Wisconsin and Minnesota, and the completion of a canal from Ashtabula to Pittsburg, now promoted by a private company. Altogether, the Atlantic Interior System has the appearance of the nearest approach ever formulated to a national waterways system.

The Columbia-Puget System is described in its name. Its greatest project is the improvement of the lower Columbia and Willamette for navigation and the development of power. The lakes and channels of the upper Columbia and Snake are to be opened to navigation, the Chehalis Canal is to be built connecting the Columbia and Puget Sound Systems, floods are to be controlled by reservoirs and the waters used for irrigation on a scale hitherto unattained.

The third is called the California System, and embraces an immense all-California waterway, from the north end of the State to the south, by the canaliza-

tion of the San Joaquin and Sacramento rivers, the improvement of the Feather, and the bettering of the coastwise bays.

The fourth is the System of the Rio Colorado, taking in many extensive projects, not yet well worked out, but which must relate more to irrigation and power than to navigation.

Such is the outline of the tasks accomplished, and of the greater and more alluring work to be undertaken. Necessarily, our glance at the subject has been hasty; and no claim is made to comprehensiveness, except in outline, or to accuracy in mere details. Many subjects have been dipped into, while some important matters have been left unmentioned. The old scientists divided nature into the four elements of earth, air, fire, and water. We have seen how, in matters of coal-consumption, forest-destruction, power-waste, flood-damages, soil-waste, and the like, these four react on each other. We have begun to see that we cannot allow them to ravage the world unchecked. The time must come when he who cuts a tree must ask permission of the rest of the world, and he who burns coal must first prove that there is no way of doing the work by water-power. A muddied stream, carrying off the richest of the soil, will be proof of crime in the community whence comes the silt; and all over the land will be found the reservoirs—small and great—from which in drought will flow the waters to make all our rivers navigable. In those days the

“blight of continental distances” will be removed. From Pembina on the north, Great Falls on the northwest, and Sackett’s Harbor on the northeast, down to the Gulf, will run the new seaboard, and the same ships will ply the lakes in summer and carry cargoes to the tropics in winter. In a hundred streams now useless will run the regulated flow that will carry commerce, and, save in exceptional cases, every town in the land will have its waterway to the sea.

Unless something like this takes place, we must suffer in the commercial race. Our people must be poorer than they otherwise would be. I have spoken of Germany’s system of waterways. That great industrial nation is also engaged in wiping out the interest charges of her railways, so that in a generation the German freight rates will be as low by water as may be, and German goods will be carried by rail at the mere cost of operation, with no “fixed charges.” System, co-ordination, science—these are the watchwords of the commerce and industry of the future. Whether or no we shall fail in their application is to be tested in our manner of meeting now this great problem of Inland Waterways.



This Machine at Ashtabula, O., Dumps Cars of Coal as a Boy
Empties a Box of Strawberries.

Photo by Detroit Publishing Co.

Chapter VII

The Battle of the Engineers

NO treatment, however discursive, of the subject of inland waterways can be considered complete in the absence of some notice of the development of the subject in both the technical and the lay mind since the conservation movement began during the administration of President Roosevelt. Prior to that time no conception of the various relations of the subject to national resources had been formed in the public mind. We had had a reclamation service doing fine work in its field; a corps of engineers of the army usefully engaged in the very unmilitary work of improving harbors and waterways; a forest service struggling upward to something like a parity with those of Europe; a geological survey concerning itself with our water resources and our mineral wealth and its waste. And, all at once, the great truth dawned on the people that all these things are related and inter-related and that our national efforts with reference to them should be systematized if the best results are to be expected.

It became apparent to the national mind that in taking water from streams for irrigation purposes, or

in draining swamps, the reclamation service is doing a work which directly affects the flow of streams and the amount of water capable of being used for navigation. The accepted belief was that the stripping from our high lands of their ancient protection of forests results in a more uncertain flow in our rivers, in wasteful floods and disastrous periods of low water, and the old notion that more rain falls in forests, all things being equal, than on deforested lands, rejected by most meteorologists, was gradually winning its way back to acceptance. The believers in this theory saw in the destruction of our forests not only the loss of regularity in the flow of our streams, but the cause of absolute diminution in our rainfall. The enormous loss to the world in the power wasted in our rivers had been brought sharply to our attention by calculations of experts showing that the exhaustion of our coal measures is going on almost as rapidly as the destruction of our timber supply; and the thought that the former, unlike the latter, can never be renewed by growth added gravity to the statement. Coal is valuable for its heat, its light, and its power. The waste at our unused power sites is in these very units of heat, light, and mechanical energy; and the very water running off wild, uncontrolled, and destructive in our floods, and through our unharnessed streams, might be used in place of the coal we are so gaily burning up to the impoverishment of posterity.

Reclamation, flood-control, forest-preservation, re-



The Cleveland and Pittsburg Ore Docks, Cleveland.

The ore is hoisted by steam from the open hold of the ship.

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forestation, economy of fuel—all these began to link themselves together in a single national problem, into which there entered through our bitter need for better transportation facilities the problem of a more complete use of our inland waterways as a complementary system of free highways to carry the tonnage which in good times the railways cannot bear.

Message after message went from the White House to Congress. A commission was appointed for the purpose of considering our needs. Scientists began collaboration upon plans dealing with all these colossal questions, and for a time it seemed that the forces of progress were bearing everything before them and that we were about to enter upon the most elaborate system of internal improvements ever undertaken in a single generation by any people, when, into the full chorus of the conservation movement there broke the discord of the professional adherents to the old régime, whose labors in legislation, in engineering, and in administration, and whose very manner of thought made them incapable, rightly or wrongly, of lending themselves willingly to the newer system. Such discord was of course inevitable.

If the new projects were based on error, science must of course point out that error, and wherever found not indisputably true conservatism must inevitably oppose them. Lord Kelvin has said, I believe, that the theory of the conservation of energy has had nothing added to it by science since the days of the group of

men who first gave it to the world; but those who taught physics in the colleges and universities of that day, and the engineers who were dealing with problems of physics in their professions, and specialists the world over, almost without exception, lived out their lives denying the principle of the conservation of energy and died without having acknowledged it. It is quite likely to be the practitioner who denies or rejects a new thing in his profession. It is not at all strange, therefore, that the engineers of the army, having in charge our river improvements, should fail to welcome the larger movement in which their work was sought to be absorbed and by the loss of which their practice was sought to be modified.

If the engineers looked askance at the new movement, many men powerful in political life met it with absolute hostility. The engineers fought behind no breastwork. In the open plain of science they had no advantage over their opponents, and arguments and demonstration were ultimately to award the victory to the forces most strongly armed in reason and knowledge.

But surrounding the legislators and the administrators like a stone wall was the Constitution of the United States. It is not generally known, but it is nevertheless true, that the constitutionality of the laws under which the Reclamation Service is doing its beneficent work is open to question. That the United States has a perfect right to improve its own land by devoting it to forestry is unquestionable: but the constitutional



Modern Docks at the World's Greatest Port, New York.

Holland-America Line, Hoboken, N. J.

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power to purchase tracts not already owned, like the Appalachian water-shed and the White Mountains, for purposes of pure forestry is very doubtful. The government, however, has the right to improve its waterways, and if, as science has long believed, the existence of forests at the head-waters of rivers is necessary to that regular and uniform flow required for purposes of navigation, then the constitutional difficulty vanishes and the White Mountains and Appalachian forests and all their water-sheds desirable to be acquired may be bought and reforested, not for the purpose of forestry primarily, but of forestry as incidental to the improvement of our navigable streams.

That a controversy should occur in such a situation was inevitable. The car-shortage of 1906 and the early part of 1907 had stirred the people from ocean to ocean. They saw that our boasted transportation system had broken down under the burden of a tonnage it had created. In September, 1907, President Theodore Roosevelt went down the Mississippi to the waterways convention at Memphis. All through 1907 and a large part of 1908 advocates of a co-ordinated system of conservation of our national resources, with the improvement of our waterways as its rallying point, had had things their own way in the field of newspapers and magazines. In May, 1908, in an engineering magazine, Marshall O. Leighton, chief hydrographer of the Geological Survey, published the résumé of his report to the Inland Waterways Commission on the

relation of water conservation to flood prevention and navigation in the Ohio River, which is in large measure the basis and authority of an earlier chapter in this book. It was a daring appeal for a great project by one of the conspicuous advocates of the new coordinated conservation movement as against the old methods of unrelated and piecemeal work. Its suggestion of the improvement of the Ohio River by the control of its head-waters, and the utilization of the vast horse-power now wasted down the slopes by the erection of dams for the double purpose of holding back the flood-waters and developing power; its prospectus of financial returns for this power sufficient to make the whole gigantic operation a paying one; and its implications that the improvement work already installed in such rivers as the Monongahela and Ohio is in large measure not only useless but actually harmful, challenged the attention of all men to whose minds was presented the rather intricate and abstruse government report in which these startling statements and suggestions are embodied.

Out of this paper, which challenged the attention of army engineers, piqued, if not jealous of what they seem to have regarded as an invasion of their peculiar domain by a civilian member of their profession, sprang a controversy which is of the utmost interest to every citizen and which has gone on through the columns of the technical magazines and the proceedings of the American Society of Civil Engineers, shaking thrones



Clam-shell Hoists for Unloading Ore at Cleveland.

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and disturbing council rooms while the great millions of untechnical people have been quite ignorant of the tempest raging through the engineering world.

We have heard of the battle of the engineers over the Panama Canal, but the controversy which grew out of the Leighton report is as much more important than the Panama dispute as the continent is greater than the isthmus. It was in the issue of the *Engineering News* of May 7, 1908, that Mr. Leighton's résumé of his paper appeared. In the issue of June 11th Capt. W. D. Connor, of the corps of army engineers, struck the first blow in the controversy against the conservation movement. He assumed the somewhat patronizing attitude of attacking Mr. Leighton's reservoir project as visionary and impracticable. A reservoir for the control of head-waters, Captain Connor said, was ideal in theory but impracticable in practice. Only four great rivers of the world, he said, have reservoirs of any consequence at their head-waters: the Volga and that other Russian river whose head-waters mingle with the Volga, the Msta, the Mississippi, and the Nile. Therefore, he contended, reservoir control for rivers in general is an untried scheme.

Mr. Leighton had made some calculations as to the amount of water to be held back by the proposed reservoir. Captain Connor insisted that the run-off assumed by Mr. Leighton is greater than the actual run-off of these slopes. Furthermore, said Captain Connor, these reservoirs would cover valuable and fertile ground upon

which are located the homes of many people, and the graves of their friends; and from this consideration would come pressure upon Congress which would be irresistible. The time necessary for so elaborate a system of reservoirs is, to Captain Connor's mind, a great objection to the scheme, as it would put off the day of river improvement insufferably. Mr. Leighton had made some tentative estimate which placed the cost of his system, judged by the cost of reservoirs actually constructed, at \$125,000,000. Captain Connor strongly contended that it would cost much more than this.

Furthermore, he urged, the danger of holding back such enormous volumes of water as would be impounded in these reservoirs would be something which could not be contemplated without concern. One dam far up in a system of dams would burst, carrying away those below, and the immense volume of water would roll down the valley carrying death and destruction before it. "I think," said Captain Connor, "that I hear a 'No' that will reach from ocean to ocean and cause a rejection of the whole scheme."

If not rejected, Captain Connor argued, the reservoirs would fill with mud and silt within a comparatively short time and be ruined. As to Mr. Leighton's plan of maintaining a nine-foot channel in the Ohio by holding back floods and letting the water out gradually at the time of need, his critic asserted that if all the rainfall in the Ohio Valley were so conserved it would not be sufficient for that purpose and that Mr.



**Mountains of Ore in Storage at Cleveland, and the Machines by
which they are Made.**

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Leighton's project for conserving only one third of it must be condemned as utterly inadequate. As for the government obtaining any revenue from the power generated at the dams, Captain Connor insisted that this could not be counted upon because the government is not in the water-power business, and, he implied, will not enter it; and anyhow, the conflict between the needs of the power plants and the needs of the boats in the river would be a difficult one to settle. Altogether, Captain Connor insisted in excellent engineering parlance, Mr. Leighton's scheme would not do at all. This was the first gun.

An answering projectile was fired by Mr. Leighton in a reply published as a note to the Connor paper. His report, he said, simply estimated the possibilities and demanded further and more minute investigation of the problem of the control of head-waters. He did not claim that by the reservoir system alone the Ohio could be given a channel of nine feet, but he insisted that in the flatter portions of the river it would do this and would render needless the expenditure of many millions of dollars in slack-watering the river.

As to the cost of the reservoir system, Mr. Leighton contended that \$125,000,000 was a reasonable tentative estimate. "And," said he, "let Captain Connor assume that the reservoir system will cost three times this estimate, and it will not be difficult to prove that this is a profitable project aside from navigation." Answering Captain Connor's suggestion that he had

“assumed” an excessive run-off, Mr. Leighton retorted that he had assumed nothing and had actually measured and gauged the run-off of the streams and therefore knew what he was talking about. The Alleghany highlands, he suggested, receive more intense rains than most people know, and their steep slopes shoot the water down into the valley so rapidly that their contributions to floods are all out of proportion to the actual area.

As to the cost of lands for reservoirs, Mr. Leighton insisted that the land where reservoirs must be placed is mostly poor and low in value, that the rural population is decreasing, and that by overflowing this land a strip two miles wide the whole length of the Ohio might be in large measure relieved from the danger of flood, this strip being of incalculable value for sites for manufacturing plants and terminals. As to Captain Connor's dramatic recital of the dangers from the bursting of the dams, Mr. Leighton pointed out the fact that in all the history of this country there have been only four instances of that kind worth mentioning: that at Williamsburg, Mass., in 1874, resulting in 140 deaths; that of Johnstown, Pa., in 1889, destroying about 10,000; that of Walnut Grove, Arizona, in 1890, when 129 people were drowned, and that at Oakmont Park, Pa., in 1903, when from 50 to 75 were lost. “In each case,” said Mr. Leighton, “the cause of the disaster is definitely ascertained and inexcusable.”

As for the improvement of the Ohio and other



Shipping in a Flourishing Lake Harbor, Milwaukee.

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rivers while this reservoir system is being installed, Mr. Leighton suggested that inasmuch as some channel work would be necessary in any case this might go on while the reservoirs were being built.

The battle of the engineers, having been so merrily begun, lulled as great battles sometimes do, until it might have been thought it was all over. But the army was simply bringing up larger artillery: not that the contributions to this subject were abler than that of Captain Connor, but according to rank a major must be regarded as a heavier piece of ordnance than a captain, and when the louder detonation of the issue of October, 1908, of the same magazine was heard, it came from the discharge of a third shot, this time by Major H. C. Newcomer, also of the engineering corps of the army.

As if conscious of having been repulsed in Captain Connor's frontal attack, Major Newcomer took the conservationists in the flank. Admitting that the Inland Waterways Commission had declared in favor of the reservoir system, he called attention to the fact that among its members the commission had only one river engineer. Having disposed of the Inland Waterways Commission in this manner Major Newcomer proceeded to the suggestion that the unsanitary conditions which must attend the fluctuations of level in Mr. Leighton's reservoirs constituted a great objection to them. Disease and death might follow exposure of the bottoms of the reservoirs at the drawing out of

their waters for use in navigation or for power. Anyhow, floods would arise in spite of the reservoirs, for it would be impossible to hold back the water of the whole valley, and storms would occur in the regions unprovided with reservoirs, and cause freshets.

As for the financial returns from the sale of power, Major Newcomer asserted that the government would not in any case own the flow and could not therefore sell it. Even if it did own it, he declared, it could not sell it at anything like twenty dollars per horse-power per year (which amount Mr. Leighton had assumed as the commercial value of the power), since water-power leases have been made not long since in the province of Ontario at from 25 cents to \$1.00 per horse-power per annum.¹

By this time the engineering world was aware of the fact that a great controversy was raging; and on November 5th of the same year, and in the same magazine, Mr. Leighton answered Major Newcomer. The personnel of the Inland Waterways Commission, said Mr. Leighton, was not entirely destitute of men of engineering proficiency, notwithstanding that it was not composed entirely of army engineers. In addition to the river engineer named by Major Newcomer—General McKenzie,—there was another engineer on the commission, Mr. Newell, of the Reclamation Service, who had given his whole life to the consideration of storage problems and their effect upon stream flow.

¹ See note *n* at end of volume.



Ore-handling Machinery Unloading Ore at Buffalo, N. Y.

The hold of the vessel opens wide at the top.

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Civilian engineers, Mr. Leighton suggested, are quite as able to deal with such questions as army engineers.

As to the unsanitary conditions growing out of the fluctuations of water levels in reservoirs, Mr. Leighton, who, by the way, begun his professional life as a sanitary engineer, remarked that "this idea is so old and discredited that the present announcement makes it seem almost new," and, he added, the time has gone by when disease is attributed by well-informed people to effluvia from the wet lands and swamps; and if Major Newcomer would investigate conditions in places like the Sudbury, Mass., area, where reservoirs in years gone by have been frequently emptied, that he would not urge this as an objection. As to the silting up of the reservoirs referred to by Captain Connor and Major Newcomer alike, Mr. Leighton answered on authority of the chief engineer of the New York Water Supply Commission, that the silting up of the reservoirs in New York regions takes place so slowly that the greatest municipal reservoir ever built in the United States, that of New York, is constructed without any reference to the phenomenon; that if the Appalachian slopes are protected by forests there is no reason for anticipating any trouble from sediment; but that if sediment does gather in the reservoirs the nation which now dredges river bottoms in the interest of navigation might, for cognate reasons, dredge the reservoirs quite as easily.

.. Floods, Mr. Leighton admitted, might possibly

rise through storms occurring outside of the protected area, but they could hardly be as destructive and certainly could not be as frequent as if the entire watershed were left free to discharge its waters in the stream. Mr. Leighton disclaimed any intention of determining as to the ownership of the flow over the government dams, but stood pat upon the proposition that enormous power would inevitably be developed on these dams which would belong to some one, and which industrially would be quite as important if belonging to the States as if owned by the general government. If he, Leighton, had overestimated the value of the power, he would accept Major Newcomer's estimate of \$5 per horse-power per year as a maximum rental for the stream flow and would show that even at that figure the government could go into the reservoir business with the assurance of making money, and that as our coal supply is becoming exhausted the increase in the value of power would render the business a more and more profitable one as time shall pass.

As to the cost of the reservoirs, he insisted that the necessary expenses had been grossly overestimated by his opponent; that masonry dams are not necessary; that in fact rock-filled dams are quite as safe as masonry dams, and perhaps safer, and much cheaper; that the Newcomer estimate of one billion dollars as the cost of the reservoir system could not be accepted; that the calculations which placed the outlay at \$500,000,000 are really above the mark; but that even



Ore Hoists at Conneaut, Ohio.

Photo by Detroit Publishing Co.

on that basis the reservoir project would be not only a wise, but a profitable one.

Disorganization of road systems and the necessity of moving railway tracks alike he regarded as trivial objections, while as to the overflow of important towns and coal mines, this could be avoided by merely rejecting these sites and choosing others.

At this point the misunderstandings and conflicts in opinion had been pretty thoroughly developed. Apparently, Mr. Leighton had erred through over-enthusiasm in the direction of underestimating the expense of the reservoir system. The army engineers had erred in assuming that advocates of the reservoir system expected to abandon present methods and to rely wholly upon new ones. Out of the argument a practical agreement seemed to have become possible. The reservoirs would be expensive but they would be useful. They might not absolutely protect the valley from all floods, but they would decrease almost all of them and prevent most of them. Canalization would still be necessary at the worst places in the rivers, but many of the dams and locks could be dispensed with, and in the case of the Ohio River the epidemics of typhoid and other diseases, arising from the pollution of drinking water from the stagnant condition of the river in summer, would be cured by the steady flow of pure water from the reservoirs all through the season.

Neither plaintiff nor defendant is likely to be convinced by the evidence of the other side, and the jury,

in this case (the whole people) might have thought themselves in position to render a verdict even while the combatants still held out for disagreement, when the army reopened the battle and fired its heaviest gun in a paper read before the American Society of Civil Engineers, by Col. Hiram M. Chittenden, also of the corps of army engineers, in which he resumed the assault upon the position of the Geological Survey, and, not content with that, carried the war into Africa by attacking the whole project of reforestation. Col. Chittenden surprised the scientific world by the delivery of an address in which he not only ably reiterated the arguments against the reservoir system, but stated boldly that forests have no utility in holding back floods or in protecting water-sheds from erosion; that the water-shed completely denuded of its trees sends out to rivers a flow which is just as good for purposes of navigation as the forested water-shed, and no more harmful in the matter of floods.

In view of the almost unanimous opinion of geologists, foresters, and engineers against the Colonel's views, no one can withhold admiration for the hardihood involved in this doughty deliverance. This essay has already been seized upon by selfish interests whose plans Col. Chittenden could not have intended to further, as an utterance by which to justify governmental action along the old lines of waste and destruction, and the ruin of the interests of posterity for the swollen fortunes of to-morrow. Colonel Chittenden is



An Eroded Alluvial Bottom on Cane Creek, Mitchell County, N. C.

. Two miles below Bakersville, showing the destructive work of the freshet of May 21, 1901. Water came up to the railings of the porch of the house on the left hand side of the picture.

From a photograph by U. S. Forest Service.

an eminent engineer. He has written extensively on matters relating to the improvement of inland waterways and on historical subjects, and has always written well. His paper was to the ears of the reactionaries like the far-off trumpet of reinforcements in a battle going heavily against them. Severely technical as it is, this essay ought to be understood by the public. If its arguments are well founded we should abandon our plan of reforesting the mountain slopes for the purpose of benefiting our rivers and protecting our highlands from erosion, should give up forever the idea of the control of head-waters for the mitigation of floods, and should abate our recent enthusiasm in the so-called conservation movement.

If, on the other hand, this essay embodies an error, the error should be pointed out and appreciated; for it has already been read into the *Congressional Record* and widely circulated in the interests of the campaign against the newer ideas. It is impossible here to do more than to attempt a brief translation of the Chittenden paper into less technical language, together with a condensation of the arguments by which it has been met.

In the first place, said he, the idea that storm water is stored in the litter, moss and humus of the forests and so held back as to prevent floods holds good only for the average conditions; but when the forest area is saturated this run-off will be quite as rapid as from any other ground—just as a piece of blotting paper,

once thoroughly soaked, will shed water as rapidly as oil-cloth. Ordinarily, said Colonel Chittenden, the forest bed does hold back rain; but in a period of heavy downpour, which alone can cause a great flood in a large river, the forest becomes soaked and holds back nothing. He even argues that by prolonging the period of run-off forest water-sheds may keep streams at high water during such prolonged periods as to combine freshets from many branches and make the floods even worse than they would be without the presence of the forests.

“It is not contended that this increase is ever very great,” said he, “but it is contended that forests never diminish great floods and that they probably do increase them somewhat.”

Small streams and springs do dry up, he admitted, in deforested areas more completely than in deep woods; but the holding back of occasional summer showers, while it may conduce to the permanency of springs, on the whole is of no low-water benefit to rivers; and the idea of obtaining a better summer flow through reforestation is an error.

As to the effects of forests upon the melting of snow, this paper is still more at variance with the theory that by retarding the spring thaw the run-off of snow water is prolonged. Deep snowdrifts of the open country, he argues, form better reservoirs than the depths of the forests. In the open country snow melts earlier than in the woods and nothing like a flood arises



Deforested Mountains in Shan Si Province, China, Showing Artificial
Terracing to Prevent Erosion.

From a photograph by U. S. Forest Service.



from such melting: under the cover of forests, however, the snow hangs upon the trees and lies on the ground until spring is far advanced, or a warm rain occurs, when it melts suddenly off and may cause destructive floods which would not have occurred had the forest been absent. Records of flood, Col. Chittenden said, prove conclusively that there has been no marked change in them since the settlement of the country began, and "that such change as there has been, is on the side of higher high waters and lower low waters, before the forests were cut off."

There is very little, he said, to support the claim that forests increase the rainfall; and in the very important matter of the deposition of dew the forests are unfavorable to moisture, because dew is seldom known in the depths of a wood.

Proceeding to the matter of erosion, Col. Chittenden stated that he had been unable to find anything to confirm the idea that forests are necessary to prevent the washing away of steep slopes and the silting up the reservoirs and watercourses below, and that he had never seen a single case where the mere cutting off of forest trees had led to extensive erosion; that the soil that will stand a heavy forest growth will grow up to brush and other plants immediately upon the destruction of the forest to such an extent that the soil will be protected from wash more effectively than by the forest itself. He did not deny that the soil had eroded in many places formerly forested; but he attri-

butes this, not to the forest-cutting alone, but to cultivation, roads, trails, and other artificial breaking of the soil.

There is nothing, he said, to support the popular notion that our rivers are shoaling up more than they used to do, and the frequent statement that one million tons of our soil are annually carried out into the ocean by the rivers he pronounces a bugaboo, the only foundation for which is the natural carving down of highlands and the building up of valleys and estuaries below. Finally, Col. Chittenden said, forests should be planted where they will grow best, and not necessarily on rocky and inaccessible mountains; and the highlands should be permitted to take care of themselves.

Having thus disposed of most of the arguments of the advocates of reforestation, he proceeded to recapitulate and elaborate the arguments against Mr. Leighton's proposed reservoir system for the Appalachian highlands, dwelling upon the engineering, constitutional, and financial objections to the scheme, and rejecting it on all grounds.

Such was the blow evidently meant to demolish the plans for a co-ordinated conservation movement, first by convincing the dignified and influential American Society of Civil Engineers, thence spreading out through the people and turning back the movement in political conventions, legislatures, Congress, and in the great forum of the people's opinions. If the dis-



Bynum's Bluff, Mitchell County, N. C.

Linville River and Falls, showing steep rocky gorge whose walls are from
500 to nearly 2000 feet high.

From a photograph by U. S. Forest Service.

tinguished writer of this paper, however, expected to carry his point without response, he was disappointed. More than twenty of the greatest engineers in the country, besides geologists and foresters, discussed the Chittenden paper in the most notable symposium on any such topic ever produced in America.

Let us, as sketchily as possible, see what they said and thought. Mr. F. Collingwood acknowledged the force of Col. Chittenden's arguments but was unable to accept them. He thought that Col. Chittenden underestimated the amount of water held back by forests, and the difference between the water running off directly and that twisting and turning about the obstacles of the forest. Mr. Collingwood remembers that in the woods and on the hills near Elmira, N. Y., drifts of snow used to remain long after every bit of snow had disappeared from the open; and as to the matter of erosion he urged the fact that in his boyhood, on the banks of the Chemung, "the stream had a fairly uniform width; the banks were largely grassed; the channel was comparatively uniform; there were very few bars and all through the summer there was a good flow of water." After twenty years' of absence, he says, he went back in 1889 and was amazed at the changes in the stream. It had widened, washed away mould, cut away arable land, and generally wasted its valley. "Here is a stream," says Mr. Collingwood, "flowing for centuries, having a uniform regimen, with fairly uniform section and smooth banks up

to, say, fifty years ago, showing up to that time but few signs of destruction from floods. Within twenty years there is a complete change and a beautiful stream is transformed into an irregular, wilful, destructive thing. If the cutting of the timber did not do it, what was it?"

Mr. Thomas P. Roberts, a United States engineer, in the main agreed with Col. Chittenden, and gave the records of the rise and fall of the Ohio at Pittsburg in support of his views. Mr. Roberts believed in the levee method of flood control, rather than in the Leighton project, but paid Mr. Leighton a very high compliment for his valuable study of water-powers.

Mr. Stephen Child frankly admitted that he was entirely unable to meet Col. Chittenden's arguments.

Mr. L. J. Le Conte agreed in the main with Col. Chittenden, especially as to the irreconcilable conflict between flood control purposes and power and irrigation purposes, in the use of reservoirs. He pronounced the grand scheme of storage reservoirs proposed for the Ohio as altogether too Utopian, and utterly impracticable as applied to the control of great river floods.

Mr. F. B. Maltby agreed emphatically with Col. Chittenden that the popular belief that deforestation is responsible for floods is an erroneous one, although very much can and should be done in the direction of forestation, water supply for power purposes and navigation, and the control of floods.

Mr. J. Francis Le Baron, while agreeing with some



Land Erosion near Marion, N. C.

Showing rapid removal of the soil by heavy rains when the forest is reduced or destroyed.

From a photograph by the U. S. Forest Service.



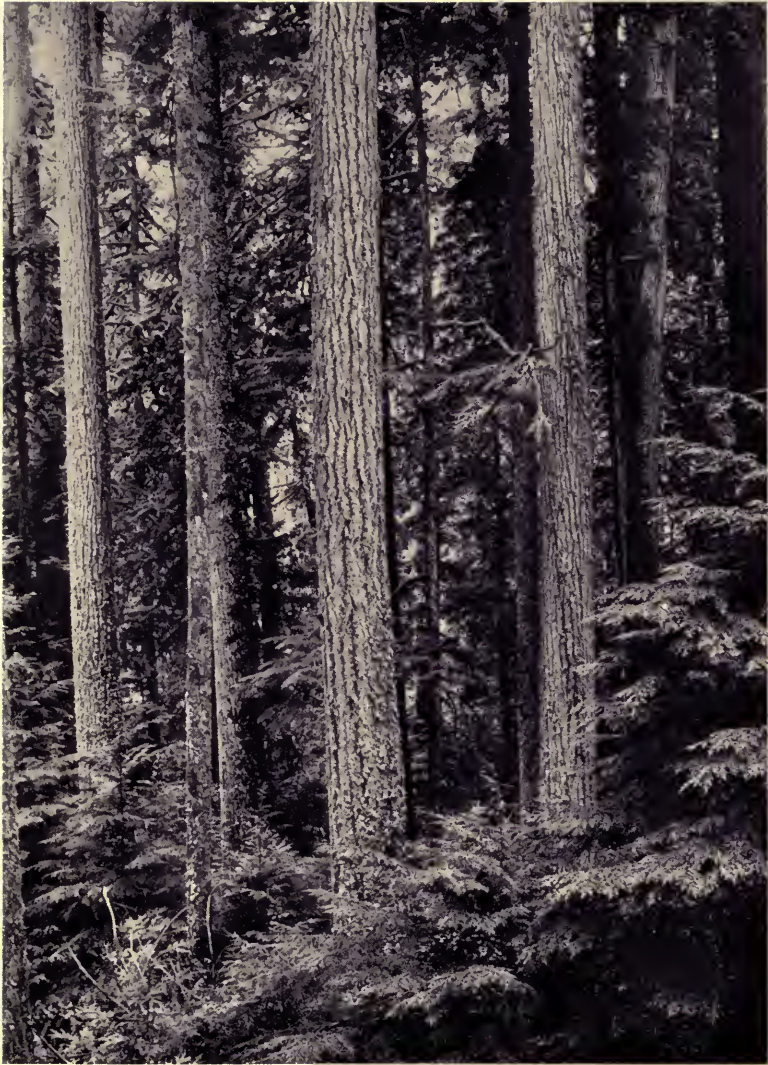
of Col. Chittenden's statements, took emphatic issue on the question of the influence of forests on rainfall; and in so doing contributed a remarkable statement to the discussion. Contending that the presence of forests actually causes more rainfall, Mr. Le Baron adduced the fact that the warm trade winds from the Caribbean Sea which blow day after day over the eastern slopes of Nicaragua afford phenomenal precipitation of rain when they come in contact with the air over the forests, and that it is abundantly proven throughout the whole of Central America that the excessive rainfall on the eastern side, amounting to 365 inches per year at Greytown, cannot be attributed to the mountains, because the whole peninsula is low, but must be attributed to the presence of the dense and cool forest jungles which cover the entire eastern watershed. Mr. Le Baron further pointed out that to speak of deforestation as consisting merely of the cutting away of the forests is altogether too narrow a term—that cultivation and breaking of the soil is part of the process of deforestation; and that when Col. Chittenden suggests that it is this which causes erosion, and not deforestation, he admits the case of those who attribute the washing of slopes to the destruction of forests.

Mr. Edward P. North, agreeing in the main with Col. Chittenden, questioned the benefit of national forests even if established; and saw in the army of government employees, in the forests and about the government power plants, a danger to the nation.

Mr. A. Miller Todd did not believe that floods in the lower Mississippi valley have increased owing to deforestation; but attributed our present-day greater disasters and suffering from floods to the crowding of population into the danger zone.

Mr. William W. Harts expressed the opinion that many of the claims of the advocates of forestry are unsound, and repeated Col. Chittenden's observation that the worst scour from rainfall is found, not on merely deforested lands, but where the clearings have been ploughed also. Mr. Harts contributed to the discussion a history of reservoirs for the control of head-waters, and gave his verdict with the opponents of Mr. Leighton on that branch of the subject.

Dr. George Otis Smith, director of the United States Geological Survey and a geologist, took occasion to correct Col. Chittenden's views as to the functions of the forest cover in storing water. The most important effect of the forest cover, said Dr. Smith, is that of saturating the soils and rocks below them. In other words, it is not merely a litter of leaves, trash, moss, and humus that is saturated, in a forest, but the mountain itself is soaked. "The underground circulation of water," says Dr. Smith, "is therefore not a negligible but a most important factor. This is, indeed, the important factor in maintaining stream flow during dry periods; and the beneficial effects that geologists generally believe forests to exert are exerted



Elbe, Eatonville, Washington.

Heavy stand of red fir nearly pure. Hemlock underwood.

Photograph by U. S. Forest Service.

through their influence upon subsurface storage and circulation.”

Mr. George F. Swain was glad to find in the many contradictory statements of Col. Chittenden the admission of most of what is claimed for forests. He thought his paper a valuable corrective for extreme views, although itself extreme in some directions. Mr. Swain admitted the possibility in some rare cases of floods being rendered worse by the presence of forests; but on the whole thought it a distinct gain if the forest floor can absorb even a part of the rainfall, and lead it gradually into the soil beneath. “Col. Chittenden,” said Mr. Swain, “makes a fundamental error in the very beginning of his discussion which vitiates all his reasoning on this matter, when he illustrates the action of the forest by comparing it to the action of a layer of sand on an inclined surface practically impervious to water. The ground under the forest bed is not impervious to water, but is in fact kept by that bed in a highly absorbent condition.” Mr. Swain asserted that there is considerable proof that forests increase rainfall; that in Hanover in 1887 it was decided to reforest a large area by planting about one thousand trees annually, so that in 1891 about 18,000 acres had been reforested in pine and oak; and that observations taken at three stations in that vicinity from 1882 to 1890 indicated an increase of rainfall in the forest as compared with the regions outside of it, and that similar results obtained at Nancy seem to indicate,

other things being equal, that it rains more at the centre of the forest than at the edges, and more at the edges than in the open. Mr. Swain's belief in erosion of the slopes and the silting up of rivers owing to the operations attendant upon deforestation was in no wise disturbed by Col. Chittenden's paper.

Mr. W. H. Leffingwell submitted elaborate observations on California streams tending to support Col. Chittenden's arguments.

Dr. Bailey Willis, of the Geological Survey, controverting most of Col. Chittenden's arguments, mentioned the fact that Prof. Glenn, of Nashville, has described forty-six creeks and small rivers, the watersheds of which are timbered, and which are "known, according to observation and local repute, to rise gradually in times of flood, to continue high for several days and to subside slowly, carrying little sediment and having a good flow during dry seasons; while thirty-eight creeks and small rivers, having cleared slopes, are similarly known to rise rapidly in times of flood to an extreme height, to carry excessive quantities of mud, sand, and gravel, and to fall quickly to a very low stage."

"Such evidence as this," says Dr. Willis, "collected by a qualified and impartial observer, with reference to individual watersheds, establishes, for the region in question, comprising the mountains of North Carolina, Tennessee, and Georgia, the fact that forests do exert a beneficial influence on stream flow by storing



Panorama from May View China.

Valley foreground showing partial removal of forest cover for agricultural purposes, land erosions, etc. Hanging rock on left. Beech Mountain in right distance.

From a photograph by U. S. Forest Service.

waters from rain and melting snow, preventing their rapid rush to the streams, and paying them out gradually afterward, thus acting as true reservoirs in equalizing the run-off." As against these observations Dr. Willis did not regard the arguments of Col. Chittenden as having any value.

Dr. Willis emphatically expressed the opinion that forests do increase the rainfall, and that mountain forests increase it more than the forests of the lowlands. "The principle," said he, "which underlies the effects of forests on precipitation is very simple. Moist air currents rising into the upper strata of the atmosphere are dilated and cooled. Their vapor is condensed and falls as rain. Any effect which increases the proportion of moisture and lowers the temperature promotes precipitation; any effect which decreases the proportion of moisture or raises the temperature lessens precipitation."

It was hard for Dr. Willis to understand how Col. Chittenden could say that there is no evidence of the increase of erosion through deforestation. In all parts of the United States, throughout Europe, and in not a small part of China, Dr. Willis had observed evidences of erosion so caused, and could not recall an exception to the fact that streams flowing from hills which have been denuded of forests have filled their lower valleys with broad flats of sand and gravel through which the waters meander in shifting, uncertain channels. The first effect of deforestation, he said,

followed as it usually is by fire and the breaking of the soil, is the vigorous growth of gullies, scarcely noticeable at first, but growing like the branches of a tree, and against which vegetation cannot win.

It may be added here that Dr. Willis is the scientist who brought back from China the remarkable photographs with which President Roosevelt illustrated his message to Congress at the beginning of the second session of the Sixtieth Congress which shows graphically the terrible effects of deforestation in Northern China.¹

Mr. Marshall O. Leighton, whose report to the Inland Waterways Commission was the occasion of all this controversy, answered Col. Chittenden at length, stoutly maintaining his position, urging the importance of forests as regulators of stream flow, defending the reservoir system both as to efficiency and cost, and appending a series of diagrams showing that, in spite of the statements of Col. Chittenden and those who agreed with him, it takes less rainfall to cause a flood in the Ohio River system now than before the forests were so largely stripped from its slopes. Both in this reply to Col. Chittenden and elsewhere, Mr. Leighton has gone more elaborately into the matter of showing the relative increase of floods under deforested conditions than under forested conditions, than any one else.

Dr. Willis speaks of the southern Appalachian as

¹ See note *o* at end of volume.



River Front from Brooklyn Bridge, New York.

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being the most critical region in the United States so far as erosion is concerned. Mr. Leighton went exhaustively into the matter of floods in Tennessee, a stream having head-waters in the very region mentioned by Dr. Willis. He compared flood records with rainfall for twenty-four years and found a decrease in the number and duration of floods during that period and a still greater decrease in the rainfall; so that the final result is that the flood tendencies have increased, the increase according to these observations being no less than 18.75%, with no change in conditions to account for it except deforestation.¹

Out of all this wealth of argument and poverty of conclusion, the lay mind emerges in some bewilderment. Why should it not, in view of the fact that the engineering mind is confused? And, after all, the best clearing up of the confused and muddled condition likely to result from following all these arguments is that of the plain Wisconsin lumberman who on being told of Col. Chittenden's paper and its arguments said: "Why, a man does not need any learning to know that forests protect the hills from washing and regulate the flow of streams. All he needs is common sense."

Common sense will teach him that when our forests are cut away destructive conflagrations always follow the lumber crew; and that after the conflagration comes the man with the plough, to stir up the soil by a few years' shiftless cultivation, and to start the ever-

¹ See note *p* at end of volume.

accelerating process of destruction, which Prof. Shaler said, even in his lifetime, was annually reducing one hundred square miles of the Appalachian watersheds alone to a condition of permanent ruin. Common sense teaches that the influences which have ruined Northern China will ruin any region similarly situated and treated in like manner. Science, if one not too fully instructed may presume to judge, speaks the same judgment. Science cannot really be permanently at variance with educated common sense—nay, science is only educated common sense. And in submitting to the consideration of his countrymen this imperfect and too desultory treatment of the great questions relating to the conservation and development of our national resources, grouped in large measure as they seem to be about the related subjects of our water resources, and especially of our inland waterways, the writer appeals to the broad judgment and trained common sense of citizens and statesmen to distinguish between inaction and conservatism, to remember that in such a case as this the new thing is likely to be essentially the conservative thing, and that in the policy of doing nothing lies concealed ruin and destruction of the most criminal character. This earth is ours only to occupy and deliver to our posterity. It is an estate which must be more and more highly developed decade by decade if it is to fulfil its destiny of sustaining in happiness and prosperity its teeming tenantry. We can do much to ruin it. We can do something to make it



Mitchell County, N. C.

Looking up the valley of Cane Creek, showing destruction of homes and fields by floods and eroded alluvial land. The creek formally ran at the base of the hill on the right.

Photograph by U. S. Forest Service.

more fruitful. Which we do is the test of our fitness for its occupancy. Not to do the best thing for the great earth-estate, is to make racial and national failure—and this in a universe in which the organism or the race which fails must, in the end, inevitably give way to the one which succeeds.

Notes

Notes

NOTE *a*

EXPENDITURES ON HARBOR OF ROTTERDAM

“It would be hard to find so small a city as Rotterdam which has undertaken so large a scheme of development with such signal success. The vigor of the people and the faith in the future have made the ventures, step by step, resulting in one of the world’s greatest ports. From 1870 to 1908, the city has spent in harbor construction and equipment the sum of \$30,872,067. This sum includes the city’s ten per cent. share of the cost of making the New Waterway to the sea, and also what has been paid for bridges and for real estate condemned for harbor extension, some part of which is resold at a large profit. Subtracting such investments, the capital cost of the harbor since 1870 is probably not far from \$20,000,000. This has been spent by the city alone. Not a dollar has been contributed by the general government.”

J. PAUL GOODE,

Report to the Chicago Harbor Commission.

Rotterdam is a city of about 400,000—a third larger than Milwaukee or Providence, but much smaller than Pittsburg.

NOTE *b*

SUCCESS OF THE MANCHESTER SHIP CANAL

“The annual income (of the Manchester Ship Canal), which has crept steadily up to about \$2,500,000, shows in its regular increase a comfortable promise for the future. Viewed as a stock company, merely, it must be considered a success. It is carrying its load, including a sinking fund, and with this

year (1908) hopes to begin payment of dividends on common stock. It has accomplished great and permanent reductions in the freight charges for the traffic of the region. There are no two opinions about its success among the people of Manchester. The Manchester Co-operative Wholesale Society stated officially before the canal had been in operation eight months that their subscription of \$100,000 had been very nearly recovered by the savings in freight rates."

J. PAUL GOODE,

Report to the Chicago Harbor Commission.

It is a curious proof of the worth or worthlessness of some reports that Mr. Ray G. Reid, Waterways Commissioner of the State of Wisconsin, in the Commission's first Annual Report speaks of the Manchester Canal as a failure. Mr. Reid's report is recommended to the examination of the curious as an instance of almost everything that such a report should not be.

NOTE c

THE GEORGIAN BAY SHIP CANAL

In newspaper dispatches published in the winter of 1908-9, a Canadian government engineering authority is quoted as saying in an address at Toronto that the government purposes to give Toronto 24 feet of water from Lake Erie to Lake Ontario. This would seem to indicate that Toronto's protest against being side-tracked by the Georgian Bay Ship Canal is to be met by deepening and enlarging the Welland, or by paralleling it with a ship channel—and thus clearing a political obstacle from the path of the Georgian Bay route.

NOTE d

CHICAGO AND THE GEORGIAN BAY ROUTE

"The second alternative is the new route the Canadian government has under consideration at this time—a canal which will lead out of the Georgian Bay to Lake Nipissing, thence over the divide and down the Ottawa River to Montreal. The preliminary surveys are made for this venture, and

the engineers are working out the question of costs. This scheme is of the greatest significance to Chicago, for it will be seen by an inspection of a globe that this route will give Chicago practically a great circle route to Liverpool and the other ports of Northwest Europe, saving 774 miles over the present journey by way of New York. Another very patent advantage to us is that this route will give the Chicago merchant a choice again of playing the advantage of this route against the New York route, under conditions almost certain to assure the best service and the lowest rates in the trade with Europe."

J. PAUL GOODE,

Report to the Chicago Harbor Commission.

This excellent report was published in 1909, after the text of this chapter was printed in *The Reader*. Prof. Goode sagaciously points out the advantage to Chicago of the Georgian Bay route in times of commercial peace. There seems no reason to doubt, however, that Canadian ship-owners would look out for their own interests in demanding the monopoly of its free navigation for their own vessels and, perhaps, those of the mother country. And, of course, Chicago's goods, in common with those of all United States ports, might be made subject to such discriminative dues as Canada might deem it best to impose for passage through her own canal.

NOTE *e*

DEPTHS ATTAINABLE FROM CHICAGO TO ST. LOUIS

Mr. Lyman E. Cooley, in a private letter dated April 7, 1909, says: "In the Report which I wrote for the Internal Improvement Commission of Illinois in 1907 it is stated that with the water supply that can be made available by the works in existence on the Chicago Divide (some 15,000 cubic feet per second, including the I. & M. Canal) 24 feet can be carried to the city of Peoria, and 18 to 20 feet to the city of St. Louis. . . . You will find that the report of the Board of Engineers forwarded to Washington on April 1, 1909, determines the feasibility of 14 feet of water through the Mississippi River between St. Louis and Cairo by two methods, and that one of

these methods lends itself to further development of 20 or 24 feet."

The writer at this time has not had access to the report last mentioned; but its support of the statements in the text—written long ago—is here pointed out.

NOTE *f*

RELATION OF WATERWAYS TO RAILWAY PROFITS

"Within an area of less than 800,000 square miles, comprising Austria, Hungary, Belgium, France, Holland, Germany, and Italy, there has been expended in the last half century in improvement and construction of internal waterways an amount which, if to it be added the probable cost of improvements now in hand, will aggregate not far from a billion dollars. . . . Those countries which have taken most pains and gone to greatest expense to improve and systematize waterways, and which have most carefully protected them in a share of traffic, are fully committed to the policy of developing both rail and water transportation side by side, as complements, one of the other. . . . It is universal experience that development of waterways, resulting in a great increase in their tonnage, does not injure the traffic of railways. Instead, the railways appear to have actually benefited by the expansion of the waterway systems, because with each extension of facilities traffic has increased in still larger proportions. Thus is the remarkable showing made of railroad traffic increasing by leaps and bounds at the very time when waterways were most highly improved and constantly adding to their tonnage."

J. C. WELLIVER,

In Preliminary Report of the Inland Waterways
Commission, 1908.

NOTE *g*

(From "Report of the Inland Waterways Commission.")

RAILROAD CONTROL OF RIVER TRAFFIC AND PRIVATE CANALS

River Lines

On the Mississippi River and its tributaries the following

packet lines show traces of railroad influence. It is to be noted that vessels of these lines run from St. Louis and Evansville to points on the Tennessee and Cumberland rivers, and the railroad apparently interested in such lines is the Louisville and Nashville.

The St. Louis and Tennessee River Packet Company is generally believed to be controlled by the Louisville and Nashville Railroad, although this is denied by a representative of the packet line. The Louisville and Nashville Railroad Company reports to the Interstate Commerce Commission that it owns stock in this packet company amounting to \$27,700; and also reports stock ownership to the amount of \$25,200 in the Tennessee River Packet Company. Capt. Lee Howell, of Evansville, Ind., one of the directors of the St. Louis and Tennessee River Packet Company, is general freight agent of the Louisville and Nashville at Evansville, Ind.

Evansville and Bowling Green Packet Company: The president and treasurer of this company is Capt. Lee Howell, who is also a director and stockholder in the same. H. P. Cornick, secretary of this company, is assistant to Mr. Howell in the Louisville and Nashville freight office at Evansville.

Evansville, Paducah, and Cairo Packet Line: Capt. Lee Howell is also a stockholder in this company, which indicates Louisville and Nashville influence. The company is a successor to the Tennessee and Ohio River Transportation Company.

Ryman Line: H. W. Buttorff, president of this line, is a director of the Nashville, Chattanooga, and St. Louis Railway Company, which is controlled by the Louisville and Nashville Railroad through stock ownership.

A group of railroads centring at St. Louis controls the Wiggins Ferry Company at that point, and this company in turn owns stock in the St. Louis Steel Barge Company.

Private Canals

Delaware and Raritan: The Delaware and Raritan Canal is owned by the United New Jersey Railroad and Canal Com-

pany, all the property of which was leased to the Pennsylvania Railroad Company in June, 1871, for 999 years.

The Morris Canal was leased in perpetuity to the Lehigh Valley Railroad Company in 1871 under authority of a special act of the New Jersey legislature.

The Lehigh Canal is owned by the Lehigh Coal and Navigation Company. The managers of this company assert that the canal is operated independently of all other lines and is not connected with any carrier engaged in interstate business. According to *Moody's Manual* for 1907 (p. 2100) several railroad lines belonging to this company are leased to the Central Railroad of New Jersey; and the latter company is controlled by the Reading Company, which owned \$14,504,000 of the \$27,431,800 capital stock outstanding on June 30, 1906. It also appears that three of the managers of the Lehigh Coal and Navigation Company (Samuel Dixon, Joseph S. Harris, and H. P. McKeen) are also directors in the Reading Company.

The Delaware Division Canal is now controlled by the Lehigh Coal and Navigation Company, which owns practically all the capital stock.

The Schuylkill Navigation Company, according to the statement of its manager, operates its own works, which are not leased from any railroad company. The principal office of the company, however, is at the Reading Terminal, Philadelphia, Pa., and out of 65,975 shares of preferred stock all but 106 shares are owned by the Reading Company (the holding company for the Reading Railroad system); and out of 13,270 shares of common stock the Reading Company owns 12,907 shares.

The Chesapeake and Ohio Canal is now operated by two trustees, one of whom, H. L. Bond, Jr., of Baltimore, Md., is general attorney for the Baltimore and Ohio Railroad. According to *Moody's Manual* for 1907 (p. 296), of the bond issue of 1878, \$500,000 was held by the Baltimore and Ohio on June 30, 1906, and the same authority also credits the Baltimore and Ohio with the ownership of \$861,000 of the bond issue of 1844.

The Baltimore and Ohio Railroad Company also owns \$5,353,200 (a majority) of the capital stock (\$10,250,000) of

the Consolidation Coal Company of Baltimore, Md., which owns most of the boats on this canal and handles the greater bulk of tonnage.

Mr. F. S. Landstreet, a director of the Western Maryland Railroad, acquired the interests in this canal formerly held by the State of Maryland. But these interests were conveyed to the Continental Trust Company of Maryland in August, 1907.

The abandoned Pennsylvania canals are largely controlled by the Pennsylvania Railroad, which holds \$3,517,150 stock in the Pennsylvania Canal Company, and \$384,000 mortgage bonds, and in 1906 had \$2,006,490 of mortgage coupons.

The Central Railroad of Georgia owns \$160,000 stock in the Savannah and Ogeechee Canal Company, also an abandoned canal.

NOTE *h*

NECESSITY OF REGULATION OF RAILWAY COMPETITION WITH WATERWAYS

“ We recommend that any plans for improving the inland waterways shall take into account the present and prospective relation of rail lines to such waterways, and shall ascertain so far as may be whether such waterways when improved will be effectively used in the face of railway competition; and that the relations between railways and waterways be further examined for the purpose of devising means of rendering the two systems complementary and harmonious, and making such fair division of traffic that rates and management may be co-ordinated economically and with benefit to the country.”

PRELIMINARY REPORT OF THE INLAND WATERWAYS
COMMISSION—“ FINDINGS.”

See also Note *g*.

NOTE *i*

EUROPEAN METHODS OF REGULATING COMPETITION

“ It has been suggested that in both Great Britain and the

United States the railroads have been charged with more than their real part of responsibility for preventing the development of internal waterways, yet the fact remains that it is in those countries which have government ownership of railroads, and where governmental policy has protected the developing waterway systems from ruinous competition with the railways that the waterways have been developed to the greatest extent and efficiency. . . . The fact that in different countries it has repeatedly been found necessary to prevent the railroads from destroying the business of internal waterways by the simple process of hauling freight more cheaply than it could be moved by water must be met by the advocates of waterway development. . . . In many cases railways are forbidden by law to make as low rates as the canals. The fact that in Germany, France, and Belgium this intervention is necessary in order to protect the canals in their proportion of the traffic, is always emphasized in railroad arguments. But the State's policy, where States own and operate the railways, is primarily to facilitate business, rather than to monopolize it. Experience has taught that it is not good business for the railways to be allowed to monopolize traffic by hauling it at unremunerative rates. The State insists upon maintaining both transportation systems in effective operation, on the theory that in the long run business will go to the system which can most profitably handle it. The public is accommodated and the waste of competition avoided. Such competition at best would be useless, because, after making a low rate to get the business, the railroad would either have to continue doing it at a loss—which would be a waste of the State's property—or else it would have to raise the rate again, and leave the public worse off than ever. . . . As a result of the success of some of the [French] railways in securing control of private canals, which were promptly deprived of a large proportion of their tonnage, and also because of efforts of the railroads to take business away from publicly owned canals by dint of extreme competition, the railroad administrative authorities some years ago fixed a general rule that railroads must charge a somewhat higher rate than waterways. . . . There is a feeling that while the railways probably could

in a comparatively few years, if permitted, take much of the traffic from the waterways, the result of such a proceeding would necessarily be to increase the cost of traffic by rail. . . . One of the methods adopted by the railroad administrative authorities to prevent this sort of thing was the requirement that if a railroad reduced its rates for the purpose of attracting the tonnage of a particular establishment, it must make the same reduction as to the business of all establishments similarly located. . . . There is no doubt that transportation rates as a whole are decidedly lower in France to-day by reason of the development of waterways. This is true, notwithstanding that it has been found necessary, to protect waterways against the ruinous competition which the railways would have been glad to force upon them."

J. C. WELLIVER,

In Prelim. Rep. Inland Waterways Com.

NOTE j

EFFECT OF RAILWAY COMPETITION

"The Commission finds that it was unregulated railroad competition which prevented or destroyed the development of commerce on our inland waterways. The Mississippi, our greatest natural highway, is a case in point. At one time the traffic upon it was without a rival in any country. The report shows that commerce was driven from the Mississippi by the railroads. While production was limited, the railways, with their convenient terminals, gave quicker and more satisfactory service than the waterways. Later they prevented the restoration of river traffic by keeping down their rates along the rivers, recouping themselves by higher charges elsewhere. They also acquired water fronts and terminals to an extent which made water competition impossible. Throughout the country the railways have secured such control of canals and steamboat lines that to-day inland waterway transportation is largely in their hands. This was natural and doubtless inevitable under the circumstances, but it should not be allowed to continue unless under careful Government regulation.

"Comparatively little inland freight is carried by boat which

is not carried a part of its journey by rail also. As the report shows, the successful development and use of our interstate waterways will require intelligent regulation of the relations between rail and water traffic. When this is done the railways and waterways will assist instead of injuring each other. Both will benefit, but the chief benefit will accrue to the people in general through quicker and cheaper transportation."

MESSAGE OF PRESIDENT ROOSEVELT, ACCOMPANYING PRELIMINARY REPORT OF INLAND WATERWAYS COMMISSION.

NOTE *k*

EFFECT OF INADEQUATE TERMINALS

"It is typical of Chicago's attitude of indifference toward water shipping that these boat lines are regarded in many quarters as private enterprises that must take care of themselves.

"Ordinarily cities lack the power to deprive a railroad or a group of railroads of their terminal facilities. Even if Chicago possessed the power, the proposition to take away from a railroad its terminal facilities, without a thought as to whether or not the line could provide itself with other facilities to enable it to do business, would be condemned as contrary to wise public policy, unless the health of the community or some other consideration more important than commercial development should require the action. If Chicago is not prepared to deal with water transportation as public business, akin in nature to railroad business, instead of treating it like strictly private enterprises, of course the city can expect no further shipping development.

"Bridges are also frequently suggested at Wabash avenue and at La Salle street. A bridge at Wabash avenue would destroy the Graham & Morton dock. One at La Salle street would prevent the further use of the Anchor line dock, except by much smaller boats than even now tie up there.

"If Chicago seriously cares to encourage water shipping it will, when planning new bridge construction that will destroy

docks, give careful consideration to the question as to what the ousted boat lines are to do for new dock facilities.”

GEO. C. SIKES,

Report to Chicago Harbor Commission.

NOTE *l*

CHICAGO'S TERMINAL PROBLEM

“The most important consideration is that such facilities as are now to be had are limited. The existing boat lines are unduly circumscribed and are without opportunity for expansion. The Interstate Commerce Commission, in the case of *Benton Transit Company v. Benton Harbor-St. Joe Railway & Light Company*, No. 1372, p. 549, found, speaking of the Graham & Morton dock in Chicago, that ‘the least adequate of its facilities is its wharf in Chicago.’ And yet the Graham & Morton dock, for convenience, ranks comparatively well among the boat landings of this city. It is almost impossible for a new boat line to get a foothold in Chicago because of inability to secure dock accommodations. Those established most recently are paying 20 per cent. of their gross freight receipts for the use for freight purposes of unsatisfactory terminal facilities in the Chicago port. Some men have given up the struggle. The steamer *Eastland*, built for use in Chicago, is now operating out of Cleveland. If contemplated plans for new bridge construction go through, the available dockage facilities of the city will be considerably reduced, and long established boat lines will be at a loss to know what to do for quarters.”

GEO. C. SIKES,

Report to Chicago Harbor Commission.

NOTE *m*

THE MENACE OF A WATER-POWER TRUST

“Among these monopolies, as the report of the Commission points out, there is no other which threatens, or has ever threatened, such intolerable interference with the daily life of the people as the consolidation of companies controlling water-

power. I call your special attention to the attempt of the power corporations, through bills introduced at the present session, to escape from the possibility of Government regulation in the interests of the people. These bills are intended to enable the corporations to take possession in perpetuity of national forest lands for the purposes of their business, where and as they please, wholly without compensation to the public. Yet the effect of granting such privileges, taken together with rights already acquired under State laws, would be to give away properties of enormous value. Through lack of foresight we have formed the habit of granting without compensation extremely valuable rights amounting to monopolies on navigable streams and on the public domain. The repurchase at great expense of water rights thus carelessly given away without return has already begun in the East, and before long will be necessary in the West also. No rights involving water-power should be granted to any corporations in perpetuity, but only for a length of time sufficient to allow them to conduct their business profitably. A reasonable charge should of course be made for valuable rights and privileges which they obtain from the National Government. The values for which this charge is made will ultimately, through the natural growth and orderly development of our population and industries, reach enormous amounts. A fair share of the increase should be safeguarded for the benefit of the people, from whose labor it springs. The proceeds thus secured, after the cost of administration and improvement has been met, should naturally be devoted to the development of our inland waterways."

MESSAGE OF PRESIDENT ROOSEVELT, ACCOMPANYING PRELIMINARY REPORT OF INLAND WATERWAYS COMMISSION.

NOTE *n*

FROM THE "ENGINEERING NEWS," OCTOBER 8, 1908

"Major Newcomer makes a strong presentation of the difficulties that stand in the way of reservoir river control, particularly the cost obstacle, but we think his arguments increase



An Abandoned Pasture Land on Tributary of Cane Creek,
Mitchell County, N. C.

There are several gullies on this land. Restocking is taking place
very slowly, chiefly by hardwoods.

From a photograph by U. S. Forest Service.

rather than decrease the force of Mr. Leighton's thesis for a thorough-going study of the whole subject.

"What we should like to impress on our readers is the need for the broadest possible consideration of everything pertaining to the water resources of each of the great drainage systems of the United States, beginning with those presenting the most urgent problems, but keeping constantly in mind the best possible means of conserving and utilizing to their utmost all the water resources of the country, as rapidly as needed.

"River improvement and utilization has or should now become more than a mere matter of dredging, levee building, and dam building, in the interests of navigation or navigation and flood protection. Other possibilities of river-flow control ought to be given full and fair consideration, and other ways of utilizing water than in moving boats should receive such attention as the peculiar needs and possibilities of each stream demands.

"That the broader views of river improvement and control disclose physical, financial, and governmental difficulties is no reason for throwing up the hands. No, not if the full utilization and control of our natural waters should finally demand, as it bids fair to do, either a combination or the co-operation of national, state, and municipal agencies.

"That some change is demanded to serve the needs of navigation alone is evident from the little progress that has been made on the Ohio River improvements in the eighty years' work which is reviewed in the article that follows Major Newcomer's contribution in this issue. In nearly a century of time, the friends of Ohio River navigation have wrung from Congress and there has been expended only some \$10,600,000, while \$63,000,000 is estimated as necessary to secure nine feet of water from Pittsburg to the mouth of the Ohio. Of the \$10,600,000 expended up to June 30, 1907, \$3,900,000 was for the canal and accessories at the Falls of the Ohio.

"Does any one doubt but that more money might have been secured in the past and far more in the future if instead of navigation alone, there was placed before Congress and the legislatures of the Ohio valley states, the municipal govern-

ments of Pittsburg, Louisville, Cincinnati, etc., and before their respective constituents, a well-considered plan of water storage, power development, flood prevention, and navigation improvement? We are well aware of the difficulties involved in such a comprehensive scheme for either the Ohio or any other of our great river basins, but no difficulty has yet been suggested that seems formidable enough to warrant vetoing the careful and comprehensive studies advocated by Mr. Leighton."

NOTE o

ROOSEVELT ON DEFORESTATION

"If there is any one duty which more than another we owe to our children and our children's children to perform at once, it is to save the forests of this country, for they constitute the first and most important element in the conservation of the natural resources of the country. There are of course two kinds of natural resources. One is the kind which can only be used as part of a process of exhaustion; this is true of mines, natural oil and gas wells, and the like. The other, and of course ultimately by far the most important, includes the resources which can be improved in the process of wise use; the soil, the rivers, and the forests come under this head. Any really civilized nation will so use all of these three great national assets that the nation will have their benefit in the future. Just as a farmer, after all his life making his living from his farm, will, if he is an expert farmer, leave it as an asset of increased value to his son, so we should leave our national domain to our children, increased in value and not worn out. There are small sections of our own country, in the East and in the West, in the Adirondacks, the White Mountains, and the Appalachians, and in the Rocky Mountains, where we can already see for ourselves the damage in the shape of permanent injury to the soil and the river systems which comes from reckless deforestation. It matters not whether this deforestation is due to the actual reckless cutting of timber, to the fires that inevitably follow such reckless cutting of timber, or to reckless and uncontrolled



Saving what Is Left of the Soil when the Forests are Gone. Artificial Terracing in China.

From a photograph by U. S. Forest Service.

grazing, especially by the great migratory bands of sheep, the unchecked wandering of which over the country means destruction to forests and disaster to the small home makers, the settlers of limited means.

“Shortsighted persons, or persons blinded to the future by desire to make money in every way out of the present, sometimes speak as if no great damage would be done by the reckless destruction of our forests. It is difficult to have patience with the arguments of these persons. Thanks to our own recklessness in the use of our splendid forests, we have already crossed the verge of a timber famine in this country, and no measures that we now take can, at least for many years, undo the mischief that has already been done. But we can prevent further mischief being done; and it would be in the highest degree reprehensible to let any consideration of temporary convenience or temporary cost interfere with such action, especially as regards the National Forests which the nation can *now*, at this very moment, control.

“All serious students of the question are aware of the great damage that has been done in the Mediterranean countries of Europe, Asia, and Africa by deforestation. The similar damage that has been done in Eastern Asia is less well known. A recent investigation into conditions in North China by Mr. Frank N. Meyer, of the Bureau of Plant Industry of the United States Department of Agriculture, has incidentally furnished in very striking fashion proof of the ruin that comes from reckless deforestation of mountains, and of the further fact that the damage once done may prove practically irreparable. So important are these investigations that I herewith attach as an appendix to my message certain photographs showing present conditions in China. They show in vivid fashion the appalling desolation, taking the shape of barren mountains and gravel- and sand-covered plains, which immediately follows and depends upon the deforestation of the mountains. Not many centuries ago the country of northern China was one of the most fertile and beautiful spots in the entire world, and was heavily forested. We know this not only from the old Chinese records, but from the accounts given by the traveller, Marco Polo. He, for instance, mentions that in

visiting the provinces of Shansi and Shensi he observed many plantations of mulberry trees. Now there is hardly a single mulberry tree in either of these provinces, and the culture of the silkworm has moved farther south, to regions of atmospheric moisture. As an illustration of the complete change in the rivers, we may take Polo's statement that a certain river, the Hun Ho, was so large and deep that merchants ascended it from the sea with heavily laden boats; to-day this river is simply a broad sandy bed, with shallow, rapid currents wandering hither and thither across it, absolutely un-navigable. But we do not have to depend upon written records. The dry wells, and the wells with water far below the former watermark, bear testimony to the good days of the past and the evil days of the present. Wherever the native vegetation has been allowed to remain, as, for instance, here and there around a sacred temple or imperial burying ground, there are still huge trees and tangled jungle, fragments of the glorious ancient forests. The thick, matted forest growth formerly covered the mountains to their summits. All natural factors favored this dense forest growth, and as long as it was permitted to exist, the plains at the foot of the mountains were among the most fertile on the globe, and the whole country was a garden. Not the slightest effort was made, however, to prevent the unchecked cutting of the trees, or to secure reforestation. Doubtless for many centuries the tree-cutting by the inhabitants of the mountains worked but slowly in bringing about the changes that have now come to pass; doubtless for generations the inroads were scarcely noticeable. But there came a time when the forest had shrunk sufficiently to make each year's cutting a serious matter, and from that time on the destruction proceeded with appalling rapidity; for of course each year of destruction rendered the forest less able to recuperate, less able to resist next year's inroad. Mr. Meyer describes the ceaseless progress of the destruction even now, when there is so little left to destroy. Every morning men and boys go out armed with mattox or axe, scale the steepest mountain sides, and cut down and grub out, root and branch, the small trees and shrubs still to be found. The big trees disappeared centuries ago, so that now one of these



Lake McDonald, Montana.

From a photograph by U. S. Forest Service.

is never seen save in the neighborhood of temples, where they are artificially protected; and even here it takes all the watch and care of the tree-loving priests to prevent their destruction. Each family, each community, where there is no common care exercised in the interest of all of them to prevent deforestation, finds its profit in the immediate use of the fuel which would otherwise be used by some other family or some other community. In the total absence of regulation of the matter in the interest of the whole people, each small group is inevitably pushed into a policy of destruction which cannot afford to take thought for the morrow. This is just one of those matters which it is fatal to leave to unsupervised individual control. The forests can only be protected by the State, by the Nation; and the liberty of action of individuals must be conditioned upon what the State or Nation determines to be necessary for the common safety.

“The lesson of deforestation in China is a lesson which mankind should have learned many times already from what has occurred in other places. Denudation leaves naked soil; then gullying cuts down to the bare rock; and meanwhile the rock-waste buries the bottomlands. When the soil is gone, men must go; and the process does not take long.

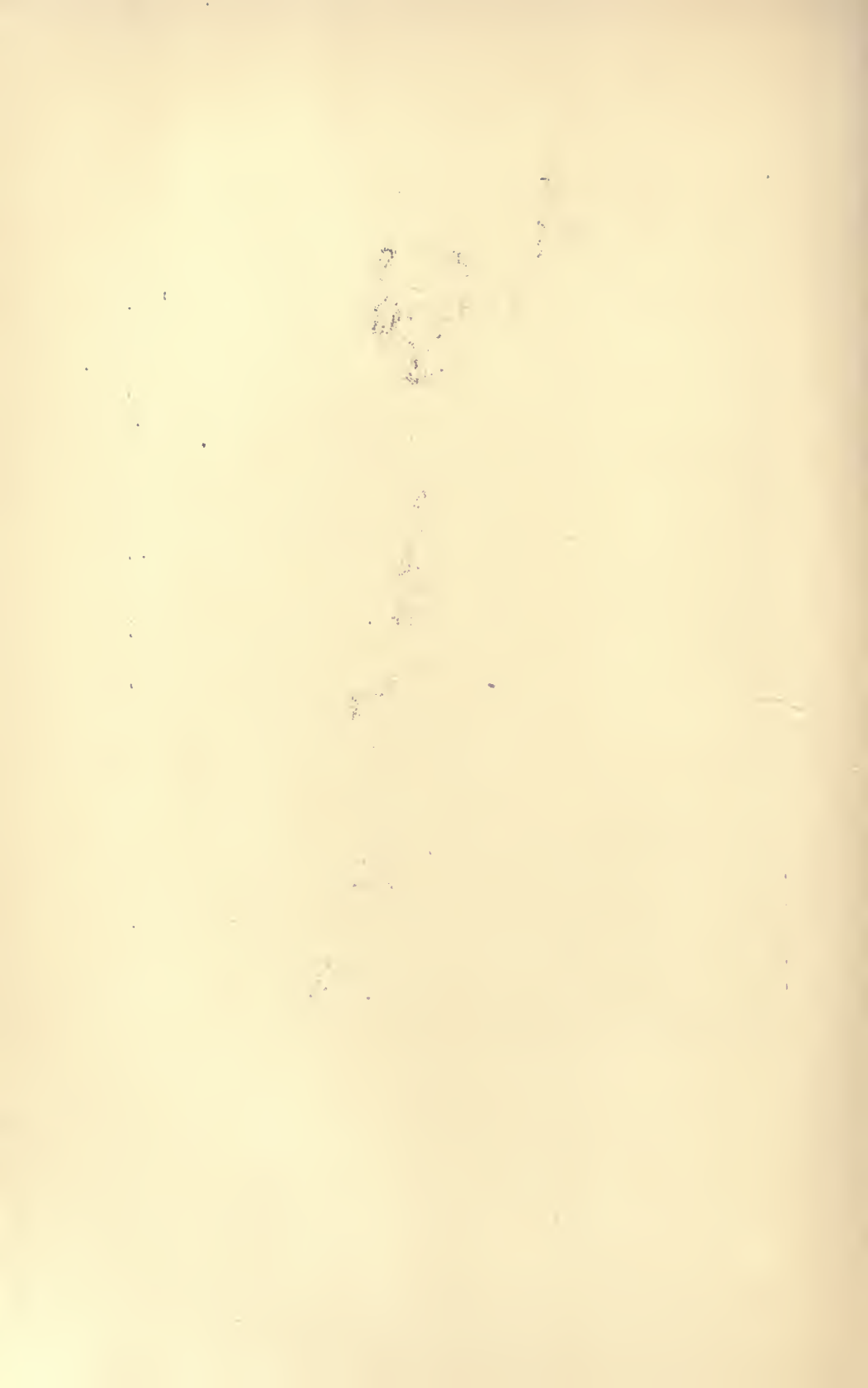
“This ruthless destruction of the forests in northern China has brought about, or has aided in bringing about, desolation, just as the destruction of the forests in central Asia aided in bringing ruin to the once rich central Asian cities; just as the destruction of the forests in northern Africa helped towards the ruin of a region that was a fertile granary in Roman days. Shortsighted man, whether barbaric, semi-civilized, or what he mistakenly regards as fully civilized, when he has destroyed the forests, has rendered certain the ultimate destruction of the land itself. In northern China the mountains are now such as are shown by the accompanying photographs, absolutely barren peaks. Not only have the forests been destroyed, but because of their destruction the soil has been washed off the naked rock. The terrible consequence is that it is impossible now to undo the damage that has been done. Many centuries would have to pass before soil would again collect, or could be made to collect, in suffi-

cient quantity once more to support the old-time forest growth. In consequence the Mongol Desert is practically extending eastward over northern China. The climate has changed and is still changing. It has changed even within the last half century, as the work of tree destruction has been consummated. The great masses of arboreal vegetation on the mountains formerly absorbed the heat of the sun and sent up currents of cool air which brought the moisture-laden clouds lower and forced them to precipitate in rain a part of their burden of water. Now that there is no vegetation, the barren mountains, scorched by the sun, send up currents of heated air which drive away instead of attracting the rain clouds, and cause their moisture to be disseminated. In consequence, instead of the regular and plentiful rains which existed in these regions of China when the forests were still in evidence, the unfortunate inhabitants of the deforested lands now see their crops wither for lack of rainfall, while the seasons grow more and more irregular; and as the air becomes dryer certain crops refuse longer to grow at all. That everything dries out faster than formerly is shown by the fact that the level of the wells all over the land has sunk perceptibly, many of them having become totally dry. In addition to the resulting agricultural distress, the watercourses have changed. Formerly they were narrow and deep, with an abundance of clear water the year around; for the roots and humus of the forests caught the rainwater and let it escape by slow, regular seepage. They have now become broad, shallow stream beds, in which muddy water trickles in slender currents during the dry seasons, while when it rains there are freshets, and roaring muddy torrents come tearing down, bringing disaster and destruction everywhere. Moreover, these floods and freshets, which diversify the general dryness, wash away from the mountain sides, and either wash away or cover in the valleys the rich fertile soil which it took tens of thousands of years for Nature to form; and it is lost forever, and until the forests grow again it cannot be replaced. The sand and stones from the mountain sides are washed loose and come rolling down to cover the arable lands, and in consequence, throughout this part of China, many formerly rich districts are now



Wheat Being Drawn up out of Boats into Elevators at Buffalo.

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sandy wastes, useless for human cultivation, and even for pasture. The cities have been of course seriously affected, for the streams have gradually ceased to be navigable. There is testimony that even within the memory of men now living there has been a serious diminution of the rainfall of north-eastern China. The level of the Sungari River in northern Manchuria has been sensibly lowered during the last fifty years, at least partly as the result of the indiscriminate cutting of the forests forming its watershed. Almost all the rivers of northern China have become uncontrollable, and very dangerous to the dwellers along their banks, as a direct result of the destruction of the forests. The journey from Peking to Jehol shows in melancholy fashion how the soil has been washed away from whole valleys, so that they have been converted into deserts.

“ In northern China this disastrous process has gone on so long and has proceeded so far that no complete remedy could be applied. There are certain mountains in China from which the soil is gone so utterly that only the slow action of the ages could again restore it; although of course much could be done to prevent the still further eastward extension of the Mongolian Desert if the Chinese Government would act at once. The accompanying cuts from photographs show the inconceivable desolation of the barren mountains in which certain of these rivers rise—mountains, be it remembered, which formerly supported dense forests of larches and firs, now unable to produce any wood, and because of their condition a source of danger to the whole country. The photographs also show the same rivers after they have passed through the mountains, the beds having become broad and sandy because of the deforestation of the mountains. One of the photographs shows a caravan passing through a valley. Formerly, when the mountains were forested, it was thickly peopled by prosperous peasants. Now the floods have carried destruction all over the land and the valley is a stony desert. Another photograph shows a mountain road covered with the stones and rocks that are brought down in the rainy season from the mountains which have already been deforested by human hands. Another shows a pebbly river-bed in southern Man-

churia where what was once a great stream has dried up owing to the deforestation in the mountains. Only some scrub wood is left, which will disappear within a half century. Yet another shows the effect of one of the washouts, destroying an arable mountain side, these washouts being due to the removal of all vegetation; yet in this photograph the foreground shows that reforestation is still a possibility in places.

“What has thus happened in northern China, what has happened in central Asia, in Palestine, in North Africa, in parts of the Mediterranean countries of Europe, will surely happen in our country if we do not exercise that wise forethought which should be one of the chief marks of any people calling itself civilized. Nothing should be permitted to stand in the way of the preservation of the forests, and it is criminal to permit individuals to purchase a little gain for themselves through the destruction of forests when this destruction is fatal to the well-being of the whole country in the future.”

ROOSEVELT'S MESSAGE TO SECOND SESSION, 60TH CONGRESS.

If now we divide the number of flood days by the number of storms, the result will be the number of days per storm. Applying this to each of the series in the above table, the following result is reached:

DAYS OF FLOOD PER STORM
1884-1895 AND 1896-1907

Period	Storms in Inches Precipitated							
	1-1.5	1.5-2	2-2.5	2.5-3	3-3.5	3.5-4	4-4.5	4.5-5
1884-1895	.7	.5	2.5	1.8	2.6	5	6	8.1
1896-1907	.4	.9	2.6	2.7	3.2	6	8	6.7
Percentage increase	-43	80	4	50	22	20	33	-17

The algebraic sum of the above percentages is 149.00 and the average is 18.75, which sums up the effect of deforestation on run-off from 1884 to 1907, inclusive.

MARSHALL O. LEIGHTON.







West 90° from Greenwich 85° 80° 75°

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