and a sugar combine, while Mr. Alphonse Verville, M. P., who was the principal speaker at a meeting held in the Labor Temple a week ago to discuss the local food question, emphatically gave it as his opinion that there was a canned goods trust in local operation." So says the Montreal Herald. These matters are to be investigated as a result of growing complaints about the high cost of living.

* * *

In 1911 the fire loss in the United States was $2.31 per capita, as compared with eighty-one cents in France, fifty-three cents in England, and twenty-one cents in Germany. The fire loss in New York in 1911 was $2.45 as against sixty cents in Paris, fifty-four cents in London, and eighteen cents in Hamburg. Boston, a city of about the same size as Hamburg, had a fire loss of $3.26 per capita, or more than eighteen times as great. The American record as regards railroad accidents is almost equally bad. And the road back to sanity and safety is long and hard.

* * *

Vienna hears reports of strained relations between Austria and Russia over the Balkan situation, and in some quarters there is fear of a general war in Europe. These reports are probably exaggerated. Mr. Asquith's Guildhall speech on Saturday indicated that the great powers were working harmoniously together in regard to the Balkan situation, and it was on the whole a most quieting utterance. Mr. Asquith said that so far as Great Britain is concerned its relations with other powers, without a single exception, were never more friendly and cordial. Mr. Asquith does not seem to belong to the "emergency" school in politics.

* * *

A pleasing custom was that of Ortie McManigal, the informer in the American dynamite case, who testified the other day that as he traveled over the United States, blowing up buildings here and there, he always sent home to his family a souvenir spoon from each town where he destroyed property. This man was responsible for many deaths, and the property losses caused by his acts ran into many millions. He seems to have been one of the most cold-blooded and desperate characters recently disclosed to the world. There will be universal regret that justice has found it necessary to give him a certain degree of immunity in payment for his testimony.

* * *

The Lemieux act for settling labor disputes has been in force for five years. During that time 124 industrial disputes have been dealt with under it. In only fourteen of these cases did the operation of the act fail to avert a strike. The Ottawa Journal, in praising this legislation, says: "What do you think of a law which in five years has aided to avert one hundred and ten strikes in Canada, in services greatly affecting the public comfort and welfare? Could there be anything more simple, more sensible, more desirable? Could anything be much more effective, as the story of five years tells? Could any law much better deserve the support of the people?"

* * *

The questions of loans for farmers is attracting increasing attention in the United States. The Democratic platform contained this plank:

"Of equal importance with the question of currency reform is the question of rural credits or agricultural finance. Therefore, we recommend that an investigation of agricultural credit societies in foreign countries be made, so that it may be ascertained whether a system of rural credits may be devised suitable to conditions in the United States; and we also favor legislation permitting national banks to loan a reasonable proportion of their funds on real estate security."

A conference is to be held in Minneapolis at which the whole question of rural credit legislation is to be dealt with, the idea being to recommend a feasible plan for rural loans on farm security.

MONCTON TEMPERANCE MEN WANT CHIEF OF POLICE RETAINED

Moncton, N. B., Nov. 12—At a meeting of Moncton Division, Sons of Temperance, a resolution moved by E. McCarthy, seconded by E. B. Hicks, was unanimously adopted expressing full confidence in Chief of Police Rideout and opposing the petition of the provincial constables who request his removal from office.

J. B. T. Caron, of the I. C. R. board of management left last evening to be at the bedside of his aged father who is critically ill at his home near Quebec.

Arrangements are being made by local promoters to have Sam Anderson and Filonis wrestle for the world's middleweight championship here on next Monday night.

ABE MARTIN

A kicker allus wants somethin' t' boot. It's worth all it costs t' keep peace in th' family.

ENGINEERS FILE LENGTHY REPORT ON THE ST. JOHN RIVER

CONSERVATION OF THE WATERS OF THE BIG STREAM

An Important and Interesting Document---Elaborate System of Water Storage and Channel Improvements and Estimate of the Cost---The Development of the Water Powers---Commission Appointed as Result of Trouble of Long Standing.

The consulting engineers of the International St. John River Commission have filed their report which is an interesting document dealing with an elaborate system of water storage and channel improvements and giving an estimate of the cost. There has been trouble along the river, chiefly between Canadian and United States interests and at one time blood was shed at Van Buren.

To prevent a repetition of this trouble and to conduct a careful investigation of the river and all its uses the St. John River commission received its authority from the two governments in 1909 and on that commission at the present time are M. G. Teed, K. C., of St. John (N. B.); John Keefe, of St. John (N. B.); George A. Murchie, of Calais, and Peter Charles Keegan, of Van Buren. Hon. O. F. Fellows is counsel for the United States before the commission.

In order to adequately consider the important question of the use of the river for the lumber industry and the conservation of water, both as an aid to that industry and for the purposes of power development it was necessary that a complete survey of the entire section be made, and Hardy S. Ferguson, formerly chief engineer of the Great Northern Paper Co., and now of New York city, was appointed with S. J. Chapleau, of the department of public work of the dominion at Ottawa, were appointed consulting engineers.

After nearly two years of work and the expenditure of thousands of dollars under the direction of Mark H. Ranney, C. E., of Mohawk (N. Y.), the consulting engineers have submitted their eport. This report is the most complete study of the St. John river ever attempted, and its value to the interests along both sides of the river cannot be overestimated.

The engineers have found that with the expenditure of $471,510 for dams the tributaries can be raised to the present high level and kept there, which would greatly facilitate the log driving on the river. To raise the water to the proposed high water level, which means that at al ltimes there would be plenty of water for all purposes on the river—the highest practicable development of the river—would, for the dams, cost aggregating to the engineers' estimate, $1,273,576. To these amounts must be added the flowage damages, which in some instances would be large.

In order to improve the conditions for log driving channel improvements along the river at many points have been suggested and the engineers say that from $200,000 to $300,000 might well be expended in this manner, from $10,000 to $15,000 being spent each year.

The Purpose and Scope of the Report.

The St. John river drains the largest territory of any river flowing into the Atlantic ocean between the St. Lawrence and Susquehanna rivers, with the total length of about 45 square miles, and total drainage area of about 26,000 square miles. The headwaters of the main or southwest branch lie in the mountainous region of the boundary between Maine and the province of Quebec where they are interwoven with the northwest branch of the Penobscot. The northwest branch flows mostly to the junction of the streams through the province of Quebec.

At the junction of these two branches the river first takes its name and for a distance for about 90 miles to where it receives the St. Francis river it flows in a northeasterly direction nearly parallel to the Canadian boundary. In this distance it receives several smaller tributaries which collect their water largely from Canadian territory. From the south side it receives the Allagash river, the largest tributary in its entire length with the exception of the Aroostook river. For a distance of about 70 miles from St. Francis nearly to Grand Falls the St. John river forms the boundary between Maine and New Brunswick. In this distance it receives the Fish river from the south and several small rivers from the Canadian side. Below Grand Falls there are but two important branches, the Aroostook river from Maine and the Tobique from New Brunswick.

Above Grand Falls the St. John drains in the state of Maine and if the 270 square miles which drain into Chamberlain Lake, and 4,179 square miles in Quebec and New Brunswick are included the total is 8,700 square miles, 90 per cent is probably covered with forest growth.

Thus far, the chief use made of the river from its source to Fredericton, a total of over 300 miles, has been for driving the yearly harvest of timber, which is cut on its watershed, to the sawmills located on its various points along the main river as far as Fredericton and St. John.

For many years there has been friction regarding log driving operations and water storage on the Allagash and the maintenance of booms along the main river, and it finally resulted in the appointment of an international commission as a step toward the settlement of the legal question involved.

This commission received its authority in January, 1909, and was first authorized to consider only the questions involved in log driving operations. But later, in February, 1910, it was further authorized to consider the matter of conservation of water for log driving and water power purposes and to conduct an investigation to determine the results to be attained from such developments.

These additional duties involved many engineering problems requiring for their proper solution a large amount of investigation in the field, as well as time and study to digest the data resulting from the field work. For this work the present board of engineers was selected and appointed by the commission, with instructions to investigate and report on the following general questions:

First: The amount of water which may be conserved by the erection of dams without exceeding the present high water level on the St. John river and the several lakes and tributaries thereof.

Second: Whether or not such conservation would facilitate the driving of logs on the St. John river, and if so to what extent.

Third: Whether such conservation of water without exceeding the high water mark would be sufficient to insure the effective driving of logs on the St. John river.

Fourth: What would be the approximate expenses involved therein?

Fifth: If the storage of water to a level not exceeding the present high water mark would not be sufficient for the effective driving of logs on the St. John river, to what extent and at what points should further storage be created, and the approximate cost thereof?

Sixth: What improvements should be made upon the main St. John river to facilitate the driving of logs, and what would be the approximate expense?

Seventh: Any other suggestions and recommendations which could be made along these lines."

An engineering staff was organized with headquarters at Van Buren (Me.), and the surveys for the collection of hydraulic and silled data commenced in June, 1910.

The field and office work was placed under the direction of M. H. Ranney, C. E., of Mohawk (N. Y.), as chief engineer, who has brought it to a successful conclusion, the results of which form the basis of this report.

At this point in the report, the engineers follow with a technical description of the establishment of bench marks and the running of individual lines of levels which were done preliminary to the actual work. In this manner, the location and extent of the principal lakes and streams tributary to the main St. John river were either determined individually by the engineering staff or compiled from reliable sources. A general map was constructed to a scale of five miles to the inch, embracing the whole of the St. John river watershed above Fredericton. Profiles were made of a large portion of the river and of the tributaries upon which important storage could be developed. To determine the quantity of water and stages of river required for log driving operations at critical points on the main river and its tributaries, stream metering stations were established at Van Buren, Fort Kent, just below the mouth of the Little Black river, on Fish river below Wallagrass stream, on the Allagash river just above its mouth, on the Madawaska river, at St. Rose, and on the St. Francis river at its mouth.

Gauges were established and records of daily observation kept at various important points along the river.

At the outlet of each lake or reservoir where storage development seem to be justified, sights for reservoir dams were examined, selected and surveyed for the purpose of determining the limits of the heights of the structures and their costs.

Log Driving—Present Methods and Conditions.

The logs which are cut on the St. John river above the mouth of the Allagash and on all of the tributaries are driven to the main river by individual owners and are there delivered to the driving corporation which take them to their destination.

The Madawaska Log Driving Association drive the logs between Big Rapids above the mouth of the Allagash river and Grand Falls. The contractors for this company employ from 100 to 200 men during the driving season.

At a point just above the "pitch" at Grand Falls the control of the drive is assumed by the St. John Log Driving Company, which is responsible for the delivery of logs into the Fredericton boom. This company employs 80 men.

For the ten years, 1902 to 1911, the size of the drive handled by the Madawaska Log Driving Association has varied from 80,000,000 feet in the years 1905 and 1908 to 127,000,000 in the year 1907. The latter was the largest drive of the past 21 years handled by this concern. Of the total quantity of lumber driven during the ten years referred to 78 per cent has come from the upper St. John and Allagash rivers and for the past five years 86 per cent has been cut on these waters.

It usually takes from the last of April until nearly the first week in June to get the logs out of the brooks and smaller tributaries of the upper St. John and down the "corporation limit" near Big Rapids, where they are turned over to the Madawaska Log Driving Association. Before this time the height of the flood is past, and the river has fallen perhaps two to five feet.

Occasionally it is necessary to discontinue driving because of low water, before all the logs arrive at the corporation limits, and in 1905 a very considerable portion of the logs from the Allagash were left in the stream above Allagash Falls.

If a good driving stage exists when the last of the logs arrive at Big Rapids ordinarily there is not much trouble in getting the drive down to Grand Falls, excepting the labor and expense of returning to the water those logs which were carried on shore during the time of highest water.

With the best stage of water some of the logs will run from Big Rapids to Fredericton, a distance of 230 miles in sixty hours; and the "rear" ordinarily can be driven from Big Rapids (near the mouth of the Allagash) to Fort Kent in aoout two weeks, or to Grand Falls in about the same time. But frequently delay in reaching Grand Falls is caused by waiting for the last of the logs from the larger tributaries. St. Francis and the Allagash. For example, in the year 1909, the "rear" of the Allagash drive reached the main river July 1.

Below Grand Falls the "rut" is sometimes stranded by reason of the low water that usually occurs in late July or in August.

In recent years the "rear" has not usually reached the Fredericton boom earlier than September, and has often been "hung up" before it reached Fredericton, though not always at the same points, nor in every year.

Generally speaking, the chief difficulty met with in driving the main St. John river is due to the rapid and extensive decrease of the flow of water after about the middle of May, when the spring freshet, caused by the melting snow on the upper portion of the watershed, has subsided. This abatement is sometimes as rapid as one foot per day in the depth of the river at Fort Kent. A secondary difficulty is due to the presence of numerous boulders and gravel bars at many points along the river, which form serious obstructions to the free passage of logs, increasing in their effect as the water recedes.

These two conditions should abviously be corrected as rapidly and extensively as possible, that the length of time occupied by driving may be shortened, the cost of driving thus reduced and more especially that the successful completion of the drive each year shall be assured.

If this can be accomplished, it will not only contribute to the satisfaction of the present sawmill owners along the river, but later on when the existing water power sites are developed, as they should be, a balance of stored water may be left, sufficient to enable them to operate in a manner warranted by the apparent size of the river.

Improvements Recommended.

In studying the subject of log driving the engineers find the coure of the St. John river to divide itself naturally, both by its physical characteristics and by the methods of handling the logs, into three general sections as follows:

First. The upper St. John, which is that portion of the river from the forks of the northwest and southwest branches to the mouth of the Allagash river. This portion of the river is driven by individuals, who deliver their logs to the Madawaska Log Driving Association at the mouth of the Allagash, or a few miles above at Big Rapids.

It is stated that this part of the river is so difficult that no corporation would care to enter into contract for driving it.

In this section is found the least portunity for water storage of any portion of the entire St. John system. In fact, but six square miles or only two-tenths per cent. of its entire drainage area of 1,850 square miles is occupied by lakes or ponds, as compared with nearly three per cent. on the Allagash, four per cent. on the Madawaska, and six per cent. on the Fish river system.

This leads to a very rapid run-off of the melting snow as the early spring rains at about the time the log drives are started, often resulting hard driving conditions when the snow-water has drained away, especially on account of the rapid fall and rocky nature of the river bed.

For this reason all advantage possible should be taken of what storage opportunities there are and particular attention should be paid to improving the channel on these upper waters to the end that the logs may be advanced as far as possible on their journey before the flood water is gone.

Second: From the mouth of the Allagash to Grand Falls. There is testimony to the effect that when the rear of the river drive reached the mouth of the Allagash they are usually considered safe. With the proper handling of the storage reservoirs which can be developed on the Allagash and St. Francis rivers and attention to getting the logs from those streams into the main river at an early date, comparatively little trouble should be experienced on this section.

Third: From Grand Falls to Fredericton. This section is almost entirely dependent on a sufficient volume of water to float the logs and this can be easily provided by the storage reservoirs that are recommended in the report.

On the upper St. John river, at St. John pond, and at Baker lake it is practicable to store 100 per cent. more water than at present.

These reservoirs should be fully developed. At English lake and Dasquam deadwater dams should be built, which will also store considerable water for flushing the logs from point to point, as is done on smaller streams. The stored water, which can be obtained from these reservoirs, together with such clearing and improvement of the river channels as can be readily done, should ensure for any year the safe driving of logs, cut on these waters, down to Seven Islands.

At this point a dam should be erected to carry a "head" of sixteen feet of water, submerging the islands, and creating a pond about five miles long. Here the logs would be collected and sluiced intermittently with the quantity of water which would be accumulated during each interval. By this method of operation the logs would be driven over Priestly Rapids to Louis St. John's, about nine miles below. In this distance there are about one mile of boulders which should be removed.

Twelve miles below Seven Islands at a point called "Basford Rock," a site has been selected where another driving dam should be built to flow back to Louis St. John's. This dam would be operated in the same manner as that at Seven Islands, to flush the logs to the mouth of the Big Black river.

Future experience may show the desirability of building a roll dam at Priestly Rapids, which is a difficult section of the river to drive, and a suitable site is available at that point.

We have also examined a site for a driving dam which should be built on the main river at Big Black rapids, about two miles above the mouth of Big Black river. Serious difficulties are now experienced from large jams forming on the gravel bars and reefs of ledge composing these rapids. In the drive of 1910 from 15,000,000 to 20,000,000 feet of logs were caught in the jam which formed here, and which extended up the river for about four miles. This condition no doubt can, and should be, considerably improved by blasting, and the construction of wing-dams to contract the channel, but the chief dependence must probably be placed on maintaining a sufficient depth of water to float the logs freely past this stretch of river by means of driving dams mentioned.

The same may be said of the sight and one-half miles from Half Way brook to the foot of Big Rapids, where about 10,000,000 feet of logs were jammed in the driving season of 1910. There are fifteen or eighteen points in the twenty-four miles between Big Black River rapids and those known as "Big Rapids," about four miles above the mouth of Little Black river, that give some trouble, and the worst of them could be submerged by the construction of several low roll dams, should future experience prove that the reservoirs recommended, and a reasonable amount of channel clearing are insufficient to easily and safely pass the logs over this section of the river.

At "Sinclair's Bar," just above the mouth of the Little Black river, is a wide, shallow stretch, about one and one-half miles long, which is said to be impossible to drive over on a low stage of water on account of insufficient depth of water to float the logs. It is suggested that wing dams be built here to restrict the channel. Also about 200 boulders should be removed along here in a distance of about two miles.

On the Big Black river, additional storage is recommended on Depot lake, and the construction of a dam on the deadwater, about six miles above the mouth. The latter dam would create a comparatively large reservoir, which would be used for maintaining a suitable driving stage in the main river between the mouth of this tributary and the mouth of the Allagash river. Another large reservoir would be obtained by a dam which should be built on Little Black river at "Johnson brook," about three miles above the mouth.

It is believed that the several dams which are recommended and the liberal use of dynamite to remove and level the worst of the boulders along the line will make the driving of the logs on the 75 miles of river known as the upper St. John safe and economical.

Allagash and St. Francis Rivers.

On the main river from the mouth of portunity exists for obtaining a large quantity of storage, sufficient not only for driving logs but for increasing the flow of the river.

This increase would be greatly to the benefit of any water power which may be developed. Dams should be built at the outlet of Eagle, Churchill, Long, Round, Musquacook lakes, of sufficient height for log driving purposes. These could be raised in the future to the highest limits when demanded by the water power conditions. There is a suitable site for a driving dam on the main Allagash stream at "Five Finger brook," if such a dam is found to be necessary, and a dam should be constructed at Allagash Falls, similar to the one on the St. John river at Seven Islands. This work with comparatively little blasting of boulders and points of ledge will make fine driving conditions for the whole length of this stream.

On the main river from the mouth of the Allagash to St. Francis, very little can be done except to blast boulders which now cause jams at low stages of water. About 300 of these should be removed in this twelve miles. The Allagash river and Little Black river reservoirs should be used for maintaining a sufficient driving stage in this section of the main river.

On the St. Francis there should be erected a dam at the foot of Boundary Lake, flowing Cross and Beau lakes. These would be used primarily for storage and for maintaining a driving stage on the main river, as they would not be drawn on very heavily for driving out of this stream.

St. Francis to Grand Falls.

Six miles below the St. Francis, at Little River flat, much trouble has been experienced from logs going ashore at high water, and involving considerable expense to return them to the channel. This can be remedied without great expense by the construction of a wing dam 300 feet long. Three miles below this is Hafford's Bar and rocks, where much trouble is caused by logs grounding on the gravel bar and rocks. It is called "The worst place between St. Francis and Fort Kent," but it seems that the proper attention to the placing of booms should correct almost all of this difficulty.

At "Chapel rocks" is another place where at high water many logs are thrown ashore behind an island on the Canadian side. This can be corrected by a short and inexpensive wing dam. At McCulloms rock and Canadian Island, Fish River Rapids, Baker Brook Island and Pine Island ledges similar difficulty is experienced on falling water, but it is believed that all these can be corrected by a suitable arrangement of piers and booms.

About the only place that gives much trouble between Fort Kent and Edmundston is Michaud's Flat and ledges, about 13 miles below Fort Kent. The flat being on the outside of the bend of the river it is hard to protect by a boom and it is doubtful if logs can be prevented from going ashore there at high water. But at Michaud's ledges about a mile below a judicious amount of blasting would prevent logs from collecting. Aside from these points no difficulty is experienced through to Grand Falls as is evidenced by the fact that one driving crew attends to this 13 miles of river.

Grand Falls.

At this point are located the only falls of any magnitude on the St. John river, and here are presented the most serious difficulties to log driving, of those existing anywhere along the river. These falls have a sheer drop of about 65 feet, and aside from other troubles, many of the logs are badly bruised and broken up by passing over them, and this loss is considerable every year. Much less difficulty of this nature is experienced at moderately high stages than at low stages.

About 300 feet above "the pitch" on the westerly shore of the river, a wing dam has been built with the object of guiding logs away from the rocks and the eddy below the "pitch," and keeping them in the main current of the river. This dam is too short and is too low at high water, to best accomplish its object, and many logs are caught at the westerly end of the falls, causing much trouble to extricate them after the water recedes.

After leaving the falls, and passing under the suspension bridge, the logs next encounter "Greenier's Eddy" at the first bend in the gorge.

Here is a small ledge island near the side of the gorge, and a wing dam of sufficient height and length should be constructed to sheer the logs away from it and to prevent them from catching on the ledges or becoming entangled in the eddy below.

About 700 feet below Greenier's eddy on the west side of the gorge is another eddy known as the "Coffee Mill," which is perhaps one of the worst features of the whole river, and in which many hundred thousand feet of lumber are sometimes entangled. Many of these become broken and most of them become grounded as the river recedes, making it very expensive to move and return them to the channel. In 1910 the contractor used a cable, erected across the gorge over this eddy, with which to pull them out. It seems practicable to build a low dam across this eddy, without too great cost, which would eliminate all this expense and trouble, but most important of all, it would materially hasten the drive.

One more point along here requires attention, the "Camel's Back," a small island about three-fourths of a mile below the "pitch," and just around the bend from the "Coffee Mill." A wing dam is needed here to prevent jams and to keep the logs moving along without interruption.

The very best means for avoiding all these difficulties at Grand Falls would be a long sluice of sufficient capacity, built along the sides of the gorge from the head of the falls to some point below the "Coffee Mill." This would be difficult to construct and expensive. No estimate has been made of the probable cost of such a sluice, as to determine that would require a very careful survey of the side-walls and surroundings of the gorge. From inspection, however, it seems perfectly feasible from the engineering standpoint, and likely to prove a good investment from a financial stanpoint, considering the large amount of lumber and driving expense that would be saved annually. It is believed that this feature should receive careful consideration as among the most beneficial improvements that can be made.

It would also be advisable in case a log sluice was proved to be too expensive, to consider the construction of a roll dam.

This dam could be located in some point in the civinity of the Camel's Back, which would raise the level of the river sufficiently to flow out the eddy at the "Coffee mill." This would have to be very high and it would be a great benefit, perhaps more effective, and perhaps be cheaper, than the dam siuggested for the "Coffee mill."

Grand Falls to Fredericton.

Continuing down the river from Grand Falls, it is found that for thirty-two miles but little is required in the shape of channel improvements. Some blasting should be done at White Rapids, Black Rapids, Sullivan's Rapids, and Tobique Rocks, all of which are now partially protected by booms.

The worst place on the river below Grand Falls is at "Muniac Rocks," a very rocky rapid, about two miles long and thirty-four miles from Grand Falls. It is so bad that drives have had to be abandoned at this point. But this appears to be primarily due to the fact that by the time the rear of the drive reaches this part of the river, the summer is usually well advanced and the water has fallen to a low stage. When a sufficient height of water prevails for comfortable driving in adjacent parts of the river, little difficulty is experienced at this point. No doubt some blasting could be done to advantage, but doubtless a somewhat larger flow of water than that which generally exists, must be used in order to easily float the logs past this part of the river. With the supply of water made available by the storage reservoir and the earlier date at which the rear should arrive in the lower portion of the river, it is believed that little difficulty need be experienced below Grand Falls.

Booms should be hung at Little River Rapids, Aroostook Bar, Presque Isle Bar, and at Grand Bar at Newburgh Junction. Much trouble seems to be experienced at the various bridges which span the river, the logs catching on the piers and forming dams. In some cases these dams must from a menace to the safety of the bridges but it is believed that with reasonable attention from the log drivers and a proper arrangement of shear booms, these troubles can be avoided.

General Improvements.

The general improvements suggested by the engineers are divided into three classes: Channel improvements, driving or flushing dams and reservoir dams. It is stated that the more the river channel can be improved the less reservoir development will be found necessary or the greater will be the reserve of watr for power purposes.

With the exception of a portion of about forty miles in length the presence of boulders which cause trouble for the drives is general. It is not practicable to remove enough of these boulders to make driving entirely easy and safe but a large amount of such work should be done to reduce the amount of storage water necessary for driving purposes.

The chief improvements will consist of storing as great a portion of the spring floods as possible thereby reducing the height of the freshet stage and forming a reserve to be used when dry weather comes as it usually comes every summer.

Taking into consideration the matters of economy and return on investments required, the engineers suggest that instead of undertaking at once all of the improvements which have been suggested the most feasible way is to extend them over a series of years, doing that part of the work first that would appear to produce the greatest effect and halting the work when that stage of improvement has been reached, beyond which expenditures do not seem to be justified by the results to be obtained therefrom.

All of the channel improvements suggested should be undertaken and carried through as promptly as circumstances will permit.

The reservoirs and driving dams suggested for the Upper St. John and Big and Little Black rivers are necessary to insure safe driving.

The storage reservoirs which can be developed on the St. John river are much greater in capacity than that required for long driving alone. Until there are some water power requirements on the river a complete development of these reservoirs to their utmost capacity would not be justified.

The engineers recommended that sufficient reservoir capacity be developed at an early date to meet the requirements of the long drive.

When the suggested improvements are carried out to something like completeness the last of the drive will arrive at the lower section of the river at a considerably earlier date than is now the case, and there will be ample water in reserve to raise the level of the river enough to enable the rear driving crew to easily and quickly remove the logs as they work down the river and to arrive at Fredericton with a "clean rear" in midsummer.

It is not a large quantity of water that is best for driving logs but as steady and uniform flow a spossible throughout the entire driving season. Absolute uniformity of flow cannot be attained on the St. John river, as there are opportunities for storing only a limited proportion of the spring freshet. By the construction of the reservoir dams recommended the freshets will be materially reduced in height and on some of the branches will be nearly eliminated, thus reducing the expense and delay now experienced by returning to the water logs that have stranded at the height of the flood.

The engineers believe that it will be desirable for the best and most economical handling of the water if one corporation could be made responsible for driving the logs through the whole length of the river as far up as Seven Islands at least. It has been stated that no corporation or individual would care to contract for driving the logs in the upper St. John under the present conditions. Those conditions would be so relieved by these improvements that a practical river man would not hesitate to resume the responsibility of handling the logs in the upper section of the river.

As a result of the investigation the engineers have decided that there will be necessary for log driving purposes a flow of 4,500 second feet at Fort Kent during the month of June and of 8,000 second feet at Grand Falls during the month of July. It is believed that it will rarely or never be necessary to use stored water for log driving during the month of June. During the past eleven years it would have been necessary for eight out of the eleven to release stored water in July.

The maximum amount required was in the year 1903 and amounted to 14,000 second feet for the month, which corresponded to a quantity of storage of 10,500,000,000 cubic feet. This is about 15 per cent of the quantity of water that can be stored on the tributaries of the St. John if the storage above Chamberlain lake is included. If it is not included, the maximum requirements for log driving would be about 18 per cent of the total storage.

Considering only the amount of storage that can be obtained by limiting it to present high water marks in the various lakes, the maximum requirement for log driving would be about 32 per cent, including Chamberlain lake, and 40 per cent without Chamberlain lake.

The average quantity of water required for log driving as shown by estimates covering the last eleven years, is about 5,000 million cubic feet or seven per cent of the total possible storage (including Chamberlain lake) and about 15 per cent of the storage available to present high water levels.

It is thus seen that in the ordinary year the amount of stored water required for log driving will be small in amount. In a dry year about one-third of the storage to present high water levels would be required for log driving or about one-sixth of the total possible storage.

The engineers include in the report a table which shows the maximum amount of storage capacity proposed.

It is noted that in the ordinary year there is sufficient spring run-off to fill all the reservoirs with the exception of those on the Allagash river at and above the outlet of Chamberlain lake.

Around the shores of the natural lakes most of the merchantable lumber has been removed, and much of the growth which is left is of a comparatively worthless nature at the present time. In some cases the shores have been burned and are now growing up to a poplar growth so that for the most of the reservoirs, at least, the stored water would be a far more valuable consideration than any damage that would be done to growing timber by raising the water.

In the case of the new reservoirs proposed at Seven Islands and on Big Black and Little Black rivers, where almost their entire area to be flooded is now covered with cedar and all the swamps, comparatively little damage will result.

In only a few cases will extensive damages be caused to buildings, agricultural land and other property. At Eagle lake where the most apparent damage would occur, the low flats around the village of Wallagrass would be flooded, and the mill at the village at Eagle lake. Also for some distance the Bangor & Aroostook railroad tracks would be submerged and their alignment would have to be changed further up the westerly shore. Some damage would also result to a few cultivated fields along the westerly shore. In all of these cases probably the value of the impounded water will more than offset the resulting damages after power developments makes the maximum possible storage necessary or desirable.

Possibilities for Water Power Development.

While the St. John river is one of the large streams of the country and the upper part of its drainage basin is at a comparatively high evelation above sea level, the fall is with few exceptions comparatively uniform and the opportunities for economical water power development are therefore few. Similarly, on the tributaries of the St. John the opportunities for water power development are comparatively few, although in general more numerous than on the main river. The best power sites are found on the Allagash and Fish rivers, where the opportunities for storage are also exceptionally good, as previously shown.

Upper St. John River.

Above the mouth of the Allagash river the slope of the St. John is fairly uniform, averaging about five or six feet to the mile, the only exception to this being found about two miles above the mouth of the Little Black river, where in a distance of two miles, there is a fall of about thirty-six feet. The opportunities for storage on the upper St. John are comparatively few and such storage as can be obtained will be required largely for log driving purposes. The available water power on the upper St. John is, therefore, of little consequence, at least considering the present undeveloped state of that territory.

Allagash River.

In the seventy-seven miles below the outlet of Chamberlain lake, the Allagash river falls about 360 feet. Between Churchill and Long lakes, a distance of about six miles, there is a fall of about 100 feet. Between Long lake and Round pond, a distance of about ten miles, there is a fall of about forty feet. The remainder of the river below Round pond in general has a slope of about four feet to the mile, except in the vicinity of Allagash Falls, about fourteen miles above the mouth of the river, where there is a concentrated fall of about forty feet.

With the excellent storage facilities exist on the Allagash river it has some good opportunities for water power developing, probably the best to be found on any of the tributaries of the St. John river.

Fish River.

The greater portion of the fall of the Fish river occurs in the twelve miles above its mouth or below Eagle lake.

From the outlet of Eagle lake there is a total fall at present of about eighty feet.

At Big Fish falls, five miles from the mouth of the river, there is a concentrated fall of about fifteen feet, which can be increased by means of a dam to about forty feet.

With the large amount of storage available on Fish river these power sites are of considerable value as it is possible to obtain a very uniform flow of water, and therefore a comparatively large amount of dependable water.

St. Francis and Madawaska Rivers

No opportunities for very large power developments are found upon these two rivers. One fairly good site occurs that at Murchie's dam, near the mouth of the Madawaska, where a twelve-foot development already exists. On the other hand there are good storage facilities, which, if developed, will result in a very uniform flow of these rivers. So that eventually it may be worth while to make low head development at one or two points.

From the Allagash river to the tide water above Fredericton, a distance of about 223 miles, there is a total fall of about 580 feet. With one important exception, namely at Grand Falls, about eighty-six miles below the Allagash, the fall of the river is fairly uniform, and no power sites are found. The average fall in this lower portion of the river (not including Grand Falls) is about two feet per mile. At Grand Falls, occurs a concentrated fall of about sixty-five feet, and a total fall of about 120 feet in a distance of about a mile. Grand Falls is practically the only water power site of magnitude on the St. John river, and the power development there has been under consideration for a number of years.

Tables showing the characteristics of the flow of the St. John river and its tributaries obtained from stations along teh river are given by the engineers. Average yearly flow of the St. John river at Fort Kent bases on records for ten years it about 7,300 second feet or 1.60 second feet per square mile of drainage area. This corresponds to a depth of about twenty-two inches over the entire drainage area. Statistics which show the relative yield of the St. John and its tributaries are given also statistics showing water available for power after meeting requirements for log driving.

A study of the tables given by the engineers show that after allowing for the use of water for log driving if the storage available at present is properly handled the minimum dependable flow on tributaries where storage is available, or at Grand Falls, can be very materially increased. Thus, if present storage be operated for best results at Grand Falls a minimum discharge of about 2,760 second feet could be obtained at that point, whereas under existing conditions without care and use of stored water the discharge has probably been as low as 1,000 second feet.

A complete development of storage, properly handled for best results at Grand Falls would give a minimum flow of about 4,080 second feet (not including Chamberlain Lake Drainage) which would correspond to about 40,000 h. p. (on wheel shaft—24 hr. 365 days) for the head of 115 feet at Grand Falls.

In the ordinary year with complete storage development there will be not less than about 60,000 h. p. at Grand Falls. With complete development of storage there would still be sufficient water to nearly always fill the reservoirs during April and May of each year, but there would be considerable decrease in the amount of water held in storage.

The engineers have prepared tables which give the estimated maximum flow which can be sustained on the principal tributaries no water being used for log driving.

Cost of Improvements.

Having the surveys and reconnaissance of the locations as a basis detailed estimates have been prepared of the cost of all the important dams referred to in the report. For each, estimates shows the cost of the structure designed to hold the basin above not only to its present high water level, but also to the highest practicable level that the topography of the outlet and the limiting flood contour of the basin will permit.

Two designs were estimated for each sight, one for the control of the storage for the present high water level and the other to the highest practicable level. Descriptions of these dams are given. Dams are suggested for 26 lakes.

The cost of dams to store water to proposed high water level would be $1,273,576; to present high water levels $471,510.

Channel Improvements.

No attempt has been made to estimate the cost of various channel improvements which have been outlined in this report. The very nature of the work involved in making such improvements is such that no reliable estimate of the cost could possibly be made without an enormous amount of time and expense being devoted to it. The question of deciding just what channel improvements to make and at what points, is one which will not permit of precise solution. This is another reason why it would be impracticable to make or attempt to make detailed estimates of cost.

As has been previously stated, a practical way of carrying out these improvements would be to distribute the work over a series of years, undertaking at first, those parts of the work which promise to give the greatest and quickest results, and after determining their effect, deciding what shall be done next.

Surveys have been made at certain dam sites along the river below Seven Islands, which would be used for flushing the logs or flowing out difficult places to drive. The river has been examined and inspected for its entire length for the purpose of outlining the improvements which appear to be necessary or desirable, and this is as far as the engineers felt justified in going into the matter for the report.

It is said that for the purpose of making various channel improvements which have been suggested from $10,000 to $15,000 per year for a series could be expended to advantage. What the final aggregate of such expenditures would amount to cannot be foretold. It is probable that from $200,000 to $300,000 could be expended for these purposes. Although with ample amount of storage, capacity, it may be that reasonably ideal conditions would be secured in the various channels for a much less amount.

Appended to the report is a long list of the lakes to be reservoired and a brief description of the physical features surrounding the shores and outlets of the various storage sites. It gives the chracter of the shores, the nature of the timber surrounding the lakes and the general chracter of the dam sites.

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