



STEAM
ON THE
CANALS.

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STEAM ON THE CANALS.

THIRD ANNUAL

Report of the Commission

Appointed by Chapter 868, Laws of 1871.

TRANSMITTED TO THE LEGISLATURE FEBRUARY 20, 1874.

ALBANY:
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1874.

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STATE OF NEW YORK.

COMMISSION APPOINTED BY CHAPTER 868, LAWS OF 1871

GEORGE B. McCLELLAN,
DAVID DOWS,
VAN R. RICHMOND,
GEORGE W. CHAPMAN,
JOHN D. FAY,

ERASTUS S. PROSSER,
GEORGE GEDDES,
WILLIS S. NELSON,
WILLIAM W. WRIGHT,
DANIEL CROUSE.

VAN R. RICHMOND, *Chairman.*

DAVID M. GREENE, *Engineer*, Troy, N. Y.

HENRY A. PETRIE, *Secretary*, Albany, N. Y.

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STATE OF NEW YORK.

No. 65.

IN ASSEMBLY,

February 20, 1874.

REPORT

OF THE COMMISSION APPOINTED BY CHAPTER 868, LAWS OF 1871, ENTITLED "AN ACT TO FOSTER AND DEVELOP THE INTERNAL COMMERCE OF THE STATE, BY INVITING AND REWARDING THE PRACTICAL AND PROFITABLE INTRODUCTION UPON THE CANALS, OF STEAM, CALORIC, ELECTRICITY, OR ANY MOTOR OTHER THAN ANIMAL POWER, FOR THE PROPULSION OF BOATS," FOR THE YEAR 1873.

ALBANY, *February 20, 1874.*

HON. JAMES W. HUSTED,

Speaker of the Assembly:

SIR—I have the honor to transmit herewith the report of the commission appointed by chapter 868, Laws of 1871, entitled "An act to foster and develop the internal commerce of the state, by inviting and rewarding the practical and profitable introduction upon the canals, of steam, caloric, electricity, or any motor other than animal power, for the propulsion of boats," for the year 1873.

Yours, very respectfully,

VAN R. RICHMOND,
Chairman.

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REPORT.

ALBANY, *February 19, 1874.*

To the Legislature of the State of New York :

The commission appointed by chapter 868, Laws of 1871, entitled "An act to foster and develop the internal commerce of the state, by inviting and rewarding the practical and profitable introduction upon the canals, of steam, caloric, electricity, or any motor other than animal power, for the propulsion of boats," and which was directed therein to practically examine and test all inventions and devices which might be submitted to it for that purpose, respectfully report :

That, during the past season of navigation, much time and attention have been given to the matters submitted to its charge.

That, pursuant to the second requirement of section 1, that a test or trial exhibition of the competing boats, under the rules and regulations now governing the boats navigating the canals, was held, after public notice, on the 15th and 16th of October, 1873, between Syracuse and Utica.

That the results attained by this test or trial are fully set forth in the report of David M. Greene, Esq., engineer of this commission, to which reference is made.

His report gives in detail the important facts that have been established, his estimate of the comparative cost of different methods of propulsion, and the conclusions to which he has arrived.

This commission submits his valuable report herewith, with an expression of confidence in the accuracy of his statement of facts, as far as they came under his personal observation, and the care and ability with which he has compiled and reported the information obtained.

For the government of this commission the law provides that it shall "reject all inventions or devices if in their opinion none of said inventions or devices shall fully and satisfactorily meet the

requirements of this act," and the commission is directed to demand and require:

First. The inventions or devices to be tested and tried at the cost of the parties offering them.

Second. That the boat shall, in addition to the weight of machinery and fuel reasonably necessary for the propulsion of said boat, be enabled to transport and shall actually transport on the Erie canal, *on a test or trial exhibition*, under the rules and regulations now governing the boats navigating the canals, *at least two hundred tons of cargo.*

Third. That the rate of speed made by said boat *shall not be less than an average of three miles per hour*, without injury to the canals or their structures.

Fourth. That the boat can be readily and easily stopped or backed by the use and power of its own machinery.

Fifth. That the simplicity, economy and durability of the invention or device must be elements of its worth and usefulness.

Sixth. That the invention, device or improvement can be readily adapted to the present canal-boats; and,

Lastly. That the commissioners *shall be fully satisfied* that the invention or device will lessen the cost of canal transportation and increase the capacity of the canals.

And in the third section the further condition is made: "If the commissioners shall, upon such examination and test, as is provided for in the first section, *conclude and determine*, at any time, that one or more inventions or devices as aforesaid, but not exceeding three in number, *shall be in all respects a full and satisfactory, practicable and profitable adaptation* to the wants of the canals by reason of a new, useful and economical means of propulsion for boats, within the meaning of this act," the commissioners shall grant certificates to the owners in manner further provided by the law.

At a meeting of the commissioners, held at Albany on the 17th of February, 1874, after reading and considering the report of Mr. Greene, and hearing the arguments of the owners of the boats "William Baxter" and "William Newman," the opinion of the attorney-general was procured as to the construction to be placed upon certain portions of the law, by the following correspondence:

ALBANY, *February 18, 1874.*

HON. DANIEL PRATT, *Attorney-General:*

DEAR SIR — The commission appointed by chapter 868, Laws of 1871, to test and examine inventions or devices by which any motor

other than animal power can be practically and profitably used for the propulsion of boats upon the canals, respectfully ask for your opinion upon the following questions arising under the act above named :

First. Does the law contemplate that the models of the boats used for the trial or test of inventions or devices should in all respects conform to the form of boats now in general use upon the canals of this state ?

Second. Is it necessary, under the sixth requirement of section 1, that, in addition to the test or trial exhibition of inventions or devices provided for by the law, evidence should have been given to satisfy the commission that the devices used to propel the boats exhibited could be "readily adapted to the present canal-boats;" and that, when so adapted, would propel such boats at the rate of three miles per hour, carrying 200 tons of cargo, and lessen the cost of canal transportation as now carried on by animal power, and increase the capacity of the canals ?

Third. Can the performance of boats subsequent to the test or trial exhibition appointed and held by the commission in October, 1873, which were made after a change of propeller, and not under the personal supervision of the commission, but which were inspected and reported on by the engineer of the commission, and are claimed by the owner to supply the deficiencies shown by such boats at the said trial, be considered by the commission in its final determination ?

Yours, very respectfully,

VAN R. RICHMOND,

Chairman.

OFFICE OF THE ATTORNEY-GENERAL, }
ALBANY, February 18, 1874. }

HON. VAN R. RICHMOND, *Chairman :*

In answer to the questions propounded by the commission appointed by chapter 868, Laws of 1871, of which you are chairman, the attorney-general begs leave to state :

First. In answer to your first interrogatory, he would state that, in his opinion, the act does not require the models of the boats used for the trial or test of the inventions to conform in all respects to the form of the canal-boats now in general use upon the canals of the state. They should, undoubtedly, so far conform to the model of the present canal-boats as to enable the commissioners to form a

satisfactory opinion upon the question whether the "invention, device or improvement" can be readily adapted to those boats. But it should not be assumed that the design of the act was to effect simply some improvement in the motive power only, precluding any and all efforts to improve the models of the boat or craft to be used. Indeed, the provisions of the act requiring the contemplated improvement to be readily adapted to the present boats, assumed that the models to be used upon the test trials may be different in form from those boats.

Second. In answer to the second interrogatory, the opinion of the attorney-general is that the commissioners, either from personal inspection or test, or by evidence, should be satisfied that the "invention, device or improvement" can be readily adapted to the canal-boats now in general use, so that they may, with the improvement, fulfill the requirements of the act in regard to speed, tonnage and economy in motive power. This provision is somewhat obscure in its meaning, but, upon a careful examination of the entire act, it is thought by the attorney-general that the above is its proper construction.

Third. In answer to the third interrogatory, it is the opinion of the attorney-general that the test or trial exhibition should be public, and open to all competitors. Having competed at the public exhibition, it would not be fair to others to allow one competitor to change his machinery and to claim that, on a private trial, he excelled his other competitors. Such private trial would not answer the requirements of the act, and should not be considered by the commissioners in making their final determination.

All of which is respectfully submitted,

DANIEL PRATT,
Attorney-General.

After a further examination of the record of the competing boats, and of the conditions and requirements of the law, it was finally determined by a majority of the commission that no award or certificate be made to any competitor.

The commission then adopted the following resolutions by the unanimous vote of all the members present:

Resolved, That in the opinion of this commission, after all the tests and trials made, the inventions, devices and arrangement of machinery of the boat William Baxter are the best adapted to fulfill the objects sought to be secured by the law.

Resolved, That the inventions, devices and arrangement of the machinery of the boat William Newman have given highly satisfactory results, and possess, in the judgment of this commission, very great merit.

Resolved, That doubts having arisen as to the meaning of some of the provisions of the law under which this commission is acting, and differences of opinion existing among its members as to its powers and duties, growing out of the complex and stringent conditions to be fulfilled by competitors, it is believed that the object of the law will be better attained by the legislature dealing directly with the subject than by continuing the powers of this commission beyond the time now limited by law.

Resolved, That this commission respectfully recommends that the legislature shall enact a law that shall do justice to those competitors who have so nearly met the requirements of the law of 1871, in spite of the stringency of its provisions, and have spent much time and money in the introduction of the steam for the propulsion of canal-boats, and have, by their boats in actual use, shown the value to the state of their improvements; and to that end the commission, following the general drift and intention of the law, respectfully submits the following draft of a law, that in its opinion will be just and equitable to certain competitors therein named, and will best fulfill the honorable obligations assumed by the state in its effort to foster and develop its internal commerce by inviting and rewarding the introduction of steam or any motor other than animal power for the propulsion of boats upon the canals:

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

SECTION 1. The comptroller shall pay William Baxter, or his legal representatives, upon the presentation of the certificate of the state engineer and surveyor that said William Baxter has placed, during the season of navigation of 1874, upon the canals of this state, seven steamboats fully equipped, and being in all respects equal in power and capacity to the steam canal-boat "City of New York," to fulfill the requirements and conditions of chapter 868 of the Laws of 1871, the sum of \$35,000; and the comptroller shall in like manner, upon the certificate of the state engineer and surveyor, pay to David P. Dobbins, or his legal representatives, whenever he shall, within the season of navigation of 1874, have placed upon the canals of this state three steamboats, each fully equipped, and being in all respects fully equal in power and capacity to fulfill the requirements and conditions of chapter 868 of the Laws of 1871, to the steam canal-boat "William Newman," the sum of \$15,000.

Resolved, That the foregoing report and resolutions, together with the report of the engineer, be transmitted to the legislature by the chairman of this commission.

Dated ALBANY, *February* 19, 1874.

Respectfully submitted,

VAN R. RICHMOND,
GEORGE GEDDES,
DAVID DOWS,
WILLIS S. NELSON,
GEORGE W. CHAPMAN,
WILLIAM W. WRIGHT,
JOHN D. FAY,
DANIEL CROUSE,

Commissioners appointed by chapter 868, Laws of 1871.

THIRD ANNUAL REPORT

OF THE

ENGINEER OF COMMISSION APPOINTED BY ACT CHAPTER 868,
LAWS OF 1871, FOR THE YEAR 1873.

HON. VAN R. RICHMOND, *Chairman* :

SIR—I have the honor to report the results of the performances of the several competitors for the prize offered by the state of New York for the successful and economical introduction of “steam, caloric, electricity, or any other motor than animal power,” upon the canals of the state, so far as my attention has been called to such competitors, for the season of 1873.

The commission will doubtless desire to be advised specially as to whether those boats which entered into competition last year, and whose performances were reported at the close of the season of 1872, have continued in operation during the past season, and as to what extent they have succeeded in meeting the requirements of the law.

The operations of these boats are therefore presented in the order in which they were reported last year.

I. THE “A. H. H. DAWSON.”

No detailed statement of the performances of the “Dawson,” for the season of 1873, has been furnished. I understand, however, that she ran during the season, up to the 10th of October, and that she was principally employed in the transportation of coal from Watkins, on Seneca lake, to points on the Erie canal.

Mr. Main, one of the owners of the “Dawson,” informs me that his boat left Watkins at 10 A. M. on the 10th of October, laden with coal, and that, at 5 P. M. on the same day, just after passing the locks at Waterloo, she struck a rock in the bottom of the canal, or river, and stove a hole in her forward port bilge, from the effects of which she soon after sank.

After being raised, the "Dawson" was laid up at Waterloo for the winter, in good order, except that two of the blades of her propeller wheel have been carried away, and that the two blades remaining are patched.

Mr. Main calls attention to the fact that, with only two blades upon her propeller, the "Dawson" made the run from Watkins to Waterloo in seven hours.

I was not advised of the movements of this boat during the season of navigation, and hence can report nothing as the result of personal examination or observation.

Exception having been taken, by the owners of the "Dawson," to the estimates of the power developed by her machinery, as given in my reports for 1871 and 1872, it is deemed proper, in this connection, to say, in explanation of those estimates, that the first, of twenty-two horses, was based upon the coal consumption as reported by Mr. Main, together with my estimate of the probable rate of consumption per horse power per hour, for machinery similar to that of the boat in question. The steam pressure, size of cylinder, point of cut-off and revolutions were not used in the estimate, which was only intended as a moderately close approximation to the truth.

The second estimate, of 38.6 horses power, given in my report for 1872, was based upon all the elements necessary to be considered in a tolerably accurate estimate of the average power developed during the time covered by the observations, and was made precisely as were those of all the competing boats except the "Baxter," whose compound condensing engine required different treatment. I am aware that, on account of the throttling of the steam, the actual power may have been less than 38.6 horses; but the precise effect of throttling being, under the circumstances, indeterminate, it was neglected in every case.

It is presumed that the performances of the "Dawson" during the past season have not exceeded those of the season of 1872, reported last year, and upon which, under the circumstances, her merits must be judged.

II. THE "WILLIAM NEWMAN."

This steamer has been running during the entire season. Prior to September 9th she was in the same condition, as to hull, machinery and screw, that she was in at the close of the season of 1872. Like the "Dawson," she was principally employed in the transportation of coal from Watkins to points on the Erie canal, except during the

early part of the season, when she was employed in transporting wheat and flour on the western division of the canal.

She is represented as having made a fair profit for her owner, and for the parties to whom she was chartered during a part of the season.

On the 9th of September Captain D. P. Dobbins, of Buffalo, became interested in the Newman, and at once commenced various changes in her machinery, preparatory to the trial, then announced for the 14th of October, to be had between Syracuse and Utica.

The changes made by Captain Dobbins consisted in the following:

1. Clothing the boiler with a non-conducting material.
2. Adding to the heating surface in the fire-box, by attaching a series of hollow cast-iron spheres to the crown-sheet.
3. Attaching an adjustable cut-off device to the cylinder.
4. Substituting a Hubbard hydraulic propeller for the original screw.

The result of these changes was a very decided increase in the Newman's speed, as shown by a comparison of her performances during the season of 1872 and during the trial referred to. (See accompanying report of trial between Syracuse and Utica.)

During the trial, however, it was discovered that the Hubbard propeller was not only too small, but that its tendency to gather up rubbish from the bottom of the canal, and the reduction in speed, due to accumulations in the wheel, were so great as to clearly indicate its unsuitableness for canal purposes. Accordingly, Captain Dobbins decided, after the conclusion of the trial, to remove the Hubbard wheel and to substitute in its place a screw, which he placed about sixteen inches further astern than the original screw had been placed. The result of this last change has been a most gratifying improvement in the performance of the Newman, as will be seen by reference to the report of the trial.

The Newman continued to run, without further material change, until the close of navigation, when she was laid up for the winter, at Buffalo. Both the hull and the machinery of this boat are in excellent condition, and are quite ready for the business of the season of 1874.

Captain Dobbins, who is a gentleman of large experience in steam navigation on the lakes, after his experience of the past season, declares "that the Newman can *certainly* make fifteen round trips the season," and "can make a fair profit in carrying wheat from Buffalo to New York at the extremely low rate of seven cents per bushel," including tolls and all other expenses.

Comparing the results of the Newman, for the years 1872 and

1873, we find, that her average speed has been increased from 2.72 miles per hour, in 1872, to over 4 miles per hour, in 1873; and that her coal consumption has been reduced from 65.2 pounds per mile, in 1872, to 35 pounds per mile, in 1873.

The extent of the improvement may be otherwise stated, thus :

Increase in speed,

$$\begin{aligned} 4.24 - 2.72 &= 1.52 \text{ m. p. h.} \\ &= 54 \text{ per cent.} \end{aligned}$$

Increase in distance made with the hourly consumption of coal, of 1872,

$$\begin{aligned} 5.00 - 2.72 &= 2.28 \text{ m. p. h.} \\ &= 84 \text{ per cent.} \end{aligned}$$

Reduction in coal consumption per mile,

$$\begin{aligned} 65.2 - 35. &= 30.2 \text{ pounds.} \\ &= 46 \text{ per cent.} \end{aligned}$$

These results are specially gratifying, not only as showing that the speed of 3 miles per hour can be maintained, but as indicating that still further and important improvements in the economy of the motive power may be reasonably anticipated in the not remote future.

III. THE "WILLIAM BAXTER."

The "Baxter" has been running during the entire season — except while laid up for the purpose of receiving a new and larger boiler. No other change of importance has been made in the machinery of this boat, which has maintained her speed of last year, and has reduced her coal consumption from 31 pounds per mile to less than 20 pounds per mile, say 35 per cent.

Improvements of the magnitude of those effected in the case of the Newman were not to be expected, for the reason that the original design and proportions of the Baxter's hull and machinery were more nearly perfect than were those of the Newman.

For details of the Baxter's performances during the season of 1873 — so far as needed for present purposes — reference is made to the report of the Syracuse trial, already referred to :

After the close of navigation upon the Erie canal, the "Baxter" was loaded in New York, and dispatched to Baltimore, via the Delaware and Raritan canal, Delaware river, Chesapeake and Delaware canal, and Chesapeake bay. From New York to Philadelphia, the coal consumption was 1,900 pounds, or about 16 pounds per mile

From Baltimore, the *Baxter* proceeded to Fredericksburg, Va., and returned thence to Baltimore, where she was lying on the 30th of December, and whence her captain addressed a letter to Mr. Baxter, of which the following is a copy :

BALTIMORE, *December 30, 1873.*

WILLIAM BAXTER, Esq. :

DEAR SIR — The steam propeller, "William Baxter," is not only a good canal-boat, but is also a good coasting vessel. We arrived here from Fredericksburg on Saturday last, with a load, consisting of 300 barrels of flour, 1,060 bags of sumac and 706 bundles of hoops. We came up the bay against a heavy north-west wind, making a speed of about five miles per hour. We were caught off Annapolis, on Friday, in the same storm which sunk the *Virginus*, and, notwithstanding we had a heavy deck load, she faced the storm handsomely.

The sea ran very high, and schooners and large tug-boats were dancing about and trying all they could to get into some harbor. The wind blew so hard that it was impossible to stand on deck; but, nevertheless, we kept her straight on her course, and arrived here without any difficulty. A heavy sea did not strain the boat in the least. She stood through the storm as firm as if sailing on a mill-pond.

I now feel that she is a perfectly seaworthy boat, and capable of taking care of herself on the Atlantic, under all ordinary circumstances.

The boat is the favorite here, and everybody wants us to keep her on this route. There is freight enough for all winter, and we can have all the work we want.

Respectfully yours,

(Signed)

JAS. A. BAKER,

Capt. Str. "Baxter."

The *Baxter* was sent south, partly for the purpose of securing employment for the winter months, but particularly for the purpose of testing her capacity to operate upon open and deep water, and to withstand the strains incident to the navigation of waters subject to very considerable disturbance during the prevalence of heavy gales.

The experience thus far gained in this direction appears to have been in the highest degree satisfactory, and seems to indicate the entire seaworthiness of the boat under all ordinary circumstances. Attention is especially called to Captain Baker's letter, inasmuch as the question has been often raised that the build of the *Baxter*

is not such as to insure the stiffness and strength requisite for the safe navigation of the more exposed and dangerous portions of the Hudson river, between Troy and New York.

IV. THE "CHARLES HEMJE."

The "Hemje" has not been heard from, on the Erie canal, during the season of 1873. It is understood, however, that she has been south from New York, on the inland line to Baltimore. I have not seen her, nor have I received any report or statement of her performance since she left the canals of this state.

V. THE "FOUNTAIN CITY."

This boat has not been heard from since the close of navigation, in November, 1872. She, as well as the Hemje, must be judged, if judged at all, by her performance last year.

VI. THE "PORT BYRON."

The Port Byron, now owned by Mr. Peter Cooper, of New York, has been running a portion of the season at least; but my attention has not been called to her in such a manner that I could give personal attention to her operations; nor has any statement been made to me, either by her owner or her captain, which will enable me to present a detailed report of her general performance for the season.

A detailed report of her performance between Syracuse and Utica, during the October trial, will be found in the report of that trial.

VII. THE "EXCELSIOR."

This boat has never re-appeared upon the canal, since her return to New York, after the disaster which befell her, above Crescent, on the 5th of September, 1872.

VIII. THE "EUREKA."

I have received no information in regard to this boat since 1872, and can therefore give no facts in relation to her movements during the season of 1873.

IX. THE "CENTRAL CITY."

This boat has been running during a part of the past season, at least. She participated in the trial between Syracuse and Utica, in the report of which a detailed statement of her performance will be found.

Aside from the trial trip, the owner of the Central City informs me, under date of January 12, 1874 :

“The steamer has made two trips from Albany to Syracuse without any load ; one trip from Albany to Buffalo with 70 tons ; one trip from Syracuse to Buffalo with 129 tons ; one trip from Syracuse to Albany with 170 tons, and two trips from Buffalo to Albany and New York with 198 and 200 tons, respectively, working equally well with either load.”

The trip east from Utica, after the completion of the trial, appears to have been made as follows :

	Days.	Hours.	Min.
Total time from Utica to West Troy	2	8	38
		Hours.	Min.
Detentions claimed		18	43
Lockages		6	15
		<hr/>	
	1	0	58
Running time.....	1	7	40
		<hr/>	
		<hr/>	

Distance, 110 miles.

	Miles per hour.
Average speed, less detentions	3.47
Average speed, less lockages.....	2.18
Average speed, less detentions other than lockages.....	2.94
	<hr/>
	<hr/>

Coal consumption, not stated.

Subsequently, the Central City made a trip from Syracuse to Buffalo with a cargo of 120 tons salt, and 9 tons coal.

From Syracuse to Rochester, the time was as follows :

	Days.	Hours.	Min.
Total time.....	1	23	00
		Hours.	Min.
Detentions claimed		12	5
Lockages		2	22
		<hr/>	
		14	27
Running time.....	1	8	33
		<hr/>	
		<hr/>	

Distance, 93 miles.

	Miles per hour.
Average speed, less detentions.....	2.86
Average speed, less lockages.....	2.08
Average speed, less detentions other than lockages.....	2.66
	<hr/>
	<hr/>

Coal consumption, not stated.

STEAM ON THE CANALS.

From Rochester to Buffalo, no statement as to time is given, the movement of the boat having been seriously interrupted by high winds.

On the 8th of November the Central City left Buffalo for New York with a cargo of 6,600 bushels of wheat, and during the run gave the following results:

Buffalo to Rochester.

	Days.	Hours.	Min.
Total time.....	1	9	25
		Hours.	Min.
Detentions claimed		9	29
Lockages .....		..	50
		<hr/>	<hr/>
	..	10	19
		<hr/>	<hr/>
Running time.....	..	23	6
Distance, 93 miles.		<hr/>	<hr/>
			Miles per hour.
Average speed, less detentions.....			4.02
Average speed, less lockages.....			2.85
Average speed, less detentions other than lockages			3.88

Rochester to Syracuse.

	Days.	Hours.	Min.
Total time.....	2	23	
	Days.	Hours.	Min.
Detentions claimed	1	4	47
Lockages .....	..	2	22
		<hr/>	<hr/>
	1	7	9
		<hr/>	<hr/>
Running time.....	1	15	51
Distance, 93 miles.		<hr/>	<hr/>
			Miles per hour.
Average speed, less detentions.....			2.33
Average speed, less lockages.....			1.35
Average speed, less detentions other than lockages			2.20

Syracuse to Utica.

	Days.	Hours.	Min.
Total time.....	2	21	30
	Days.	Hours.	Min.
Detentions claimed.....	2	00	27
Lockages .....	..	..	33
		<hr/>	<hr/>
	2	1	..
		<hr/>	<hr/>
Running time.....	..	20	30
Distance, 56 miles.		<hr/>	<hr/>

	Miles per hour.
Average speed, less detentions.....	2.73
Average speed, less lockages.....	0.81
Average speed, less detentions other than lockages.....	2.66

Utica to head of Sixteen Locks at Cohoes.

	Days.	Hours.	Min.
Total time.....	2	19	30
	Days.	Hours.	Min.
Detentions claimed.....	1	7	21
Lockages.....	..	3	45
	1	11	26
Running time.....	1	8	04
Distance, 99 miles.			

	Miles per hour
Average speed, less detentions.....	3.09
Average speed, less lockages.....	1.55
Average speed, less detentions other than lockages.....	2.73

Buffalo to Cohoes.

	Days.	Hours.	Min.
Total time.....	10	1	08
	Days.	Hours.	Min.
Detentions claimed.....	4	21	44
Lockages.....	..	7	30
	5	5	14
Running time.....	4	19	54
Distance, 341 miles.			

	Miles per hour.
Average speed, less detentions.....	2.94
Average speed, less lockages.....	1.03
Average speed, less detentions other than lockages.....	1.95

The record of this trip stops at Cohoes, for the reason that the Central City arrived at that point on the morning of the 18th of November, and was detained there four days by snow and ice.

It appears from the foregoing, that, allowing all detentions claimed together with the usual allowance for lockage, the Central City is not able to make an average speed of three miles per hour through the canal.

XI. THE "MONTANA."

This boat, now owned by Mr. Peter Cooper, of New York, has made several trips during the past season, but no statement of her

performance has been furnished, nor has my attention been called to her while on the canal.

As the owner of the *Montana* did not enter her for the Syracuse trial, it is assumed that her performance was not satisfactory, even to those who were interested in her.

NEW BOATS.

I. THE "C. C. POPE."

My attention was first called to this boat on the 8th of September, when I found her in the dry-dock at West Troy, undergoing repairs.

The Pope participated in the Syracuse trial, in the report of which will be found a description, in detail, of the boat, and a full statement of her performance during the trial.

Full information has not been furnished, in regard to the season's work of the Pope. My impression however is, that she has not made three round trips, as required by resolution of the commission. The design of the Pope's machinery is such, that it can be applied to any ordinary horse-boat, without changing its model, and also that nearly the full immersion of the propeller may be secured, at all draughts of water; but there is room for grave doubt whether, while the results aimed at are unquestionably accomplished, the device, as a whole, will prove sufficiently strong, durable and efficient, to justify its recommendation for general adoption.

II. THE "O. C. SMITH."

This boat appeared upon the canal about the 1st of September. She was fitted up by Dr. Hunter, of Cincinnati, and was propelled by two Hunter wheels, similar to those of the *Fountain City*. Her machinery consisted of two Corliss engines, having cylinders 8 inches in diameter, by 2 feet stroke of piston.

The fire-grate of the boiler was 3 feet by 3 feet 4 inches: equal to 10 square feet. On the 20th of September I found this boat at the head of the 16 locks, bound west, with a cargo of 100 tons of coal. Since that time I have neither seen nor heard any thing of this boat; nor has any statement of her performance been furnished. The natural inference is, that upon trial she proved to be a failure.

III. THE "PETER COOPER."

This boat, owned by the gentleman whose name she bears, was built upon the same general plan as the *Port Byron* and the *Montana*. I was not advised of her movements on the canal, nor was she entered for the Syracuse trial.

As no statement of the Cooper's performance has been furnished, it is of course impossible for me to present any facts to the commission, in relation thereto.

IV. THE "A. E. WEBSTER."

The Webster was built after the model of the Dawson. The machinery consisted of an Otleib compound rotary engine, which is supplied with steam from a horizontal, return tubular boiler, which is furnished with a condensing apparatus, designed to insure a constant supply of clear water. After the completion of the boat it was ascertained that, by running her stern foremost, *i. e.*, with the screw at the after end of the boat, a decided increase in speed was realized. Accordingly the Webster was run in that manner, so long as she ran at all during the season.

It was the intention of her owner that she should participate in the Syracuse trial; but, owing to unexpected delays west of that point, she did not arrive at Syracuse until after the trial was completed. After several day's delay, the Webster continued her trip east, and I made arrangements to join her at Little Falls; but, owing to further delay, as to the occasion of which I am not advised, she failed to arrive on time, and I have neither seen nor heard of her since.

Her owner having failed to furnish any information or statement, in relation to her performance, and having also failed to keep me advised of her movements, no detailed report can be made in regard to the work of this boat.

V. THE "CITY OF NEW YORK."

This is a second boat owned by Mr. Baxter, and built upon the same general plan as the Baxter. Her hull is built in the same manner as the Baxter's, and differs from it, only in that it is a few inches wider, and about one foot deeper under deck. Her cabin is placed forward, for the purpose of giving more storage room amidships, and of insuring the proper trim to the boat when fully loaded.

The changes referred to, suggested by last years' experience with the Baxter, have not only accomplished the desired results, so far as time is concerned, but have given a carrying capacity materially greater than that of the Baxter.

The machinery of the City of New York, while it is of the compound type, possesses many advantages over that of the Baxter, among which may be mentioned its simplicity, compactness, and smoothness of operation.

The cylinders are three in number, all in a single casting; two are high pressure, and are $4\frac{3}{4}$ inches in diameter, while the third, or low pressure cylinder, is 14 inches in diameter. The common stroke of the piston is 14 inches.

Although there are three cylinders, the steam is admitted and exhausted through a single valve, operated, of course, by a single valve gear. The valves and levers for controlling the machinery, are all placed within the reach of the steersman, and sufficient means are provided by which the fireman may easily prevent the engine from hanging on its centers.

The space occupied by the engine is about $2\frac{1}{2}$ feet square (on the floor), by about 7 feet high.

The boiler is vertical, cylindrical, tubular, $48\frac{3}{4}$ inches in diameter, and about 7 feet high. At the entrance to the uptake is placed a simple and efficient superheating apparatus.

The fire-box is 3 feet 10 inches in diameter, and 2 feet high.

The tubes are 2 inches in diameter, 4 feet long, and are 162 in number.

The grate surface is something over 9 square feet, and the heating surface about 360 square feet.

The propeller is a single screw, having four blades and a moderate pitch.

A small fan blower is provided for the purpose of supplementing the natural draught whenever desirable or necessary; ordinarily, however, sufficient steam is made with the natural draught.

The City of New York was completed about the middle of October; was immediately loaded and started west, entering the Erie canal on the 16th or 17th of October.

The trip was entirely satisfactory until her arrival at Weedsport, during a dark and stormy night, when, in laying up to discharge a part of her cargo, the boat was carelessly backed against the vertical wall and two of her propeller blades carried away. The remainder of the trip to Buffalo was made with two blades on the propeller, and with a cargo of about 75 tons.

While in this condition Commissioner Geddes and myself joined the boat, on the 21st of October, between Newark and Palmyra. A strong wind was blowing across the canal, causing much inconvenience to horse boats — especially to those which were running light — yet the City of New York kept on her course, and made a very fair rate of speed considering the condition of her propeller.

At Buffalo another screw was procured, for temporary use, and the boat loaded for New York.

A detailed statement of the trip east has been furnished, as follows:

Left *Buffalo* at 9 A. M. (N. Y. time), October 29th.

	Hours.	Min.
Arrived at <i>Tonawanda</i> at 12.05 P. M.		
Detained at <i>Tonawanda</i>.....	..	35
Arrived at <i>Lockport</i> at 4.48 P. M.		
Passed the five locks in 23 minutes.		
Detained by boats aground between <i>Lockport</i> and <i>Albion</i>.....	..	30
Detained at collector's office, <i>Albion</i>.....	..	10
Detained by boats below <i>Albion</i>.....	..	15
Detained at collector's office, <i>Brockport</i>.....	..	10
Arrived at <i>Rochester</i> at 10.30 A. M., October 30th.		
Detained at <i>Rochester</i> , weighing and laying in stores....	1	30
Detained at <i>Brighton</i> locks, waiting.....	..	15
Seventeen mile level very low; not over 6 feet. October 31st; was detained by a tug towing three boats—at night—caught a tow-line of one of the boats in the wheel; spent two hours in clearing wheel; lost two hours at locks, waiting for tug and tow.....	4	..
Arrived at <i>Lyons</i> at 7.15 A. M., October 31st.		
Detained for coal.....	1	30
Arrived at <i>Syracuse</i> at 5.45 A. M., November 1st		
Detained at <i>Syracuse</i>	1	17
Left <i>Syracuse</i> at 7.02 A. M.		
Ran aground in passing a boat below <i>Canastota</i> ; lost....	..	15
The level was very low; made 5 miles in 2½ hours.		
Arrived at <i>Rome</i> at 10.50 P. M., November 1st.		
Detained at collector's office.....	..	12
Arrived at <i>Utica</i> at 3.40 A. M., November 2d.		
Detained by boats in <i>Utica</i>.....	..	20
Caught a stump in the wheel below <i>Mohawk</i> ; detained.	..	55
Detained at <i>Herkimer</i> locks.....	..	16
Detained at second lock at <i>Little Falls</i>.....	..	15
Caught a log in the wheel below <i>Little Falls</i> , and was detained thereby.....	2	25
Arrived at <i>St. Johnsville</i> at 7.02 P. M., November 2d.		
Detained considerably in passing boats during the night.		
Arrived at <i>Schenectady</i> at 12.10 P. M. November 3d.		
Detained coaling.....	1	20
Arrived at lock 18 (head of the "sixteens"), at 8.15 P. M., November 3d.		
Passed the weigh-lock at <i>West Troy</i> at 11.30 P. M., November 3d.		
Detained getting into the river.....	2	..
Locked into the river at 2 A. M., November 4th.		
Waited for a pilot until 8 A. M.; started down the river at 8.15 A. M.; detention.....	6	15
Ran aground below <i>Troy</i> at 8.40 A. M.		
Detained until 4.10 P. M.....	7	30
Towed a canal boat from <i>Poughkeepsie</i> to <i>Newburgh</i> .		

STEAM ON THE CANALS.

	Hours.	Min
Detained at Fishkill, to pack high pressure piston-rod stuffing boxes	3	30
Arrived at Pier 5, East River, New York, at 2 A. M., November 6th.		
Total detentions	35	25
	Days.	Hours.
Total time from Buffalo to West Troy	5	15
Total time from Buffalo to New York	7	17

Deductions.

	Days.	Hours.	Min.
Total time, Buffalo to Troy	5	15	..
	Hours.	Min.	
Detentions claimed.....	16	10	
Add for lockages	10		
			1 2 10
Running time	4	12	50
Distance, 345 miles.			
Average speed less detentions	3.17 miles per hour.		
Average speed less lockages	2.76 miles per hour.		
Average speed less detentions other than lockages	2.90 miles per hour.		
	Days.	Hours.	Min.
Total time, Troy to New York	2	2	..
Detentions		19	15
Running time	1	6	45
Distance, 150 miles.			
Average speed	4.88 miles per hour.		
	Days.	Hours.	Min.
Running time, Buffalo to New York	5	19	35
Distance, 495 miles.			
Average speed	3.55 miles per hour.		

Average speeds including all detentions from:

	Miles.	Miles per hour.
Buffalo to Tonawanda.....	12	3.89
Tonawanda to Lockport	19	4.02
Lockport to Rochester.....	62	3.50
Buffalo to Rochester.....	93	3.51
Rochester to Lyons	42	2.02
Lyons to Syracuse	51	2.26
Rochester to Syracuse	93	2.15
Syracuse to Rome.....	41	2.30
Rome to Utica.....	15	3.10

	Miles.	Miles per hour.
Syracuse to Utica.....	56	2.47
Utica to Schenectady.....	80	2.46
Schenectady to West Troy	23	1.95
Buffalo to West Troy.....	345	2.56
Buffalo to West Troy, less lockages.....		2.76

Average speeds between same points, exclusive of lockages and other detentions, from:

	Miles.	Miles per hour.
Buffalo to Tonawanda	12	4.00
Tonawanda to Lockport	19	4.59
Lockport to Rochester.....	62	3.91
Buffalo to Rochester.....	93	4.05
Rochester to Lyons.....	42	3.13
Lyons to Syracuse.....	51	2.53
Rochester to Syracuse	93	2.77
Syracuse to Rome.....	41	2.59
Rome to Utica.....	15	3.35
Syracuse to Utica	56	2.75
Utica to Schenectady.....	80	3.20
Schenectady to West Troy	23	3.07
Buffalo to West Troy.....	345	3.17

The coal consumption during this trip is not reported; but Mr. Baxter states: "With regard to the coal consumption, on the City of New York, we could not determine it exactly, as we broke the propeller running up, and had to put on a temporary wheel to come down. This wheel is 4 feet 10 inches in diameter by 6 feet 9 inches pitch, and the slip must be at least 50 per cent. During the up-trip we came to the conclusion that the consumption of coal would be the same, at the same speed, and with the same load, as in the old boat." The model of the boat, the boiler and the engine, being substantially the same as in the Baxter, I am of the opinion that the City of New York will run as economically, so far as coal is concerned, as the Baxter.

To complete the record of the performances of the competing boats, it only remains to submit the report of the trial, between Syracuse and Utica, as follows:

REPORT OF TRIAL OF CANAL STEAMERS BETWEEN SYRACUSE AND UTICA, OCTOBER 15 AND 16, 1873. SUBMITTED, NOVEMBER 18, 1873.

I. THE "CENTRAL CITY."

The Central City was built in Syracuse during the season of 1872, specially to compete for the premiums offered by the state. For a

detailed description of this boat and its machinery, see report for 1872, pages 106-107.

The Central City left Syracuse at 10.20 a. m., on the 15th of October, 1873, with a cargo of 204 tons. Light weight of boat and machinery 72 3-4 tons; draught of water 5 feet 8 inches and 5 feet 9 inches; mean, 5 feet 8 1-2 inches.

The times of passing the several stations between Syracuse and Utica, the total times, less 8.6 minutes, for each lock passed, and the detention at Rome, together with the average speeds, were as follows:

STATIONS.	Distance. Miles.	Time.	AVERAGE SPEED.	
			Station to station. Miles per hour.	From Syra- cuse. Miles per hour.
Syracuse .....	..	A. M. 10.20	....	....
Lodi	1	11.43½	1.04	1.04
Manlius	8	P. M. 3.05	2.08	1.85
Kirkville	11	4.19	2.44	1.62
Pool's Brook	12	4.50	1.92	1.98
Bolivar	14	5.45	2.17	2.00
Chittenango	15	6.25	1.50	1.96
New Boston	17	7.50	1.41	1.96
Canastota	21	9.00	3.33	2.05
Lenox Basin	23	10.25	1.41	1.98
Durhamville	26	11.45	2.26	2.00
Dunbarton	30	A. M. 1.53	1.88	1.96
New London	35	4.17	2.08	1.98
Rome, arrived	41	6.55	2.13	2.02
Rome, left .....	..	19.20	....	....
Oriskany	49	11.50	3.20	2.16
Whitesboro	52	P. M. 12.53	2.86	2.19
New York Mills	53	1.14	2.86	2.20
Utica	56	2.12	3.65	2.25

The detentions allowed in the foregoing are as follows:

	Hours.	Minutes.
Three locks at Syracuse.....	..	25.8
At Rome.....	2	25.0
Lock at East Utica.....	..	8.6
Total	2	59.4

	Hours.	Minutes.
Total time from Syracuse	27	52.0
Running time.....	24	52.6

	Pounds.
Total coal consumption.....	7,080
Average steam pressures.....	63
Average revolutions of engine.....	98
Average revolutions of paddle-wheels	16½

Detentions noted, other than lockages, and at Rome.

	Minutes.
By horse-boat, between weigh-lock and lock 49.....	5
East of Thompson's landing, Newman passed.....	4
At Orville Feeder, C. C. Pope passed.....	4½
At Bolivar, no cause stated.....	8
At Chittenango, no cause stated.....	22
At Durhamville, no cause stated.....	10
At Glass Works, to adjust pump.....	30
At State Bridge, no cause stated.....	15
At point east of Higginsville, no cause stated.....	10
At Stacy's no cause stated.....	15
At New London, boats aground.....	12
At three-fourths mile east of Rome, crowd of boats	8
At Newville, no cause stated.....	5
Between Newville and Oriskany, by boats.....	10
Between Oriskany and Whitesboro	5
Total	163½

Deductions.

	Hours.	Min.
Total time from Syracuse	27	52
Less four lockages, at 8.6 minutes.....	Hours.	Min.
Less stop at Rome	2	25
Less other detentions, as above	2	43.5
	5	42.9
Running time	22	09.1

	Miles per hour.
Average speed, less detentions	2.53
Average speed from Syracuse to Rome, less all detentions	2.29
Average speed from Rome to Utica, less all detentions.....	3.52

Average coal consumption per mile	126.43 pounds.
Average coal consumption per hour.....	385 pounds.
Average coal consumption from Syracuse to Rome, per mile.....	148.4 pounds.

Average coal consumption from Rome to Utica, per mile	66.7	pounds.
Average speed of paddle-wheels, in miles, per hour..	5.72	
Mean apparent slip of paddles.....	54	per cent.

Explanations.

The apparent difference between the rates of coal consumption between Syracuse and Rome, and between Rome and Utica, is thus explained:

When the Central City left Rome, on the morning of the 16th of October, her fires were fresh and clean, and were probably quite heavy. No cleaning of fires was necessary between Rome and Utica, and it is likely that the fires were quite low when the steamer reached Utica.

The increased speed between Rome and Utica, amounting to about one mile per hour, is partly explained by the condition of the fires, indicated above; but principally by the fact that, from Rome to Utica, the tendency of the current was eastwardly, *with* the motion of the boat.

The difference in speeds indicates a velocity of current of about *half a mile* per hour, which had to be stemmed from Syracuse to Rome.

Mr. Davis, the owner of the Central City, furnishes the following figures in relation to her hull and machinery:

Hull.

Length, over all.....	99	feet.
Breadth	17 $\frac{1}{2}$	feet.
Light weight	145,500	pounds
Draught of water, light.....	18	inches.
Cargo during trial.....	204	tons.

Engine.

Number of cylinders	1	
Diameter of cylinder	10	inches.
Stroke of piston	17	inches.

Boiler.

Length	16	feet.
Diameter	4	feet.
Grate surface.....	12 $\frac{1}{2}$	sq. feet
Number of flues	58	
Length of flues.....	10	feet.
Diameter of flues	2 $\frac{1}{2}$	inches.
Fire-box	41" x 45"	

Paddle-wheels.

Number of wheels	2
Diameter, to center of buckets.....	9 ft. 10 in.
Number of buckets, each wheel.....	12
Size of buckets	2' x 2'

“One-half of bucket in front of arm and one-half in rear; buckets set on an angle, and force the water to the center of the canal.”

Mr. Davis also says: “Boiler, cylinder and steam-pipes have no covering; paddle-wheels are adjusted to any dip of bucket required; engine-house (with boiler, engine and machinery) is elevated, by four screws, to nearly the height of the deck when the boat is loaded; cabin, for the crew, is raised in the same manner, leaving the entire hold available for cargo, with no obstruction from stem to stern. The engine is geared to the paddle-shaft in the ratio of six to one. Experience has shown that it should be geared in the ratio of about four and one-half to one, for a cylinder of the present size, and thereby a much greater speed attained with the same amount of fuel consumed.”

“The trial trip of the 15th of October would seem to demonstrate the fact that the screw is superior to the paddle-wheel in deep water, and also that the paddle-wheel is superior to the screw in shallow water; as the Pope and Newman passed the Central City in the wide waters east of Syracuse, and the Central City invariably gained on them where there was the least depth or poorest water.”

“The design, in building the Central City, was to test the efficacy of side wheels, as a means of propulsion on the canals and in shallow water, and, therefore, but little attention was paid to the kind of engine and boiler used in this instance; and while the condensing compound engine and other engines and boilers, adopting the latest improvements, would give far better results in regard to economy of fuel consumed, it would in nowise alter the question of the adaptability of a certain system of propulsion to canal purposes.”

Upon her arrival in Utica, the Central City was weighed and was found to weigh 543,900 pounds. Deducting the reported light weight, the weight of cargo and coal appears to have been 195 1-5 tons.

The remainder of the trip, from Utica to Troy, will be reported hereafter.

II. THE “PORT BYRON.”

For a description of the Port Byron, as originally built by Messrs. Mahan & Emerson, of Memphis, Tenn., reference is made to report

of February 18, 1873, pp. 89-90. Since the close of the season of 1872, the Port Byron was purchased by her present owner, Mr. Peter Cooper, of New York, who has changed the form of her bow and closed up the trunk which extended from stem to stern, at the bottom, and which constituted one of the principal peculiarities and advantages as claimed by the builders and former owners of the boat. In other respects, so far as I am advised or could discover, the Port Byron remains as originally constructed.

Mr. Cooper's representative upon the Port Byron, Mr. Ward, has furnished the following data:

Hull.

Length over all.....	96 feet.
Breadth.....	17 $\frac{1}{2}$ feet.
Light weight.....	160,200 pounds.
Draught of water, loaded.....	5 $\frac{1}{2}$ feet.
Cargo.....	200 $\frac{3}{4}$ tons.

Engines.

Number of cylinders.....	2.
Diameter of cylinders.....	12 inches.
Stroke of pistons.....	2 feet.

Boiler.

Length.....	13 feet.
Diameter.....	5 feet.
Length of flues.....	9 feet.
Number of flues.....	34 feet.
Diameter of flues.....	{ 2 of 12 inches.
	{ 32 of 3 inches.
Area of grate surfaces.....	8 square feet.
Size of fire-box.....	2' x 4'.

Wheel.

Number of wheels (feathering).....	1.
Diameter of wheels to center of paddles.....	10 feet.
Number of paddles.....	8.
Size of paddles.....	3' x 2'.
Size of paddles (originally).....	3' 6" x 2' 4" .

The Port Byron left Syracuse on the 15th of October, at 9.15 A. M., with a cargo of 200 tons of coal.

The following table shows the times at which the Port Byron passed the various points between Syracuse and Utica, together with the speeds, from point to point, and from Syracuse to each of the points named successively. In estimating these speeds, 8.6 minutes

are deducted from the actual time, for each lockage; also the time on the morning of the 16th of October, during which the boat laid up, under orders, at Rome:

STATIONS.	Distance. Miles.	Time. H. M.	AVERAGE SPEEDS.	
			Pt. to Pt. Miles per hour.	From Syracuse. Miles per hour.
Syracuse.....	..	A. M. 9:15	....	....
Lodi	1	10:05	2.50	2.50
Manlius	8	P. M. 1:55	2.06	1.89
Kirkville.....	11	2:55	3.00	2.10
Pool's Brook.....	12	3:40	1.33	2.01
Chittenango.....	15	5:00	2.26	2.05
New Boston.....	17	6:15	1.60	1.99
Canastota.....	21	8:00	2.29	2.03
Lenox.....	23	10:10	0.92	1.84
Durhamville	26	11:35	2.11	1.87
Rome, arrived.....	41	A. M. 6:09	2.28	2.00
Rome, left.....	..	9:00	....	....
Oriskany.....	49	11:45	2.91	2.11
Utica.....	56	P. M. 2:15	2.97	2.19

The detentions allowed in the foregoing are:

Three lockages at Syracuse	Hours.	Min.
At Rome.....	2	51
Lock in East Utica.....	..	8.6
Total	3	25.4
Total time from Syracuse.....	29	..
Running time	25	34.6
Total coal consumption	5,425	pounds.
Average steam pressure	78½	pounds.
Average revolutions per minute.....	21.44.	

Detentions noted, other than lockages, and at Rome.

Thirteen detentions in passing boats.....	Hours.	Min.
Tied up at Canastota, leak in steam-pipe, and damper out of order.....	1	46
Total	1	15
Total	3	1

Deductions.

	Hours.	Min.
Total time from Syracuse	29	..
	Hours.	Min.
Less four lockages.....	..	34.4
Less stop at Rome	2	51
Less other detentions, as above.....	3	1
	<hr/>	<hr/>
	6	26.4
	<hr/>	<hr/>
Running time	22	33.6
	<hr/>	<hr/>

	Miles per hour.
Average speed, less detentions.....	2.49
Average speed from Syracuse to Rome, less detentions	2.29
Average speed from Rome to Utica, less detentions.....	3.25
	Pounds.
Coal consumption, per mile	96.9
Coal consumption, from Syracuse to Rome, per mile.....	100.6
Coal consumption, from Rome to Utica, per mile.....	86.7
Speed of paddle-wheel	7.59 miles per hour.
Mean apparent slip of paddles	67.2 per cent.

The slip reported last year was, under quite similar circumstances, 67½ per cent. (See Report for 1872, p. 98.)

Explanations.

The explanatory remarks heretofore made in regard to the performance of the Central City, apply, with equal force, to that of the Port Byron.

It is claimed by the parties who kept the record of the performance of the Port Byron during the trial trip, that the water east of Lodi was excessively low, on account of the lockage of a large number of boats just previous to the passage of this steamer. It is to be remembered, however, that the steamers Pope and Newman passed *after* the Port Byron, and hence were compelled to encounter low water as well. There was, therefore, no advantage gained by the Pope or Newman over the Port Byron on account of the condition of the water, whatever it may have been.

III. THE "C. C. POPE."

This steamer appeared, for the first time, during the season of 1873. She is an ordinary, full-sized lake boat, and retains her original model in every particular. Upon her stern is secured a strong frame of iron, which carries the screw and rudder, both of which admit of motion in a vertical direction, for the purpose of securing full immersion of the screw at all draughts of water. The

main shaft passes through the stern-post above water, and carries a mitre-wheel, which meshes into a similar wheel upon a vertical shaft outside the stern-post. This latter shaft — which is supported upon, and moves with, the iron frame — carries, at its lower extremity, a second mitre-wheel, which meshes into a similar wheel upon the hub of the screw.

This device for raising and lowering the screw, constitutes the novel feature in the propelling machinery of the Pope.

At the stern, on deck, is placed a small steam winch, designed to expedite the passage of the boat through locks, and to aid in loading and discharging cargo, for both of which purposes it is admirably adapted. A skillful use of this winch will effect a saving of nearly a minute in the time of locking — especially in locking *up*. In locking *down*, it must be of very little service.

Mr. Sprague, the inventor, has furnished the following data in regard to the details of the hull and machinery of the "Pope."

Hull.

Length over all.....	99 feet.
Breadth	17½ feet.
Draught of water, loaded.....	5¼ feet.
Light weight.....	151,400 pounds.
Cargo	202 $\frac{1}{10}$ tons.

Engine.

Number of cylinders.....	1.
Diameter	10 inches.
Stroke of piston.....	12 inches.

Boiler.

Length.....	11 feet.
Diameter	4 feet.
Area of grate surface.....	11 $\frac{9}{10}$ square feet.
Number of flues.....	58.
Length of flues.....	5½ feet.
Diameter of flues.....	2½ inches.
Size of fire-box.....	3' 6" x 3' 6" x 2' 8"

Wheel.

Diameter of screw.....	6 feet.
Pitch of screw	6 feet.
Number of blades.....	4.

Mr. SPRAGUE says:

"The peculiarities of the C. C. Pope consist in having a small engine, to do the work with but little steam; a comparatively large

boiler to furnish that steam without forcing the fire; a large propeller to reach beyond the dead water of the boat; and in having the propeller so arranged that it can be always submerged, whether the boat be light or loaded — or lowered below the boat whenever the depth of water will permit (on river levels, deeper sections of the canals, and Hudson river especially); to act upon the solid water under the boat; also, in having the machinery so arranged that the same can be applied to any of the canal boats now in use, without changing their form or lessening their buoyancy in the least, and with but little expense.”

The Pope left the Syracuse weigh-lock on the 15th of October, at 10:47 a. m., with a cargo of 8,443 bushels of barley. The following table shows the times at which the Pope passed the several stations between Syracuse and Utica; also the average speeds from point to point, and from Syracuse to each of the several points successively. In computing these speeds, 8.6 minutes are allowed for each lockage, and the time during which the boat was tied up in Rome, under orders :

STATIONS.	Distance. Miles.	Time. H. M.	AVERAGE SPEEDS.	
			Pt. to Pt. Miles per hour.	From Syracuse. Miles per hour.
Syracuse.....	..	A. M. 10:47	....	....
Lodi	1	11:52	1.54	1.54
Manlius	8	P. M. 2:58	2.26	2.13
Kirkville	11	4:06	2.66	2.25
Pool's Brook	12	4:40	1.76	2.20
Bolivar.....	14	5:30	2.41	2.23
Chittenango	15	6:02	1.88	2.19
New Boston	17	7:20	1.54	2.09
Canastota	21	8:49	2.68	2.19
New London.....	35	A. M. 2:37	2.41	2.27
Rome	41	5:30	2.08	2.24
Rome, left .....	..	8:40	....	....
Oriskany.....	49	11:09	3.23	2.36
Whitesboro	52	P. M. 12:06	3.15	2.39
New York Mills.....	53	12:27	2.86	2.40
Utica	56	1:22	3.89	2.45

The detentions allowed in the foregoing, are:

	Hours.	Min.
Three lockages at Syracuse.....	..	25.8
Stopped at Rome.....	3	10
Lock at Utica.....	..	8.6
Total.....	3	44.4
Total time from Syracuse.....	26	35
Running time.....	22	50.6

Total coal consumption.....	2,520 pounds.
Average steam pressure.....	89.17 pounds.
Average revolutions of engine.....	129.9
Average revolutions of screw.....	75.77

Detentions noted other than lockages and at Rome:

	Min.
Waiting for lock 47.....	6
By passing of the Newman.....	5
Nut off on "Excentric" (broken).....	6
At Pool's Brook, passing horse-boats.....	3
East of Chittenango put aground by boats.....	5
Total.....	25

Deductions.

	Hours.	Min.
Total time from Syracuse.....	26	35
Less 4 lockages, at 8.6 minutes each.....	34	4
Less detention at Rome.....	3	10
Less other detentions as above.....		25
	4	09.4
Running time, actual.....	22	25.6

Average speed, less detentions.....	2.5 miles per hour.
Average speed from Syracuse to Rome, less detentions.....	2.29 miles per hour.
Average speed from Rome to Utica, less detentions.....	3.29 miles per hour.
Coal consumption per mile.....	45 pounds.
Coal consumption from Syracuse to Rome per mile.....	50 pounds.
Coal consumption from Rome to Utica per mile.....	31½ pounds.
Average speed of screw.....	5½ miles per hour.
Mean apparent slip of screw $\frac{5\frac{1}{2} - 2.5}{5\frac{1}{2}} \times 100 = 51\frac{6}{10}$ per cent.	

We observe here the same difference in the speeds, east and west of Rome, and also the diminished rate of coal consumption east of Rome. These matters having already been explained in the cases of the Central City and the Port Byron require no comment here.

The behavior of the gear wheels through which the power is transmitted in this device, was not such as to inspire confidence in its durability, efficiency or adaptation to the purposes of steam canal navigation. The device carried the boat safely through from Syracuse to Utica; but I am informed that, very shortly, after some of the gear wheels gave way, totally disabling the boat.

IV. THE "WILLIAM NEWMAN."

For a detailed description of the Newman, as originally constructed and run by Captain Small, see report for 1872, pp. 31-32.

On the 9th of September, Captain D. P. Dobbins, of Buffalo, became interested in this boat, principally for the purpose of testing the Hubbard Hydraulic Propeller, in which he is interested. Beyond the substitution of this propeller, in the place of the original screw, the changes made by Captain Dobbins, with reference to the Syracuse trial, were:

1. The addition of an independent cut-off valve.
2. Covering the boiler and pipes with non-conducting material.
3. The addition or attachment of eight hollow cast-iron spheres to the crown sheet of the boiler, for the purpose of increasing the fire surface and promoting circulation.

Beyond these changes, which were limited to the machinery, and were designed to increase its efficiency, the Newman remained as she was originally built.

Capt. Dobbins furnishes the following data in regard to the Newman:

Hull.

Length of keel	92 feet.
Length over all	96 feet.
Breadth	17½ feet.
Light weight	71 tons.
Draught of water, at trial	5½ feet.
Cargo, 7,150 bushels corn.....	200½ tons.

Engine.

Number of cylinders.....	1.
Diameter of cylinder.....	12 inches.
Stroke of piston	12 inches.

Boiler.

Length	8 feet.
Diameter	4 feet.
Grate surface	10 $\frac{83}{100}$ feet.
Flues	{ one oval, 31" x 14" x 33" ^b
	{ 34 return, 2 $\frac{1}{2}$ " dia. and 6 $\frac{5}{12}$ feet long.
Size of fire box	39" x 40".

Hydraulic Propeller.

Diameter	4 $\frac{8}{12}$ feet.
Pitch, said to be	5 $\frac{8}{12}$ feet.

The above pitch is given as it was reported, but, owing to the peculiar construction of the wheel, there is reason to doubt whether the actual pitch is precisely determinate.

Captain Dobbins says:

"Hubbard's conical hydraulic propeller wheel—first wheel of the kind ever applied to a draught vessel. We find it too small. It should be *five* feet in diameter and three feet long, for the power applied; would then give a better result every way."

The Newman left the weigh-lock at Syracuse at 11.23 A. M., October 15, drawing 5 feet 10 inches forward, and 6 feet $\frac{1}{2}$ inch aft. The times at which the several points between Syracuse and Utica were passed, together with the speeds from point to point, and from Syracuse to each point, successively, are as follows:

STATIONS.	Distance. Miles.	Time. H.M.	AVERAGE SPEEDS.	
			Pt. to pt. Miles per hour.	From Syra- cuse. Miles per hour.
Syracuse .....	..	A. M. 11:23	....	....
Lodi	1	P. M. 12:03	4.39	4.39
Manlius	8	2:55	2.44	2.58
Kirkville	11	4:00	2.78	2.63
Pool's Brook	12	4:31	1.92	2.55
Bolivar	14	5:22	2.35	2.52
Chittenango	15	6:45	0.73	2.16
Canastota	21	8:50	2.88	2.33
Durhamville	26	11:45	1.71	2.18
Higginsville .....	..	A. M. 1:50	....	....
New London	35	5:59	1.45	1.92
Rome	41	8:53	2.07	1.95
Rome, left .....	..	9:50	....	....
Oriskany	49	P. M. 12:27	3.05	2.07
Whitesboro	52	1:19	3.45	2.12
New York Mills	53	1:37	3.33	2.13
Utica	56	2:31	3.33	2.17

STEAM ON THE CANALS.

The detentions allowed in the foregoing are:

	Hours.	Min.
Three lockages at Syracuse.....	..	25.8
Stopped at Rome.....	..	57
One lockage at Utica.....	..	8.6
<hr/>		
Total	1	31.4
Total time from Syracuse	27	8
<hr/>		
Running time	25	36.6
<hr/>		
Coal consumption	4,000	pounds.
Average steam pressure	76.18	pounds.
Average revolutions per minute.....	135.37	

Detentions noted, other than lockages, and at Rome.

	Hours.	Min.
Between locks 48 and 49, by boat .....	..	4
Between locks 48 and 47, by boat .....	..	8
Pulling Price and Pope off bank.....		5
Between Thompson's and Pratt's landings, passing boats, ..		15
East of Durhamville, passing boats		10
At Stacy's, to repair brasses	2	50
At New London, passing boats.....		15
At Rome feeder, passing boat.....		10
<hr/>		
Total	3	57

Deductions.

	Hours.	Min.
Total time from Syracuse	27	8
<hr/>		
	Hours.	Min.
Less four lockages.....	..	34.4
Less detention at Rome.....	..	57
Less other detentions, as above	3	57
<hr/>		
	5	28.4
<hr/>		
Running time	21	39.6

	Miles per hour.
Average speed, less detentions	2.59
Average speed from Syracuse to Rome, less detentions.....	2.41
Average speed from Rome to Utica, less detentions	3.43

	Pounds.
Coal consumption, per mile	71.43
Coal consumption, Syracuse to Rome, per mile.....	79.3
Coal consumption, Rome to Utica, per mile	49.9

Average speed of propeller, 7.68 miles per hour.

Apparent slip, $\frac{7.68 - 2.59}{7.68} \times 100 = 66.3$ per cent.

Again we observe a difference of a mile between the speeds east and west of Rome; also, differences in coal consumption, which are explained as in the cases of the Central City and the other boats. It is claimed by some of the other competitors, and admitted by Captain Dobbins, that wood in considerable quantities was used on board the Newman. Messrs. Foster and Stoddard, who kept the log on board the Newman, put the quantity of wood used at *half a cord*. They say:

"The first eight miles out of Syracuse there was no difficulty in keeping up steam, the coal being of good quality and in good condition; from there to Rome the coal clinkered so badly that we were obliged to rake out our fire often and then to use wood to get it going again."

Since the trial, I am informed, evidence has been procured, which goes to show that strong brine had been poured over the Newman's coal, during the night preceeding the trial. During the run, steam was cut off at from $\frac{5}{12}$ to $\frac{6}{12}$ of the stroke.

The *hydraulic propeller*, while giving the Newman greater speed than she was able to develop with her screw, was found to be not only too small — as represented by Capt. Dobbins and as evinced by its rapid motion — but troublesome, on account of its tendency to collect *debris* from the bottom of the canal, which rendered frequent reversal of the engine necessary, for the purpose of clearing it. In consequence of these defects, Capt. Dobbins, upon his arrival in Utica, decided to remove the Hubbard wheel, and to substitute in its place a screw, five feet in diameter, having six feet pitch. At the same time the main shaft was lengthened 16 inches, and a timber of that thickness was secured to the after side of the stern-post. The screw is thus thrown back 16 inches and secures a much more effective hold upon the water.

The changes above referred to having been completed, I joined the Newman at Utica, on the 22d of October, at 8:20 A. M., and proceeded with her as far as the collector's office at Little Falls, where we arrived at 3:45 P. M., on the same day. No note was made of the slight detentions attending the passage of boats, or of time lost in waiting for locks. The results of this run are as follows:

Distance steamed.....	22 miles.
Locks passed.....	7
Time consumed.....	7 hours, 25 minutes.
Coal consumed.....	890 pounds.
Average steam pressure.....	90 pounds.
Average revolutions.....	108
Cut off.....	$\frac{6}{12}$

From which we make the following deductions :

Average speed, including lockages and detentions.	2.97 miles per hour.
Average speed, excluding lockages and detentions.	3.27 miles per hour.
Coal consumption, per mile.....	36.4 pounds.
Speed of screw	7.36 miles per hour.
Apparent slip $\frac{3.36-3.27}{3.36} \times 100 =$	55.6 per cent.

It is probable that the apparent slip, in this case, is not far from the true slip; as effect of current was, practically, equivalent to detentions not noted.

The Newman reached West Troy, at 11 P. M., October 23d. Her time was, therefore, 31 hours and 15 minutes; distance, 81 miles.

Without deducting lockages and other detentions, the average speed was 2.59 miles per hour. Deducting the time of 36 lockages, at 8.6 minutes each, the running time, including all detentions other than those at locks, was 26 hours, 5.4 minutes, and the average speed 3.1 miles per hour.

The Newman's last Trip West.

This trip was a remarkable one; being, it is believed, the quickest on record. The particulars of the trip, as hereinafter given, are taken from a certified copy of the clearance, from the sworn statement of Capt. Dobbins, and from my own memoranda.

The Newman left the West Troy weigh-lock, on the 31st of October, at 5:30 P. M., with a cargo of 121 tons of moulding sand, and arrived at Buffalo on the 5th of November, at 3 P. M., Buffalo time, or 3:30 P. M., Troy time.

The total time, from West Troy to Buffalo, was therefore :

	Days.	Hours.	Min.
	4	22	00
From this should be deducted 2 hours and 15 minutes lost at Schenectady, while awaiting my arrival from Troy, on the morning of November 1st.....		2	15
Total, including lockages and detentions.....	4	19	45

or 115 $\frac{3}{4}$ hours. For the entire trip, therefore, without deducting lockages, or detentions, properly chargeable to the boat, the speed averaged 2.98 miles per hour, against the current.

If 10 hours be deducted for lockages, the running time including all other detentions, was 105 $\frac{3}{4}$ hours, and the average speed 3.26 miles per hour. My own personal observations extended from

Schenectady to Port Jackson, a distance of 16 miles. My notes were as follows :

"Left Schenectady, collector's office at 7:45 A. M., November 1st, 1873: cargo, 121 tons sand; at lock 23 at 8:22 A. M.—37 minutes from Schenectady; steam, 85; revolutions, 104. Boat ran her length in 13, 14 and 12 seconds; 12 seconds in wide water; produced a swell about 16 inches high on docking. A boat-length in 13 seconds is 5.13 miles per hour; 2.8 miles in 37 minutes is an average of 4.54 miles per hour from Schenectady to lock 23."

"At 8:35 entered lock 23; at 8:40 left lock 23; steam 85; revolutions, 110; cut-off, $\frac{1}{2}$. At lock 24 at 8:51 A. M.; had to wait until 8:55 for lock; entered lock 24 at 8:55.30; left lock 24 at 9 A. M.; one of the lock tenders demanded a fee, which was refused; detained from 10:03 to 10:07 by a crowd of boats and a raft; at 10:09.45 entered lock 25; at 10:15 left lock 25; at head of lock 25 stopped in a crowd; ahead at 10:21; detention 6 minutes; from 11:45 to 11:47 detained two minutes; entered lock 26 at 12:16 P. M.; left lock 26 at 12:23; boat remained in lock for engineer; entered lock 27 at 12:29; left lock 27 at 12:34.25; strong head-wind; at 12:30 P. M., steam 35; revolutions 75; following full stroke; fires just cleaned; boat ran her length in 25 seconds; speed $2\frac{3}{4}$ miles per hour; at 12:48 steam 48; revolutions 88; and cut-off at $\frac{1}{2}$ stroke; arrived at Port Jackson at 1:23 P. M.; steam 85; revolutions 104. Total time, 7:45 A. M. to 1:23 P. M., 5 hours 38 minutes; distance 16 miles."

Deductions.

Average speed, including lockages and detentions, 2.84 miles per hour.

Time actually lost in locks :

In lock 23.....	5 minutes.
In lock 24.....	$4\frac{1}{2}$ minutes.
In lock 25.....	$5\frac{1}{4}$ minutes.
In lock 26.....	7 minutes.
In lock 27.....	$5\frac{5}{12}$ minutes.

Or.....	27' 10" in 5 locks.
Average time in locks.....	5 min. 26 sec.
Total time, less time in locks.....	5 hours, 10 min. 50 sec.
Or.....	5.18 hours.
Average speed, exclusive of time actually lost in locks.....	3.09 miles per hour.

Detentions, other than in locks, were as follows :

	Min.
At lock 23.....	13
At lock 24.....	4
In crowd.....	4
At head of lock 25.....	6
Between locks 26 and 27.....	2
	<hr/>
Total detentions.....	29
	<hr/> <hr/>

Total time, less time actually spent in locks and in other detentions, or actual running time..... 4 hours, 41 min. 50 sec.
Actual average speed, 3.41 miles per hour, against a very strong head wind, and against the current.

Upon this portion of the canal the number of locks is precisely the number due to that distance, assuming the locks to be uniformly distributed. It therefore follows that the Newman has demonstrated her ability to make an average speed of over three miles per hour, including lockages.

This run was made easily, and without any crowding of the machinery, which worked admirably, as it does at all times.

No special note was made of the coal consumption. I am satisfied, however, from close observation of the firing, that it was no greater than it was on the 22d of October, between Utica and Little Falls.

My notes indicate the following as the average steam pressure and revolutions :

Average steam pressure.....	67.6 pounds.
Average revolutions.....	96.2 pounds.
Average speed of screw.....	6.56 miles per hour.
Apparent slip $\frac{6.56 - 3.41}{6.56} \times 100 =$	48 per cent.

If the speed of the current be taken at its probable value — $\frac{1}{4}$ mile per hour, as indicated between Syracuse and Utica, the actual slip of the Newman screw appears to have been 40.4 per cent.

The following is the detailed "log" of the entire trip from West Troy to Buffalo, kept by Capt. Dobbins, verified by his oath, and accompanied by a certified copy of the Newman clearance :

Left Troy weigh-lock, October 31, 1873, at 5 P. M. (Buffalo time), with a cargo of 121 tons of moulding sand.

Detained in almost every level of the 16 locks by horse-boats and rafts, locking and passing, the night being dark and stormy.

	Min.
Estimated detention.....	50
Detained by grounding, passing loaded horse boat, near Clute's dry dock.....	15
Detained in lock 20 by horse boat aground across head of lock,	45
Detained by running at 2-3 speed during a dark, cold and stormy night; banked and backed off four times.....	60
Arrived at <i>Schenectady</i> at 5 A. M., November 1st.	
Detained by waiting for D. M. Greene to arrive from Troy to accompany us part way.....	135
Detained at 7:50 by horse boats locking in lock 23.....	8
Detained below lock 24, lock not ready.....	5
Detained by being banked and backing off.....	3
Detained by passing horse boats at 9 A. M.....	3
Detained by stopping below lock 25 for horse boats in the lock	5
Detained above lock 25 by horse boats and raft.....	3
Detained by horse boats, stopped.....	3
Detained by stopping for horse boats passing.....	2
Detained by high wind ahead.....	
Arrived at Port Jackson at 12:55 P. M., November 1st, (Buffalo time). Engineer Greene here left the boat.	
Detained in lock 28 by raft and horse boat jammed in.....	8
Detained in lock 29 cleaning fires and in keying up.....	5
Detained at Fultonville coaling and repairing head-light.....	100
Detained at Spraker's Basin for lock.....	20
Detained above Fort Plain, passing sunken boat, and crowd of horse boats.....	25
Overhauling a great number of horse boats going west and running light. Detained by passing, each one "sucking" to us.	
Detained, waiting for lock 33.....	10
Detained on three mile level, boat aground.....	30
Detained through a dark and windy night, running at 2-3 speed and passing a great crowd of horse boats, running light, which all sucked to us in passing. Estimated detention two hours.....	120
Detained at Little Falls, changed lock for us.....	10
Detained by high wind, overhauling and passing horse boats running light.....	30
Detained by a tow-line foul of the boat's bottom.....	5
Arrived at <i>Utica</i> at 11:30 A. M., November 2d.	
Detained at Collector's office.....	5
Detained at Fowler's dry dock, to take on Hubbard wheel and shaft.....	60
Detained by high wind, and passing numbers of light horse boats, which sucked to us in passing; estimated.....	45
Detained at Rome.....	10
Detained through a dark and stormy night, running at 2-3 speed, banking the boat occasionally, to Syracuse.....	90
Arrived at <i>Syracuse</i> at 4 A. M., November 3d, weather wet, cold and disagreeable.	
Detained at collector's office reporting.....	10
Detained by high wind, and in overhauling and passing light and loaded horse boats to Jordan.....	60

	Min.
Detained at Jordan, coaling and taking in stores.....	90
Detained at lock 52, lock-tender giving a scow the preference..	20
Detained in high wind, and overhauling and passing horse boats which sucked to us, from Jordan to Montezuma.....	60
Detained by sunken boat near Montezuma.....	10
Detained waiting for Clyde lock.....	10
Detained by light boat fouling us.....	5
Detained waiting for Arcadia lock.....	10
Detained waiting for Macedon lock.....	10
Detained near Waynesport by a raft.....	10
Detained in Perrington Straits by horse boats aground.....	30
Detained at stop gate by boats.....	10
Detained at Pittsford lock.....	10
Detained at lock 63, boats locking.....	10
Detained at Lower Brighton lock by a crowd of horse boats locking.....	25
Detained at lock 65 by horse boat in lock.....	5
Detained at lock 66; lock not ready.....	5
Detained running at half speed through Rochester, to weigh- lock; horse boats on each side, loading and unloading.....	10
Arrived at <i>Rochester</i> at 12:45 P. M., November 4.	
Detained at Rochester, coaling, telegraphing, etc.....	60
Detained running at half speed through Rochester, horse boats loading and unloading.....	15
Detained by passing a horse boat, light, which was allowed by her captain willfully to suck to us.....	15
Detained at Spencerport by a crowd of horse boats; wind very high.....	15
Detained by a saw-log floating across our bow.....	5.
Detained in passing a horse boat laker—light.....	5.
Detained at collector's office, Brockport.....	15
Detained by striking stop-gate at full speed.....	15
Detained by boat aground across canal.....	15
Detained at collector's office, Albion, and waiting for engineer.	20
Detained by passing light horse boats.....	5
Arrived at <i>Lockport</i> at 6:30 A. M., November 5th.	
Detained below the locks waiting for lock, and getting horse boats out of the way.....	15
Detained above the locks, coaling and taking in stores.....	50
Detained in deep rock cut by horse boat sucking to us in pass- ing, towed along in this way for a mile, unshipped steering wheel, etc.....	30
Passed Pendleton at 10 A. M., and arrived at <i>Tonawanda</i> , at 12, noon, making 12 miles in 2 hours, against a current of 1½ miles an hour.	
Detained at collector's office at <i>Tonawanda</i>	10
Overhauled and passed canal steamer in Black Rock harbor.	

Total detentions..... 1,600
Or, 26 hours and 40 minutes.

Arrived at *Buffalo* at 3-P. M., November 5th, in 4 days and 22 hours
from West Troy.

Consumed 6 tons of Lackawanna and Pittston egg-size coal on the trip from Troy to Buffalo.

Detention, exclusive of lockages, 26 $\frac{3}{4}$ hours. Average revolutions of the screw from Troy to Buffalo, 85 per minute; average steam pressure, 80 lbs., cutting off at $\frac{1}{4}$ stroke of the piston.

(Signed)

D. P. DOBBINS.

Subscribed and sworn to before me, this 10th }
day of November, 1873, at Buffalo. }

(Signed)

WM. L. BEST,

[L. S.]

Notary Public for Erie Co.

Deductions.

	Hours.	Min.	Hours.	Min.
Total time from West Troy.....	118	..		
Less lockages.....	10	..		
Less detentions claimed.....	26	40		
	<u>36</u>	<u>40</u>		
Running time.....	81	20		
Distance, 345 miles.				
			Miles per hour.	
Average speed, including lockages and other detentions...			2.98	
Average speed, exclusive of 10 hours for lockage.....			3.26	
Average speed, exclusive of lockage and other detentions :			4.24	
Average speed, exclusive of detentions other than at locks.			3.78	
Coal consumption, per mile, 34.8 lbs.				

The following table shows the average speeds between prominent points between West Troy and Buffalo.

SECTIONS OF CANAL.	Distance, miles.	AVERAGE SPEEDS — MILES PER HOUR.			
		Including all detentions.	Excluding lockages only.	Excluding detentions other than lockages.	Excluding all detentions.
West Troy to Schenectady.....	23	1.92	2.52	2.51	3.65
Schenectady to Utica.....	80	2.62	2.94	3.69	4.35
Utica to Syracuse.....	56	3.39	3.52	4.31	4.50
Syracuse to Rochester.....	93	2.94	3.08	3.57	3.94
Rochester to Lockport.....	62	3.49	3.49	4.23	4.23
Lockport to Pendleton.....	7	2.00	2.51	3.65	5.83
Pendleton to Tonawanda.....	12	6.00	6.00	6.00	6.00
Tonawanda to Buffalo.....	12	4.00	4.19	4.24	4.44

I have felt inclined to question the magnitude of the detentions claimed by Captain Dobbins; but, in view of the fact that my own observations have satisfied me of the ability of the Newman to make the speeds indicated in the foregoing table, I do not feel that I should be justified in making any changes in the log as reported.

Captain Dobbins claims special merit for the Newman on the ground that she is the only competing boat that can carry 200 tons of the lighter grains *under deck*; and on the further ground that her cost was only as follows :

Hull (oak, chesnut and pine)	\$4,500
Engine and boiler	2,500
Total cost.....	<u>\$7,000</u>

It is to be borne in mind, however, that, like the Baxter and the City of New York, her model, at least at the stern, is different from that of the ordinary horse boat of the Erie canal.

It will be observed, also, that no detentions are claimed for breakage or derangement of the Newman's machinery, which, so far as satisfactory working and promise of durability are concerned, has no superior on the canal. In economy of fuel alone, it is inferior to the machinery of the Baxter and City of New York.

At the close of two full season's operations it is in as perfect order as when it first appeared upon the canal, in the spring of 1872.

V. THE "WILLIAM BAXTER."

For a detailed description of the Baxter, see Report for 1872, pp. 45-6-7.

During the present season the original boiler of the Baxter, proving too small and defective in other respects, has been replaced by a new and larger one, of the same general form, and of the following dimensions :

Height	7 feet.
Diameter.....	46 inches.
Diameter of fire grate	40 inches.
Number of tubes, about.....	150
Diameter of tubes.....	2 inches.
Length of tubes	4 feet.
Height of fire box, about.....	2 feet.
Area of fire grate, about	8.71 sq. ft.
Area of heating surface, about.....	<u>320 sq. ft.</u>

At the foot of the smoke pipe is placed a superheating arrangement, consisting of a series of hollow cast iron spheres, connected by short pipes, through which the steam passes, on its way from the boiler to the high pressure cylinder. It will be observed that the present fire-grate of the Baxter's boiler is more than double that of

the original boiler. Now, natural draught is generally ample, to make all the steam required for the Baxter's propulsion, at the required speed. The blower is now only occasionally required, after the fires have been cleaned. The Baxter left the weigh-lock in Syracuse promptly on time, at 6:21 A. M., on the 15th of October, with a cargo of 201½ tons of wheat and grindstones. The times at which she passed the principal points between Syracuse and Utica, together with the average speeds, from point to point, and from Syracuse to each point in succession, are given in the following table:

STATIONS.	Distances.	Time.	AVERAGE SPEEDS.	
			Point to point.	From Syracuse.
Syracuse.....	..	A. M. 6:21	....	....
Lodi.....	1	7:06	3.12	3.12
Limestone Feeder.....	7	8:40	3.82	3.70
Manlius.....	8	9:30	1.20	3.94
Kirkville.....	11	10:23	3.41	2.06
Pool's Brook.....	12	10:48	2.38	3.99
Bolivar.....	14	11:25	3.23	3.02
Chittenango.....	15	11:48	2.73	2.99
		P. M.		
New Boston.....	17	12:55	1.79	2.77
Canastota.....	21	2:15	3.00	2.81
Lenox.....	23	3:08	2.27	2.75
Durhamville.....	26	4:00	3.45	7.82
Dunbarton.....	30	5:12	3.33	2.87
New London.....	35	7:00	2.78	2.86
Rome, arrived.....	41	9:26	2.47	2.80
Rome, left.....	..	9:45	....	....
		A. M.		
Oriskany.....	49	12:15	3.20	2.86
Whitesboro.....	52	1:08	3.41	2.88
New York Mills.....	53	1:35	2.22	2.87
Utica.....	56	2:30	3.89	2.91

The detentions allowed, in the foregoing are:

	Hours.	Min.
Three lockages at Syracuse.....	..	25.8
Detention at Rome.....	..	19.0
Lockage at Utica.....	..	8.6
Total.....	0	53.4
Total time from Syracuse.....	20	09.0
Running time.....	19	15.6

	Pounds.
Coal consumption.....	830 00
Average steam, high pressure cylinder.....	87.10
Average steam, low pressure cylinder.....	18.55
	<hr/>
	Inches.
Average vacuum.....	7.15
Average revolutions, Syracuse to Utica.....	100. 2
Average revolutions, Syracuse to Rome.....	101.33
Average revolutions, Rome to Utica.....	96. 8
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Detentions noted, other than lockages, and at Rome.

	Minutes.
At lock 48.....	02
At Chitenango to key up.....	10
East of Rome by boats.....	05
At New York Mills by crowd of boats.....	12
Total.....	29
	<hr/> <hr/>

Deductions.

	Hours.	Min.
Total time from Syracuse.....	20	9
Less four lockages.....	34.4	
Less detention at Rome.....	19.0	
Less other detentions as above.....	29.0	
Less 20 detentions of 2 minutes each, passing boats..	40.0	
	<hr/>	2 02.4
Running time.....	18	06.6
	<hr/> <hr/>	<hr/> <hr/>

Average speed, less all detentions.....	3.09 miles per hour.
Average speed from Syracuse to Rome, less all detentions.....	2.92 miles per hour.
Average speed from Rome to Utica, less all detentions.....	3.53 miles per hour.
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Coal consumption, per mile.....	14.82 pounds.
Coal consumption, Syracuse to Rome.....	17.17 pounds.
Coal consumption, Rome to Utica.....	8.4 pounds.
Average speed of screws.....	4.54 miles per hour.
Apparent slip $\frac{4.54 - 3.09}{4.54} \times 100$	32.1 per cent.

In this case, also, we observe a difference in the speeds west and east of Rome; the difference in this instance being, however, only 0.61 a mile; but it will be noticed that there was a marked falling off in the revolutions east of Rome. This resulted from a partial hauling of the fires at Rome upon the supposition that the boat would be ordered to tie up at that point for the night. When the

Baxter left Rome, at 9:45 P. M. her fire, although probably quite heavy, was not burning briskly, and consequently did not, for a time, make sufficient steam to maintain the previous average revolutions.

Had the revolutions been maintained it is quite likely that the difference in average speeds east and west of Rome, would have been practically the same in the case of the Baxter as in the cases of the other boats.

The Baxter had two three-bladed screws, of $4\frac{1}{2}$ feet diameter and 4 feet pitch.

During the trial, however, the starboard screw ran with only *two* blades, the third having been previously broken off at the hub. Thus it appears that this boat ran with only five-sixths of her normal propelling surface.

The main object of Mr. Baxter during the trial, appears to have been to make just the required speed with the minimum consumption of coal. A higher rate of speed could easily have been made, by forcing the fire with the blower. Such additional speed would, however, have been attained at a sacrifice of economy, and for that reason it was not attempted.

It may be asked, what evidence have we that the blower was not used? I answer that the remarkably low rate of combustion — less than five pounds of coal per square foot of grate per hour — affords evidence entirely conclusive upon that point.

For the purpose of satisfying the public generally, and the commission particularly, as to the truthfulness of the reports concerning the coal consumption of the Baxter, during and before the trial, Commissioners Geddes and Chapman decided to accompany the Engineer upon a further trial. Accordingly, the Baxter, with these and other gentlemen on board, left the weigh-lock at Utica, at 6.54 P. M., October 16th, bound east with her full cargo. The night was for the most part very dark and rainy, rendering it necessary to run with extreme caution, especially when approaching locks.

The observations of the gentlemen named extended through the night, and until 7:10 A. M., October 17th, at which hour the steamer arrived at St. Johnsville, thirty-four miles from Utica. The following notes were taken by me during the night:

Canal steamer William Baxter, left Utica weigh-lock at 6:54 P. M., October 16th, steam 80 pounds; slow, 8 minutes. Stopped from 7:16 to 7:17, one minute. At 7:30 steam 110; revolutions, 104; at 8, steam 111; revolutions, 104; at 8:30, steam 108; revolutions, 104; at 8:45, I weighed out $58\frac{1}{2}$ pounds of coal; at 9,

steam 88; revolutions, 96; stopped from 9:06 to 9:11, 5 minutes; at 9:25, I weighed out $58\frac{1}{2}$ pounds of coal; at 9:30, steam 92; revolutions, 100; stopped from 9:47 to 9:50, 3 minutes, waiting for the lock at Frankfort; at 9:54, in Frankfort lock, No. 45; at 9:59 left Frankfort lock; at 10, steam 87; revolutions, 100; stopped from 10:17 to 10:19, 2 minutes, waiting for lock 44; at 10:18, I weighed out $59\frac{1}{2}$ pounds of coal; stopped from 10:20 to 10:28, 8 minutes, waiting for same lock, 44; at 10:33 in lock 44; at 10:38 left lock 44; at 10:38, steam 105; revolutions, 96; at 11:00, steam 92; revolutions, 92; at 11:04, passed Ilion; at 11:29, stopped and backed for lock 43; at 11:34, ahead; detention 5 minutes; at 11:38, stopped; at 11:41, in lock 43; at 11:47, left lock 43; stopped from 11:51 to 11:53; 2 minutes for lock 42. At 11:56, in lock 42; at 12, midnight, left lock 42; at 12, steam 100; revolutions, 92; at 12:15 A. M., I weighed out $52\frac{1}{2}$ pounds of coal; at 12:30, steam 85; revolutions, 96. Stopped from 12:51 to 1 A. M.; 9 minutes for lock 41; 1:08 left lock 41; at 1:10, steam 98; revolutions, 100; at 1:12, weighed out $60\frac{1}{2}$ pounds of coal; at 1:30 steam 82; revolutions, 92. Stopped from 1:55 to 1:59, 4 minutes for lock 40; at 2:04 in lock 40; at 2:08 left lock 40; at 2:15 I weighed out $40\frac{1}{2}$ pounds of coal; at 2:30 steam 104; revolutions, 108; at 3 in lock 39, at Little Falls, 22 miles; at 3:06 left lock 39; 3:13 in lock 38, detained 2 minutes for lock; at 3:19 left lock 38; at 3:23 in lock 37; at 3:25 I weighed out $62\frac{1}{2}$ pounds of coal; at 3:28 left lock 27; at 3:30, steam 95; revolutions, 100; at 3:43 in lock 36; at 3:48 left lock 36; at 4, steam 80; revolutions, 92; at 4:30 I weighed out $56\frac{1}{2}$ pounds of coal; at 4:30, steam 80; revolutions, 84; at 5, steam 84; revolutions, 80. Stopped from 4:57 to 5, 3 minutes; at 5:15 engine stopped on account of a hot journal; shaft bent on port side; engine has been running slowly for half an hour; at 5:15 I weighed out 56 pounds of coal; at 5:20 ahead; detention 5 minutes; at 5:37 in lock 35; at 5:43 left lock 35; at 6:05 I weighed out $62\frac{1}{2}$ pounds of coal; at 6:43 left lock 34; 5 minutes in lock; at 7:10 A. M., October 17th, arrived at St. Johnsville, 34 miles east of Utica, having passed through 12 locks — or two more than the number due to the distance run from Utica.

	Pounds.
Coal served out between Utica and St. Johnsville.....	567.5
When the Baxter left Utica, the fire was $7\frac{1}{2}$ inches thick; but upon her arrival at St. Johnsville, it was only $5\frac{1}{2}$ inches thick. $7\frac{1}{2}$ inches thick on the grate, represents 250 pounds of coal.	
Hence we have to add to the coal served out $\frac{1\frac{1}{2}}{7\frac{1}{2}} = \frac{1}{5}$ of 250;	
or say.....	50.5
Total coal consumption	<u>617.0</u>

Average revolutions per minute, 96.47. Average steam pressure in boiler, 94.18 pounds.

Time Actually Spent in Locks.

	Min.
In lock 45.....	5
In lock 44.....	5
In lock 43.....	6
In lock 42.....	4
In lock 41.....	5
In lock 40.....	4
In lock 39.....	6
In lock 38.....	6
In lock 37.....	5
In lock 36.....	5
In lock 35.....	6
In lock 34.....	5
In 12 locks.....	<u>62</u>

Average time in locks, 5 minutes 10 seconds.

Actual Detentions, other than in Locks.

	Min.
From 7:16 to 7:17 P. M.....	1
From 9:06 to 9:11 P. M.....	5
From 9:47 to 9:50 P. M.....	3
From 10:17 to 10:19 P. M.....	2
From 10:20 to 10:28 P. M.....	8
From 10:29 to 11:34 P. M.....	5
From 11:51 to 11:53 P. M.....	2
From 12:51 to 1:00 A. M.....	9
From 1:55 to 1:59 A. M.....	4
For lock 38	2
From 4:57 to 5:00 A. M.....	3
From 5:15 to 5:20 A. M.....	5
Total, 12 detentions.....	<u>49</u>

With two exceptions, the above-detentions were due to darkness. Upon approaching locks, it was impossible to ascertain whether or not they were ready to receive the boat. This rendered it necessary to slow or stop some distance above, in order to hear the announcement, "lock ready," from the lock-tenders.

The hot journal, which caused a stoppage of five minutes, and rendered it necessary to run slowly for nearly an hour, was caused by a bent shaft, which became bent in this wise: While waiting for a lock, about midnight, the Baxter swung across the canal, in such a way that one of her port propeller blades struck, and rested upon the slope wall so heavily as to carry away the blade. The remainder of the distance to St. Johnsville was, of course, run with an aggregate of four blades, or two-thirds of the normal propelling surface of the screws; the effect of which was very apparent in the behavior of the machinery.

Deductions.

	Hours.	Min.
Total time from Utica to St. Johnsville.....	12	16
	Hours.	Min.
Less time lost in twelve locks.....	1	02
Less detentions other than in locks.....	..	49
	-----	-----
	1	51
	-----	-----
Actual running time	10	25
	-----	-----
		Miles per hour.
Average speed, less all detentions		3.26
Average speed, less detentions in locks.....		3.03
Average speed, less detentions other than in locks.....		2.97
Average speed, including all detentions		2.77
Coal consumption, per mile, 18.18 pounds.		-----

In considering the foregoing results, it should be kept constantly in mind that the run was made during a dark and stormy night; that the boat was run slowly, to avoid collisions; that no artificial means were resorted to for the purpose of increasing the draught, except for about ten minutes after the fire had been cleaned, and that the steam was throttled more or less during the entire run of 34 miles. It will also be observed that no note was taken of the time lost in passing horse-boats.

As showing the difference between running at night, and in the day time, the particulars of the run from St. Johnsville to Fultonville are given as follows:

"Baxter arrived at Fultonville, at 1:10 P. M." (Telegram received from Mr. Geo. Rowland who was on board.)

The distance from St. Johnsville to Fultonville is 20 miles. The average speed, including all detentions, between these two points, was, therefore, $\frac{20}{6} = 3.33$ miles per hour.

The total time from Utica to Fultonville, 54 miles, was 18 hours 16 minutes; and the average speed, including all detentions, 2.96 miles per hour. Deducting simply the detentions suffered during the night—exclusive of lockages—we have a running time of 17 hours, 27 minutes; and an average speed of 3.09 miles per hour.

At the same rate of increase, over the speed of the night run, the Baxter had no doubt made up her voyage, 3 miles per hour, before night, on the 17th, inclusive of all detentions.

East of Fultonville, we have no record of this trip of the Baxter. From Utica to St. Johnsville, the average speed of the screws were 4.38 miles per hour; the apparent slip was, therefore, $\frac{4.38 - 3.26}{4.38} \times 100 = 25.57$ per cent. Assuming the average speed of the current to have been half a mile per hour, the actual slip of the screws was 36.9 per cent.

General Remarks.

The invariable, and practically uniform, increase in speed, upon passing Rome, demonstrates, conclusively, the existence of currents, of considerable magnitude, running in opposite directions from that point. Indeed, this condition of things might have been anticipated, from the fact that a large portion of the water supplied to the long level entered at this point.

Being aware of the existence of these currents, and being also aware that their combined effect would be to affect the apparent speeds of all the boats, prejudicially, while running eastward, I proposed a *round trip*, between Syracuse and Utica; so that the entire distance might be traversed twice, in opposite directions, to the end that the effect of current might be wholly eliminated from the results. The proposition having been overruled, we find ourselves in possession of results which, in every case, are less than would have been shown, had the boats ran in absolutely still water, of the same width and depth that exist between Syracuse and Utica.

It remains, then, for us to eliminate, as far as we are able with the results attained, the effect of current upon the observed speeds of the several boats. Fortunately, the nearly uniform difference of speeds, east and west of Rome, enable us to say, with some degree of confidence, just what the average effect of the current was. Referring to the results already obtained, we find the following differences, in mean speeds east and west of Rome:

	Miles per Hour.
In the case of the Central City.....	1.23
In the case of the Port Byron.....	0.96
In the case of the C. C. Pope.....	1.00
In the case of the William Newman.....	1.02
In the case of the William Baxter.....	0.61
	<hr/>
Total.....	4.82
Mean.....	0.964
One-half.....	<u>0.482</u>

Thus it appears, that the mean speed of the current, between Syracuse and Utica, was, say 0.48 of a mile per hour. This quantity, added to the several speeds between Syracuse and Rome, may be taken as fairly representing the average speeds, through the water, of the several competing boats, during the trial.

We thus obtain the following results :

For the Central City.....	$2.29 + 0.48 = 2.77$ miles per hour.
For the Port Byron.....	$2.29 + 0.48 = 2.77$ miles per hour.
For the C. C. Pope.....	$2.29 + 0.48 = 2.77$ miles per hour.
For the Wm. Newman.....	$2.41 + 0.48 = 2.89$ miles per hour.
For the Wm. Baxter.....	$2.92 + 0.48 = 3.40$ miles per hour.

The apparent slips of the several propelling instruments while affected by the current, and being therefore not strictly correct, are all determined in the same manner and show relatively their respective efficiencies, except, possibly, in the case of the Baxter, where, on account of her peculiar model, less power is required for her propulsion, and where, consequently, other things being the same, her screws should slip less than the propellers of fuller modeled boats.

A summary of the performances of the several boats during the trial is appended.

Respectfully submitted,

D. M. GREENE,

Engineer to Commission.

TROY, November 17, 1873.

TRIAL of canal steamers between Syracuse and Utica, October 15th and 16th, 1873.

Assem. Doc. No. 65.]

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NAME OF PLACE.	Distance from Syracuse. Miles.	WM. BAXTER — SPEEDS. (Miles per hour.)		WM. NEWMAN — SPEEDS. (Miles per hour.)		C. C. POPE — SPEEDS. (Miles per hour.)		PORT BYRON — SPEEDS. (Miles per hour.)		CENTRAL CITY — SPEEDS. (Miles per hour.)	
		Point to point.	From Syracuse.	Point to point.	From Syracuse.	Point to point.	From Syracuse.	Point to point.	From Syracuse.	Point to point.	From Syracuse.
Syracuse	0	....	....	....	....	....	....	....	....	....	....
Lodi	1	3.12	3.12	4.39	4.39	1.54	1.54	2.50	2.50	1.04	1.04
Limestone Feeder....	7	3.82	3.70	....	....	....	....	....	....	....	....
Manlius	8	1.20	2.94	2.44	2.58	2.26	2.13	2.06	1.89	2.08	1.85
Kirkville	11	3.41	3.06	2.78	2.63	2.66	2.25	3.00	2.10	2.44	1.62
Pool's Brook.....	12	2.38	2.99	1.92	2.55	1.76	2.20	1.33	2.01	1.92	1.98
Bolivar	14	3.23	3.02	2.35	2.52	2.41	2.23	....	....	2.17	2.00
Chittenango.....	15	2.73	2.99	0.73	2.16	1.88	2.19	2.26	2.05	1.50	1.96
New Boston.....	17	1.79	2.77	....	....	1.54	2.09	1.60	1.99	1.41	1.96
Canastota.....	21	3.00	2.81	2.88	2.33	2.68	2.19	2.29	2.03	3.33	2.05
Lenox Basin	23	2.27	2.75	....	....	....	....	0.92	1.84	1.41	1.98
Durhamville.....	26	3.45	2.82	1.71	2.18	....	....	2.11	1.87	2.26	2.00
Dunbarton	30	3.33	2.87	....	....	....	....	....	....	1.88	1.96
New London.....	35	2.78	2.86	1.45	1.92	2.41	2.27	....	....	2.08	1.98
Rome	41	2.47	2.80	2.07	1.95	2.08	2.24	2.28	2.00	2.13	2.02
Oriskany	49	3.20	2.86	3.05	2.07	3.23	2.36	2.91	2.11	3.20	2.16
Whitesboro	52	3.41	2.88	3.45	2.12	3.15	2.39	....	....	2.86	2.19
New York Mills	53	2.22	2.87	3.33	2.13	2.86	2.40	....	....	2.86	2.20
Utica	56	3.89	2.91	3.33	2.17	3.89	2.45	2.97	2.19	3.65	2.25

NOTE. — In the above 8.6 minutes are allowed for each lockage. The detentions at Rome are also deducted from the total time.

REPORT OF THE ENGINEER.

SUMMARY of Results of Trial of Canal Steamers between Syracuse and Utica, on the 15th and 16th of October, 1873, under the direction of the Commission appointed under act chapter 868, Laws of 1871.

Number.	NAME OF STEAMER.	TIMES.				SPEEDS.				COAL CONSUMPTION.		PROPELLING INSTRUMENT.	
		Total from Syracuse to Utica.	Detentions in locks and at Rome.	Other detentions.	Running time.	Syracuse to Utica, miles per hour.	Syracuse to Rome, miles per hour.	Rome to Utica, miles per hour.	In still water, miles per hour.	Total, lbs.	Per mile, lbs.	Speed of, miles per hour.	Apparent slip, per cent.
		H. M.	H. M.	H. M.	H. M.								
1. . .	William Baxter	20 09	0 53.4	1 09	18 06.6	3.09	2.92	3.53	3.40	830	14.82	4.55	32.1
2. . .	William Newman	27 08	1 31.4	3 57	21 39.6	2.59	2.41	3.48	2.89	4,000	71.5	7.68	66.3
3. . .	C. C. Pope	26 35	3 44.4	0 25	22 25.6	2.50	2.29	3.29	2.77	2,520	45	5.17	51.6
4. . .	Port Byron	29 ..	3 25.4	3 01	22 33.6	2.49	2.29	3.25	2.77	5,425	96.9	7.59	67.2
5. . .	Central City	27 52	2 59.4	2 43 $\frac{1}{2}$	22 09.1	2.53	2.29	3.52	2.77	7,080	126.43	5.72	54

NOTE.—The speeds, in still water, are determined by adding to the speeds between Syracuse and Rome (against the current) one-half the average difference between the speeds east and west of Rome.

With the record before us, we have now to inquire as to how far the competing boats have succeeded in meeting the requirements of the law.

These requirements are substantially as follows :

1. That the inventions or devices shall be tested and tried at their own proper costs and charges of the parties offering the same for trial.

2. That the boat shall, in addition to the weight of the machinery and fuel reasonably necessary for the propulsion of said boat, be enabled to transport, and shall actually transport on the Erie canal, on a test or trial exhibition, under the rules and regulations now governing the boats navigating the canals, at least 200 tons of cargo.

3. That the rate of speed made by said boat shall not be less than an average of 3 miles per hour, without injury to the canals or their structures.

4. That the boat can be readily and easily stopped or backed by the use and power of its own machinery.

5. That the simplicity, economy and durability of the invention or device must be elements of its worth and usefulness.

6. That the invention, device or improvement can be readily adapted to the present canal-boats.

7. That the commissioners shall be fully satisfied that the invention or device will lessen the cost of canal transportation.

8. That the general adoption of the invention or device would increase the capacity of the canal.

To these, the commission has added, as a preliminary test —

9. That the competing boats shall make three round trips between Buffalo or Oswego and New York.

The *first* requirement has unquestionably been met by all the competitors.

All the competing boats, except the Geo. A. Feeter, have shown their ability to carry, and have actually carried cargoes of 200 tons and over, on the Erie canal. The *second* condition has therefore been satisfied by all the competing boats, excepting only the Geo. A. Feeter, which was able to carry only 168 tons on six feet draught of water (see Report, February 18, 1873, p. 106).

The *fourth* condition has been satisfied by all of the competing boats.

As to the *fifth* requirement it may be said, that the machinery of all of the boats mentioned, except, perhaps, that of the Fountain City, and that of the C. C. Pope, may be regarded as not

particularly objectionable on the ground of complexity, as giving reasonable promise of durability, provided that all the *other* conditions are satisfied. The exceptions in the cases of the Fountain City and the C. C. Pope, are made as a matter of opinion only, which, however, seems to be justified by, and is based upon, a careful examination and observation of the operation of these boats.

The commission, at its first meeting, held at Albany, July 10, 1871, prescribed as the first test, that the competing boats should make at least three round trips between New York and Buffalo or Oswego, carrying not less than 200 tons of cargo each way. Subsequently, at a meeting held at Albany on the 7th of August, 1872, the cargo required to be carried west was reduced to 100 tons.

In considering what boats, if any, have met *all* the requirements, the commission will be relieved from some embarrassment by the fact that only the Baxter, the Newman, the Port Byron and the Dawson, so far as we are advised, have made the three round trips, specially prescribed by the commission as one of the tests to be applied. The boats named above have then met the *ninth* requirement.

Have these boats, or either of them, satisfied the *third* condition, by demonstrating their ability to make an average speed of three miles per hour through the canal, with cargoes of 200 tons?

The speeds made by each of these boats on their eastern trips, so far as the same can be ascertained, taken from the report of February 18, 1873, and from the reported performances during the season of 1873, are as follows:

Trips East.

NAME OF BOAT.	FIRST TRIP.		SECOND TRIP.		THIRD TRIP.	
	Cargo.	Speed.	Cargo.	Speed.	Cargo.	Speed.
	Tons.	M. P. H.	Tons.	M. P. H.	Tons.	M. P. H.
William Baxter.....	201.6	3.38	201.0	3.06	201.0	3.48
William Newman.....	201.6	2.50	201.0	2.64	204.4	2.76
Port Byron.....	200.2	2.05	200.2	2.58	198.4	2.98
A. H. H. Dawson.....	179.3	2.16	199.9	2.18	187.5.	....

While all of these boats, except the Port Byron, averaged over 3 miles per hour between Buffalo and Rochester, and also for short distances on other parts of the canal, it appears that the Baxter alone averaged 3 miles per hour from Buffalo to West Troy. It may be that the Port Byron also averaged 3 miles per hour

between Buffalo and Rochester; but there is no evidence of the fact, as the times of arrival at Rochester were not indorsed upon the clearances.

During the season of 1873, we have the following results, attained by the Baxter: At the trial between Syracuse and Utica, 3.09 miles per hour, nearly four-fifths of the run having been made *against* the current.

Afterward, upon continuing the trip east, the following results were attained

	Miles per hour.
From Utica to St. Johnsville, less all detentions	3.26
From Utica to St. Johnsville, less detentions in locks.	3.03
From Utica to St. Johnsville, less detentions other than in locks	2.97
From Utica to St. Johnsville, including all detentions.	2.77
From St. Johnsville to Fultonville, 20 miles, including all detentions.	3.33
From Utica to Fultonville, 54 miles, including all detentions.	2.96
The Newman made, from Syracuse to Utica, an average speed of.	2.59

Upon continuing the trip east, with a screw propeller, the following results were attained :

	Miles per hour.
From Utica to Little Falls, the average speed, including all detentions, was.	2.97
Average speed, exclusive of lockages.	3.27
From Little Falls to West Troy, the average speed, including all detentions, except lockages, was	3.10
The Port Byron's speed between Syracuse and Utica, during the trial, was.	2.49

The speeds attained by these boats, on their westward trips, during the season of 1872, were as follows :

Trips West.

NAME OF BOAT.	FIRST TRIP.		SECOND TRIP.		THIRD TRIP.	
	Cargo.	Speed.	Cargo.	Speed.	Cargo.	Speed.
	Tons.	M.P.H.	Tons.	M.P.H.	Tons.	M.P.H.
William Baxter	102.25	2.80	113.12	3.48	114.5	3.45
William Newman	114	2.81	127.75	2.77	101.9	2.88
Port Byron	100	2.59	126	2.53	117	3.45
A. H. Dawson	191.65	1.79	162 av.	?	100	?

From the foregoing it appears that, during the season of 1872, the Baxter exceeded 3 miles per hour on two of the three western trips, and that the Port Byron exceeded 3 miles upon only one of her three trips, while neither of the other two boats succeeded in attaining the required speed.

During the season of 1873, the only report we have of western trips is from the Newman. After the Syracuse trial, with her screw, and the improvements effected by Capt. Dobbins, the following results were obtained :

	Miles per hour.
From Troy to Buffalo, with a cargo of 121 tons, the average speed, including all detentions, was	2.98
Average speed, exclusive of 10 hours for lockage	3.26
Average speed, exclusive of lockages and other detentions.	4.24
Average speed, exclusive of detentions other than lockages.	3.78

It appears, therefore, that of those boats which have made the three round trips required by the commission as one of its tests, the Baxter and the Newman, only, have demonstrated their ability to maintain an average speed of 3 miles per hour, on the eastward trip, with cargoes of 200 tons; while on the westward trip, the Port Byron has also shown her ability to make the required speed.

Thus, the contest is narrowed down to the Baxter and the Newman; all of the other boats having failed to meet either the *third* requirement, or the special test prescribed by the commission.

These two boats having met the first four of the requirements of the act, and having also made the required three round trips, let us inquire whether they, or either of them, have met the *seventh* requirement, by showing that, by their general adoption, the cost of transportation upon the canals would be lessened.

Estimating upon the basis of 7 round trips the season, and 27.4 cents per mile for towing, with cargoes of 230 tons east, and returning light, we found last year, the cost of transportation by horse-boats, to be as follows (see Report for 1872, pp. 118, 119):

Cost per boat, per annum	\$4,083.42
Cost per ton moved 495* miles	2.53 $\frac{8}{10}$
Cost per ton moved 1 mile	5 $\frac{1}{2}$ mills.
Cost per bushel of wheat moved 495 miles	7 $\frac{8}{100}$ cents.

It may, perhaps, be fairly assumed that the cargoes west have heretofore averaged at least one-fourth of those east, or $\frac{230}{4} = 57.5$ tons. If this assumption be justified by the facts, the costs per ton

* Distance between Buffalo and New York, via Erie canal and Hudson river.

and per bushel just given will be reduced 20 per cent, and will be in fact as follows:

Cost per ton moved 495 miles	\$2.02	$\frac{88}{100}$
Cost per ton moved 1 mile		$\frac{41}{10}$ mills.
Cost per bushel of wheat moved 495 miles		$\frac{61}{100}$ cents.
		<hr/> <hr/>

Adding tolls 3.1 cents per bushel on the canal, the above values become:

Cost per ton moved 495 miles	\$2.13	$\frac{21}{100}$
Cost per ton moved 1 mile		$\frac{43}{10}$ mills.
Cost per bushel of wheat moved 495 miles		$\frac{91}{100}$ cents.
		<hr/> <hr/>

The present cost of transporting wheat from Buffalo to New York in horse-boats will therefore be taken at 10 cents per bushel, including tolls, and exclusive of insurance, commissions and other incidental expenses, which, together with tolls, are of course common to all modes of canal transportation.

In estimating the cost of transportation by steam power, the Baxter and the Newman will be considered separately; and, while the estimates of last year are believed to be, upon the whole, entirely fair, our present estimates will be made to appear somewhat less favorable, in order that there may be no reasonable ground for doubt that, in case of the general adoption of steam, equally favorable results may be realized.

Last year the estimates were based upon an assumed coal consumption of 45 pounds per mile. This year we have, in the case of the Newman, a consumption of 35 pounds per mile; while in the case of the Baxter it is less than 20 pounds.

Considering first:

The "Baxter."

We put cost of hull, say.....	\$5,000
Cost of machinery.....	3,000
	<hr/>
Total	\$8,000
	<hr/> <hr/>

Taking the season of navigation at only 210 days, and the annual interest upon the investment at 7 per cent, the interest will be \$560; which, charged against 210 days of navigation, amounts to \$2.67 per day. An equal sum invested annually will produce a sum sufficient to renew the boat and its machinery, in a little more

than ten years. We have then the cost of renewal, assuming the life-time of the boat and machinery to be ten years, \$2.67 per day.

The cost of repairs is very variable. As showing extreme results, the cases of the tugs Matthew Roe and Witbeck, owned by Messrs. Riley and McLane of West Troy, are specially mentioned. The expense of repairs to the machinery of the former for three years was only \$9.75; while in the latter the expense for repairs amounted to \$8.70 in a single year. Messrs. Riley and McLane express the opinion that for tugs on the Hudson river, the average annual expense for repairs of machinery is about \$300.

A gentleman of very large experience in steam transportation between New York and Philadelphia, via Delaware and Raritan canal, and also upon other routes, in a recent communication to me, says:

“On ordinary fresh-water routes, and with good men, to *maintain* an engine and boiler will cost from 15 to 20 per cent, the *repairs* being from 5 to 20 per cent.”

At my request, Mr. Baxter has furnished an approximate statement of the cost of repairs to and alterations in the hull and machinery of the Baxter, for the years 1872 and 1873, as follows:

HULL.

Putting on chafing strips on bilges.....	\$86 00
Painting and caulking deck.....	36 00
Total	<u>\$122 00</u>

MACHINERY.

Replacing gearing.....	\$12 00
Replacing gearing.....	14 00
New set of brasses.....	30 00
New set of links.....	35 00
Two propellers.....	46 70
Repairing donkey pump.....	14 00
Repairing and changing pipes.....	100 00
Total	<u>251 70</u>

It should be stated, in regard to some of these items, that they could not have occurred had the design of the machinery been like that of the “City of New York,” where all gears and one set of excentrics and links are dispensed with; as is also the donkey-pump.

The expenses which have been incurred for alterations, and which are not properly chargeable as repairs, were as follows:

Putting on forward cabin.....	\$125 00
Putting in new boiler.....	1, 000 00
Putting in set of brass gears.....	130 00
Putting in larger air-pump.....	50 00
Putting in ventilators to engine-room	18 00
Felting and covering boiler	35 00
Docking boat to change propellers, and other expenses connected therewith.....	750 00
	<hr/>
Total.....	\$2, 108 00
	<hr/> <hr/>

These last may be properly designated as *experimental* expenses, and are not in any sense expenses for *repairs*, except, possibly, some portion of the expense of docking the boat.

In view of all the facts, and of all the information I am able to obtain, it seems that it cannot be reasonably claimed that the repairs upon well designed, well constructed and properly managed machinery of the kind in question, for canal purposes, will exceed an average of seven per cent upon the first cost, for each year.

The same allowance being made for repairs to the hull, we have, finally, a daily allowance of \$2.67 for repairs of all kinds; which, added to like sums, already fixed upon for interest and for maintenance, gives, for the three items, a total of \$8.01 per day.

Taking the estimated cost per season, of crew, as per report for 1872, p. 119, at \$2,355, the daily cost will be \$11.21.

Allowing now $5\frac{1}{2}$ days for the trip from Buffalo to Troy, $1\frac{1}{2}$ days for the trip from Troy to New York and 4 days for detentions at Buffalo and New York, the time required to make a round trip will be $2(5\frac{1}{2} + 1\frac{1}{2}) + 4 = 17\frac{1}{2}$ days; at which rate 12 round trips will be made in a season of 210 days. While it has been shown that, with exceptionally skillful firing, the "Baxter" may be made to run upon less than 20 pounds of coal per mile, we shall assume that, under ordinary circumstances, and with ordinarily good firing, the coal consumption will be 25 pounds per mile.

The cost of a single round trip, will, therefore, be as follows:

Interest, maintenance and repairs, $17\frac{1}{2}$ days, at \$8.01.....	\$140 17
Wages and board of crew, $17\frac{1}{2}$ days, at \$11.21	196 17
Coal $\frac{25 \times 17\frac{1}{2}}{2000} = 12.375$ tons, at \$5.50	68 06
Oil, tallow and waste, say	9 60
	<hr/>
Total.....	\$414 00
	<hr/> <hr/>

If then the boat be loaded only upon her eastern trip, we have the following results:

Cost of 200 tons, moved 495 miles	\$414 00
Cost of 1 ton, moved 495 miles	2 07
Cost per ton mile	$4\frac{18}{100}$ mills.
Cost per bushel of wheat, Buffalo to New York	$6\frac{21}{100}$ cents.

If the boat carry one-fourth of a full cargo west, or 50 tons, we have:

Cost of 250 tons, moved 495 miles	\$414 00
Cost of 1 ton, moved 495 miles	1 65 $\frac{3}{4}$
Cost per ton, mile	$3\frac{34}{100}$ mills.
Cost per bushel of wheat, Buffalo to New York	$4\frac{97}{100}$ cents.

If—as we believe it will—increased speed and regularity of movement shall secure to the steamer cargoes of 100 tons west, we shall have:

Cost of 300 tons, moved 495 miles	\$414 00
Cost of 1 ton, moved 495 miles	1 38
Cost per ton, mile	$2\frac{78}{100}$ mills.
Cost per bushel of wheat, Buffalo to New York	$4\frac{14}{100}$ cents.

If tolls be added, in each case, the costs of transporting a bushel of wheat from Buffalo to New York, in the several cases, will be as follows:

1. Boat loaded east and returning light	$9\frac{31}{100}$ cents.
2. Boat carrying 200 tons east, and 50 tons west	$8\frac{17}{100}$ cents.
3. Boat carrying 200 tons east, and 100 tons west	$7\frac{17}{100}$ cents.

as against a cost of 10 cents, exclusive of towing company's profits, by horse-boats making seven round trips, and carrying one-fourth cargoes, or $57\frac{1}{2}$ tons west.

Calling attention to the fact that, in the case of the horse-boat, we have allowed only 10 per cent per annum for maintenance and repairs; that we have assumed her to make the maximum of seven round trips the season, and that the towing company's profits have been excluded, while, in the case of the steamer, we have allowed 14 per cent per annum for maintenance and repairs, together with a number of round trips which can unquestionably be made,—and comparing results, under similar conditions as to cargoes east and west, we find a difference of $18\frac{1}{2}$ per cent in favor of the steamer in the cost of movement proper.

Tolls are, of course, excluded in the comparison, as they are a common charge to both systems.

A season's work of the horse-boat, upon the basis of seven round trips, with cargoes of 230 tons east and $57\frac{1}{2}$ tons west, will be:

Tons moved from Buffalo to New York.....	1,610
Tons moved from New York to Buffalo.....	402.5
	<hr/>
Total, moved 495 miles	2,012.5
	<hr/> <hr/>

At a cost of \$4,083.42.

A season's work of the steamer, upon the basis of 12 round trips, with cargoes of 200 tons east and 50 tons west, will be:

Tons moved from Buffalo to New York.....	2,400
Tons moved from New York to Buffalo.....	600
	<hr/>
Total, moved 495 miles	3,000
	<hr/> <hr/>

At a cost of \$4,968.

It thus appears that, by steam, 2,466 tons may be transported between Buffalo and New York at a cost certainly not greater than the cost of moving $2,012\frac{1}{2}$ tons between the same points by the present horse-boat.

In the case of

The "William Newman,"

We shall take the cost of the hull and machinery complete, as reported by her owner, at \$7,000, and shall allow, as before, 7 per cent per annum each for interest, renewal and repairs, or 21 per cent for the three items.

Taking the season of navigation, as before, at 210 days, the daily amount of these items will be \$7; the daily expense of the crew, for wages and board, will be \$11.21; the coal consumption, being in this case 35 pounds per mile, or $\frac{7}{8}$ of that of the Baxter, the cost of fuel per round trip will be $\frac{7}{8} \times \$68.06 = \95.28 . The estimate of the cost of a single round trip, made as before, in $17\frac{1}{2}$ days, will therefore be as follows:

Interest, maintenance and repairs, $17\frac{1}{2}$ days, at \$7.....	\$122 05
Wages and board of crew, $17\frac{1}{2}$ days, at \$11.21.....	196 17
Coal, 17.325 tons, at \$5.50.....	95 28
Oil, tallow and waste, say	9 50
	<hr/>
Total.....	\$423 00
	<hr/> <hr/>

It thus appears that, in the case of the Newman, the reduction in cost, due to the uncertain and, it is believed, excessive allowance for interest, maintenance and repairs, on its smaller first cost, is somewhat less than the increase in cost, due to its larger coal con-

sumption. There is, therefore, a decided, though small, difference in favor of the Baxter.

Assuming the Newman to run loaded east, and to make the return trip light, we have the following :

Cost of moving 100 tons 495 miles	\$423 00	
Cost of moving one ton 495 miles	2 11½	
Cost per ton mile	$\frac{4.27}{1000}$	mills.
Cost per bushel of wheat, 495 miles	$\frac{6.36}{1000}$	cents.

If the movement west be one-fourth of that east, the above becomes :

Cost of moving 250 tons 495 miles	\$423 00	
Cost of moving one ton 495 miles	1 69½	
Cost per ton mile	$\frac{3.46}{1000}$	mills.
Cost per bushel of wheat, Buffalo to New York	$\frac{5.78}{1000}$	cents.

If cargoes of 100 tons be secured for the westward trip, we have .

Cost of moving 300 tons 495 miles	\$423 00	
Cost of moving one ton 495 miles	1 41	
Cost per ton mile	$\frac{2.86}{1000}$	mills.
Cost per bushel of wheat, 495 miles	$\frac{4.23}{1000}$	cents.

Adding tolls, in each of the three cases, we obtain for the cost of transporting a bushel of wheat from Buffalo to New York, exclusive of commissions, insurance and other incidental expenses :

1. Boat carrying 200 tons east, and returning light $\frac{9.436}{1000}$ cents.
 2. Boat carrying 200 tons east, and 50 tons west $\frac{8.176}{1000}$ cents.
 3. Boat carrying 200 tons east, and 100 tons west $\frac{7.100}{1000}$ cents.
-

Comparing results for horse-boat and steamer, under present assumed conditions, as to cargoes east and west, we find a difference of 18 per cent in favor of the steamer Newman.

If, however, the comparison be made between the costs of transportation by horse-boats, under the present assumed conditions, and the cost by steamer carrying half cargoes west, we find a difference of 26½ per cent in favor of the steamer Newman, and a difference of 27 per cent in favor of the Baxter.

A season's work of the Newman, carrying 200 tons east and 50 tons west, will be 3,000 tons moved between Buffalo and New York, at a cost of \$5,076, as against a movement of 2,012½ tons, at a cost of \$4,083.42, by a first-class horse-boat.

The foregoing results would seem to be conclusive as to the relative merits of the steamers Baxter and Newman, as to economy of movement.

Let us next inquire as to the profits likely to be realized, per season, by the horse-boat and by the steamer, and first as to the

Season's Profit of Horse-boat.

In order to ascertain what profit per annum may be anticipated from the operations of a first-class horse-boat, we shall assume, as heretofore, that the boat will make *seven* round trips per season, carrying cargoes of 230 tons of wheat east, at an average rate of 13 cents per bushel, including insurance, commissions, tolls, etc., and returning with cargoes of 57½ tons, at \$1.50 per ton, exclusive of tolls and the expense of loading and discharging. Two hundred and thirty tons are equivalent to 7,666 bushels of wheat.

7,666 bushels, at 13 cents, is	\$996 58
Less tolls, at 3.1 cents	\$237 65
Trimming, 15 cents per bushel.....	11 50
Insurance, say	20 00
Commissions, 5 per cent on \$758.93	37 95
Elevating in New York, ¼ cent	57 49
	<hr/>
Expenses on cargo	364 59
	<hr/>
Net freight on cargo.....	\$631 99

Return Trip.

57½ tons, at \$1.50, is.....	\$86 25
Less insurance, say.....	6 24
	<hr/>
Net freight on western cargo	80 01
	<hr/>
Net freight per round trip	\$712 00
	<hr/>
Net freight for seven round trips.....	\$4,984 00
Deduct expense of boat.....	4,083 42
	<hr/>
Profit for the season.....	\$900 58
	<hr/> <hr/>

In the foregoing we have assumed the boat to cost \$4,000, and have supposed that the boatman employs his own teams. If we take the value of the teams, harness and boat furniture at \$750, we have an investment of \$4,750, yielding an annual profit of \$900.58, or about 19 per cent over and above all expenses, and 7 per cent upon the assumed cost of the boat.

If the annual interest, \$280, heretofore included in the expense of the boat, be added to the net profit above, we have, from an investment of \$4,750, a net return of \$1,180.58, or 24.8 per cent.

Nine hundred dollars and fifty-eight cents represent about 1.7 cents per bushel upon 53,662 bushels carried during the season. Deducting this from the assumed rate of 13 cents per bushel, we have 11.3 cents as the lowest paying rate at which wheat can be transported from Buffalo to New York, under the assumed conditions, by a first-class horse-boat.

Season's Profit of a Steamer.

1. *Of the Baxter.*—Taking the cargoes east at 200 tons, or 6,666 bushels of wheat, and the cargoes west at 50 tons, the rates of freight being 13 cents per bushel and \$1.50 per ton, as before, we have :

6,666 bushels, at 13 cents is		\$866 58
Less tolls, at 3.1 cents per bushel.....	\$206 65	
Trimming, at 0.15 cents per bushel	10 00	
Insurance, say	20 00	
Commission, at 5 per cent on \$659.93.....	33 00	
Elevating in New York, at $\frac{3}{4}$ cent.....	50 00	
	<hr/>	
Total expense on cargo		319 65
		<hr/>
Net freight receipts on cargo		\$546 93

Return Trip.

50 tons, at \$1.50 is	\$75 00	
Deduct insurance, say	5 00	
	<hr/>	
Net freight receipts on cargo		70 00
		<hr/>
Net freight receipts per round trip		\$616 93
		<hr/>
Net freight receipts for 12 round trips		7,403 16
Deduct expense of steamer Baxter		4,968 00
		<hr/>
Profit for the season.....		<u>\$2,435 16</u>

Which represents 30.4 per cent upon the investment of \$8,000. Adding the 7 per cent already allowed as interest, we have a net return of \$2,995.16, or 37.4 per cent over and above maintenance, repairs and running expenses; \$2,435.16 represents a trifle over 3 cents per bushel, on 79,992 bushels carried during a season. Deducting this from the assumed rate of 13 cents per bushel, we have 10 cents as the minimum paying rate by the Baxter, under the assumed conditions, of course including tolls.

2. *Of the Newman.*—Assuming as we have done, that the steamers carry equivalent cargoes, and make the same number of

round trips per season, their gross earnings will be the same, while their net earnings will differ only by the difference in the annual expense of repairs, for interest, and for maintaining and operating them. This latter, in the case of the Baxter, we have found to be \$4,968; while in the case of the Newman, we have found it to be \$5,076. The net profit of the Newman, will therefore, be \$108 less per season under similar conditions as to cargoes and rates of freight, than that of the Baxter, or \$2,327.16; which is 33.2 per cent upon the investment. Adding the interest already included in the yearly expense of the Newman, the net profit, after providing for repairs, maintenance and operating expenses, appears to be 40.4 per cent.

In this connection it will be interesting to inquire as to what inducements are offered to the owner and operator of a first-class horse-boat, to incur the expense incident to the conversion of his boat into a steamer of the Newman class.

The actual profit on a season's work of a horse-boat, with freight averaging 13 cents on wheat, we have found to be \$900.58.

Responsible parties offer to contract to build engines and boilers, and to furnish all necessary mechanical appliances similar to the machinery of the Newman, for the sum of \$2,000.

Other responsible parties offer to contract to make all necessary changes in the hull of the horse-boat, for the sum of \$500. Adding \$250 for possible contingencies, we have an expenditure of \$2,750 necessary for the proposed conversion.

With the steamer, the boatman may make a net profit of \$2,327.16 in a single season, or \$1,426.58 more than he could make with his horse-boat. It thus appears that the increased net earnings of the steamer would, in two ordinary seasons, be sufficient to pay for the conversion.

In case the steamer should carry cargoes of 100 tons west, the excess of the net earnings for the season, at the assumed rates over the net earnings of a horse-boat, would be \$2,266.58. Thus the expense of the conversion would be reimbursed from the increased net profits of a little more than a season's work.

The foregoing results, if reliable, show conclusively that the employment of steam upon either of the plans under consideration, would lessen the cost of transportation on the canals, and would, at present rates, very largely increase the profits of the boatmen.

If we are correct, then, in our assumptions and estimates, — and of that the commission must judge, — the Baxter and the Newman, have both met the *seventh* requirement of the law.

In regard to the *sixth* requirement, that the devices shall be readily applicable to the present horse-boats, it may be said: That there is nothing impracticable in the change of the models of the present horse-boats in such a manner as to make them conform, substantially, to that of the steamer Newman; that the machinery of the Baxter, or of the Newman, can, without difficulty, be placed in the boats thus changed; that, while it is very likely that more power will be required to propel these altered boats than is required to propel boats of the Baxter model, the economy and efficiency of the Baxter machinery will in no wise be changed by being placed in such boats; that the Baxter machinery, applied to boats thus altered, while not fully representing the "Baxter" system, would, nevertheless, give results fully equal to those shown by the Newman; and hence, that the devices of both the Baxter and the Newman may be readily adapted to the present horse-boats, so as to enable them to fully meet the essential requirements as to speed and economy.

In this connection, attention is called to the fact that, under the most favorable circumstances, it is not to be expected that new steamers of any class would be built more rapidly than the present horse-boats will be worn out and become worthless for canal purposes; and that, should the hopes of the most sanguine be fully realized, by the time a sufficient number of steamers can be built to transport the freight passing over the Erie canal, the horse-boats now on the canal will have disappeared, having fully served the purpose for which they were built.

The gradual introduction of boats of an entirely new model would not, therefore, necessarily entail loss or inconvenience to the owners of horse-boats.

Finally, we have to inquire whether the capacity of the canal will be increased by the introduction of steam upon either or both of the plans under consideration.

The capacity of a canal is determined by the capacity of the largest boat that can pass the locks and by the time of lockage, or the number of boats that can be locked in a given time — it being assumed, of course, that the supply of water is ample.

The capacities of the boats to be considered here may be taken at an average of 230 tons for horse-boats and 200 tons for steamers.

The time of lockage, when considered with reference to the capacity of the canal, comprises the time during which the boat is actually in the lock, the time required by the boat to enter and to leave the lock, and the time which must elapse between the

instant at which one boat leaves the lock and the instant at which a boat moving in the opposite direction begins to enter the lock. This time, with the present management of the locks, will probably average nearly 15 minutes. We are to inquire, however, not what *is* done, but what *can* be done with locks efficiently manned.

In the year 1848, experiments were made at the first lock east of Rochester, with the lock fully manned. 198 boats were passed through a single lock in 24 hours; or one in $7\frac{1}{4}$ minutes. With double locks, then, 198 boats could reach tide water every 24 hours; which, at 230 tons each, would, in a season of 210 days, represent a delivery of 9,563,400 tons at tide-water.

With the same service at the locks, steamers, carrying 200 tons, may be locked in 5 minutes; which would insure a delivery, at tide-water of 12,096,000 tons, in a season of 210 days.

We thus have—or would have, with all double locks—capacities which are, respectively, three and four times the largest deliveries ever yet realized in any single year.

If we consider the capacities of the canal with the present management of the locks, the times of lockage, for steamers and horse-boats, may be put at 7 and 15 minutes, respectively; which will insure the delivery of 8,640,240 tons by steamers, and 4,636,800 tons by horse-boats; results which, while showing that the introduction of steam will increase the capacity of the canals, show also that the tonnage of the canals has never yet reached their present capacity, and that an explanation of the failure of the canals to retain their due proportion of the increase in eastern tonnage is to be found in the greater *speed* and regularity of movement, over competing lines of transit, rather than a want of capacity in the canal.

The great present need, therefore, of the canals, is the attainment of greater speed by the boats navigating them, and a reduction in the present cost of transportation over them, rather than increased capacity.

The experience of the last three years has shown conclusively that double the present speed of horse-boats may be attained by steamers, even with the serious interruptions to their free movement, caused by the present boats, and that the cost of transportation will thus be materially lessened.

All who have witnessed the performances of the competing steamers, and particularly those who have participated in the com-

petition, have been profoundly impressed with the conviction that, had the canal been in good condition, with the full depth and width of water contemplated and provided for in the plan for the enlargement, very much better results might have been attained, and with far less difficulty.

In view of all the facts, I feel it to be a duty to repeat my suggestions of last year, which were as follows :

“In order, however, that the fullest measure of success may attend the introduction of steam, it is imperatively necessary that the full depth of seven feet of water be at all times maintained, during the season of navigation.

“The accumulations in the bottom of the canal, together with the bench-walls, should be removed.

“The locks should be more efficiently manned, in order to reduce the detention at locks to the smallest practicable limit.

“The locks themselves are, it is believed, large enough to pass boats as large as should be permitted to pass through the prism of the canal.”

It has been proposed, also, by gentlemen whose opinions are entitled to respectful consideration, that a new form of gate should be introduced at the foot of each lock, to the end that boats of greater length, and consequently of greater carrying capacity, may be employed.

Those who have had experience in the management of the boats now in use, when running at the speed necessary to insure an average of three miles per hour will scarcely need argument to convince them that the difficulty attending the proper management of these proposed longer boats would be so great as to effectually prevent their general adoption. Besides, it is believed that the relation at present existing between the dimensions of the prism of the Erie canal and the dimensions of the lock chambers, are such as experience everywhere has shown to be best adapted to all the purposes of canal navigation, and, hence, that any departure from these proportions would fail to accomplish the desired end.

With the accomplishment of the suggested improvements, we should be in possession of a channel of communication which, with the introduction of steam, would have a capacity more than four times as great as the tonnage of any single year in the past, capable of delivering freight, in New York and Buffalo, as regularly and almost as quickly as it can be delivered by rail, and at a cost from Buffalo at least five cents less, per bushel, on wheat.

With the necessities of our inland commerce thus supplied, the Erie canal will be able to attract and to retain, for many years, without further expenditure, its full share of the freight traffic between the great producing region of the west and the Atlantic sea-board.

Respectfully submitted,

TROY, *February 17, 1874.*

D. M. GREENE,
Engineer.

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APPENDIX.

REPORT OF THE ENGINEER UPON THE BELGIAN SYSTEM OF STEAM TOWING, BETWEEN LOCK- PORT AND BUFFALO.

HON. VAN R. RICHMOND, *Chairman.*

SIR — A copy of a concurrent resolution of the senate and assembly, as follows :

CONCURRENT RESOLUTION relative to the examination and test of motive power upon the canals by the commissioners appointed by the laws of eighteen hundred and seventy-one.

Resolved (if the assembly concur), That the commissioners appointed in act chapter eight hundred and sixty-eight of the laws of eighteen hundred and seventy-one, to examine and practically test all inventions and devices which may be submitted to them for that purpose, by which steam, caloric and electricity or any motor other than animal power, may be practically and profitably applied in the propulsion or towage of boats upon the canals, are hereby required to examine and test the plans for propelling and towing boats by means of a submerged cable and clip-drum, commonly known as the European or Belgian system, and report the result of their investigations to the legislature at the next session thereof. But no expense incurred in said experiments shall be chargeable to or paid by the state.

STATE OF NEW YORK.

IN SENATE, *May 2, 1872.*

The foregoing resolution was duly passed.

By order,

CHARLES R. DAYTON,
Clerk.

STATE OF NEW YORK.

IN ASSEMBLY, *May 8, 1872.*

The foregoing resolution was duly passed.

By order,

EDWARD M. JOHNSON,
Clerk.

[Indorsed.]

Filed in Secretary of State's office November 20, 1872.

ANSON S. WOOD,

Deputy Secretary of State.

Having been furnished me, by Mr. Emerson Foote, one of the trustees of the "New York Steam Cable Towing Company," in August last, with a request that a personal examination of the operation of the system between Buffalo and Lockport should be made, I proceeded on the 25th of August, to Buffalo, and on the 26th, commenced an examination which continued several days.

The line, so far as it has been put in practical operation, consists of a single continuous wire cable, one inch in diameter, extending from the pier of Genesee Street bridge, in the city of Buffalo, to the head of the combined locks, at Lockport, a distance of 31 miles.

At Black Rock the cable passes through the berine lock, and in Tonawanda creek it follows, for 12 miles, the exceedingly tortuous channel of that stream. At the sharper bends of the stream, the cable is prevented from being drawn upon the convex shore by clusters of piles, which are driven sufficiently far from the shore to insure, at all times, the requisite depth of water along the line of the cable.

The company had in operation, during the season of 1873, two cable tugs, each about 65 feet long by about 14 feet beam. These tugs are fitted up as propellers, with the ordinary engine, having a cylinder 13x13, and a screw $4\frac{1}{2}$ feet in diameter at the stern; besides which there are placed, near the center of the tug, the boiler and the towing machinery proper. This towing machinery consists of two engines, which, upon the tug M. M. Caleb, are 10 inches in diameter by 12 inches stroke of piston. These are connected at right angles, and upon the main shaft there is provided a gear-wheel, which admits of being so adjusted to a train of wheels that the motion of the engine may be reduced, either in the ratio of 3 to 1 or of 6 to 1, as may be required by the varying duty of the tug.

For heavy tows and low speeds, the ratio of 3 to 1 is employed; while for light tows and higher rates of speed, the ratio of 6 to 1 is employed.

Upon one side of the tug are placed, at bow and stern, guide pulleys, about 16 inches in diameter, the frames of which admit of free motion in all directions, laterally. The cable, after passing over the pulley at the bow, passes under a tightening pulley about 6 feet in diameter; thence it passes over the "clip-drum," which is 6 feet in diameter, and placed nearly amidships; thence under a second tightening pulley, similar to the first, and finally over the guide pulley at the stern.

The "clip-drum" is provided with, and takes its name from, a series of clips about its entire circumference, which are so arranged that the cable, as it reaches the drum, is seized and held firmly until it is about to pass off upon the opposite side, when it is promptly released.

The boiler of the Caleb is horizontal, return tubular, about 5 feet in diameter and 11 feet long. The fire grate is 4 feet 6 inches wide, and 5 feet 3 inches long, containing 23.63 square feet. The tubes are 34 in number, $2\frac{3}{4}$ inches in diameter, and 4 feet long. The return tubes are 44 in number, $2\frac{3}{4}$ inches in diameter, and 10 feet long.

On the morning of the 28th of August I joined the Caleb, which proceeded light to Tonawanda, a distance of 12 miles, at a speed varying from 6 to $7\frac{1}{2}$ miles per hour. The current between these points was running in the direction of our movement, at a velocity varying, probably, from 1 to 3 miles per hour. At 9:44 A. M. the Caleb left Tonawanda with three boats, each loaded with about 200 tons of cargo in tow, bound for Buffalo.

One mile below Black Rock, a half-loaded boat, towed by four horses, was passed in 45 seconds. At 12:30 P. M., arrived at Black Rock lock, having made the run of 8 miles in 2 hours 45 minutes, at an average speed of 2.91 miles per hour.

During this run the speed varied from 2.79 to 3.06 miles per hour, and the run was made without the slightest delay or difficulty of any kind whatever.

Before passing the lock a fourth boat carrying 100 tons, was taken in tow. At 12:45 P. M., the tow started to pass the lock, and at 1.15 P. M. the last boat was through. The time expended in passing this lock was therefore 30 minutes, or 6 minutes for each boat, including the tug.

It should be stated, however, that the lift of this lock, being at

that time, only about 1 foot, the gates were not closed after they were opened for the tug, until the last boat had passed through.

The tow arrived at Genesee street bridge, in Buffalo, at 3:25 P. M., having made the run from Black Rock, 4 miles, in 2 hours and 10 minutes: the speed ranging from 1.93 to 3 miles per hour.

Upon this part of the canal the velocity of the current, tending eastward, was previously found to vary from $1\frac{1}{2}$ to very nearly 3 miles per hour. The speed of the tow, through the water, therefore, must have been not far from 4 miles per hour—equivalent to $3\frac{1}{2}$ miles over the ground, in those parts of the canal where the current runs at a velocity of $\frac{1}{2}$ a mile per hour.

During this run the power expended by the engines of the tug varied from about 35 to about $43\frac{1}{2}$ horses, all of which, except so much as was expended in overcoming the friction of the machinery, was utilized in towing.

At 4:30 P. M. the Caleb left Buffalo light, and proceeded to Tonawanda, arriving at that point at 6:50 P. M. Deducting the detention at Black Rock lock, the average speed was 6 miles per hour. Between Buffalo and Black Rock, the speed, at times, reached $9\frac{1}{2}$ miles per hour. During 12 hours and 18 minutes, including all stops and detentions, the Caleb ran 36 miles; towing 600 tons of cargo 8 miles, and 700 tons 4 miles; equivalent to the movement of 200 tons, 38 miles, at a speed of 3 miles per hour, over the ground against the rapid current prevailing in that quarter, and with an expenditure of power, which, at the maximum, only slightly exceeded that necessary to give ordinary canal steamers the speed of 3 miles per hour, when moving with the ordinary current.

On the morning of the 29th of August the trip was continued to Lockport.

The Caleb left Tonawanda at 5:20 A. M., and arrived at Lockport at 8:50 A. M. Time, 3 hours and 30 minutes; distance 19 miles; average speed 5:43 miles per hour, including detentions.

At 10:25 A. M., the Caleb left Lockport light, on her return trip, and reached Pendleton, 7 miles, at 11:45 A. M. The average speed between these points was, therefore, 5.26 miles per hour.

At 12:30 P. M., 450 pounds of coal had been used in running about 11 miles, or about 41 pounds per mile. At this time a boat carrying 100 tons, was taken in tow, and Tonawanda was reached at 3:10 P. M.; the Caleb having made an average of 3.46 miles per hour, including detentions, with a consumption of 800 pounds of coal in a distance of 19 miles.

The last 8 miles was made in 2 hours and 40 minutes, with a single boat in tow, and with a consumption of 350 pounds of coal. Here we have a speed of 3 miles per hour, with a coal consumption of $43\frac{3}{4}$ pounds per mile.

At Tonawanda, four 200 ton boats were added to the tow, which then consisted of five boats, carrying 875 tons of cargo. The tow left Tonawanda at 3:45 P. M., and reached Black Rock, 8 miles distant, at 7:20 P. M. The average speed between Tonawanda and Black Rock was therefore 2.23 miles per hour. The coal consumption between the same points was 1,100 pounds; or 137.5 pounds per mile, equivalent to 27.5 pounds per mile for each boat, exclusive of the tug.

I left the Caleb at Black Rock, as she was preparing to pass the lock, the tow proceeded, however, and arrived at Buffalo, during the same evening. As to the speed made, and as to the coal consumption between these two points I am not advised.

Before witnessing the operation of this system of towing, I was well aware that, so far as the efficient and economical application of power is concerned, no other mode of steam towing, or of steam propulsion, can ever be expected to compete with it. At the same time, I entertained the opinion that very serious difficulty would be experienced in traversing the sharper curves of the canal; and that the passage of the locks would be attended by considerable difficulty, and by unavoidable delay.

This personal examination, however, of the practical working of the system has in some degree, modified these early impressions, so far as relates to the difficulties to be overcome.

As regards the economical and efficient application of power, there is of course, no occasion for a change of opinion. As to the curves upon the canal, there is no longer reason to doubt that they can be traversed by the tugs of this system, without material difficulty or inconvenience.

In the matter of passing locks there are the following difficulties to be overcome:

1. The detention which tows moved by any system must suffer, all of the boats being detained until the last boat has passed the lock, and the time of lockage of each boat being at least, as great as that of the present horse-boat.

2. The difficulty in arranging for the passage of the cable through the gates in such a manner as not to interfere with their free operation.

In this connection it is proper to state that the company propose,
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—especially upon the longer levels,—to place tugs upon each level, in such numbers as to obviate the necessity of their passing the locks. In that case the cable would extend from lock to lock without passing through them. It is not clear how such an arrangement would obviate loss of time, either upon the part of tugs in waiting for tows, or upon the part of tows in waiting for tugs.

As the capacity of a canal, other things being equal, depends upon the time of lockage, and as it does not appear that, by the general adoption of this system, this time would become less than it now is for horse-boats, it follows that no increase over the present capacity of the Erie canal can be reasonably expected to result, even in case a double line of cable should be put in operation throughout the entire length of the canal as is now proposed.

ESTIMATED COST OF TRANSPORTATION BY THE CABLE SYSTEM.

In estimating the cost of transportation between Buffalo and New York, with the cable system in operation upon the canal, the average tow will be assumed to consist of five boats, carrying 240 tons, equivalent to 8,000 bushels of wheat, each.

The average speed between locks will be taken at $3\frac{1}{2}$ miles per hour, and the detention at each lock at one hour, or an average of 10 minutes for each boat, including the tug. With double locks, and with boats alternating regularly up and down, it is believed that the lockages cannot be effected in less than the assumed time; but in cases where no boats require locking in a direction opposite to that in which a tow may be moving, and where each succeeding boat of the tow may be compelled to await the emptying or filling of a lock, the time of lockage would not only be largely increased but the passage of the tow would be attended by a very serious waste of water.

The running time, between Buffalo and Albany or Troy, is taken at 100 hours; adding 72 hours for lockage, we have $7\frac{1}{2}$ days for the total time between Buffalo and the Hudson river, or, say 9 days between Buffalo and New York. If we allow 2 days for detention in port, we have, for the duration of a single trip, 11 days.

The cost of a tug will be taken at \$15,000, and 21 per cent per annum will be allowed for interest, repairs and renewals. These items will then amount to \$15 per day for 210 days.

The coal consumption is estimated at $2\frac{1}{2}$ tons in 24 hours, which, at \$5.50 per ton, amounts to \$13.75 per day.

The estimated expense for crew will be based upon the experience

of the season of 1873, during which the number of persons employed and the wages paid were as follows:

Captain, per month	\$75 00
Engineer, per month.....	80 00
Fireman, per month.....	45 00
Pilot and splicer, per month.....	75 00
Deck hand, per month.....	40 00
Cook, per month.....	25 00
Total, for day service only	<u>\$340 00</u>

For day and night service, two additional men are required, one at \$40 and another at \$50 per month, making a total of \$430 per month, or \$14.33 per day. Adding to this, for board and incidentals, say \$4.67 per day, we have \$19 per day for wages and subsistence of crew.

The estimated daily expense of each towed boat, for interest, repairs, renewals, wages and board of crew, is \$10. Collecting results, we have the daily cost of the tow, including its operation, as follows:

Interest, and maintenance of tug	\$15 00
Crew of tug.....	19 00
Fuel.....	13 75
Oil, tallow and waste, say	2 25
Five boats, at \$10 each	50 00
Total	<u>\$100 00</u>

The expense of a single trip from Buffalo to New York will therefore be:

7 $\frac{1}{2}$ days of tow, at \$100 per day	\$716 66
3 $\frac{1}{2}$ days on Hudson river and in port, 5 boats at \$10.....	191 67
Towing 5 boats, at \$40 each.....	200 00
Total	<u>\$1,108 33</u>

While the work done will be 1,200 tons, or 40,000 bushels of wheat, moved 495 miles.

From the foregoing we make the following deductions:

Cost per ton moved 495 miles	92 $\frac{36}{100}$ cents.
Cost per ton moved 1 mile.....	1 $\frac{86}{100}$ mills.
Cost per bushel of wheat, Buffalo to New York	2 $\frac{77}{100}$ cents.
Cost per bushel of wheat, including tolls.....	<u>5$\frac{87}{100}$ cents.</u>

But the boats must be returned to Buffalo, either light or partly loaded, and at a cost which will not differ materially from that attending their movement from Buffalo to New York. This results from the fact that the westward movement must be effected against the prevailing eastward current, which operates as an offset to the difference between the eastward and westward cargoes.

If, then, the boats return light, the foregoing results — except the last — will be doubled, and we shall have :

Cost per ton moved 495 miles.....	\$1 84 $\frac{78}{100}$
Cost per ton moved 1 mile.....	3 $\frac{78}{100}$ mills.
Cost per bushel of wheat, Buffalo to New York.....	5 $\frac{64}{100}$ cents.
Cost per bushel of wheat, including tolls.....	8 $\frac{64}{100}$ cents.

If the boats carry one-quarter cargoes west, the movement per round trip will be five-fourths of the movement east, while the cost of the round trip will be, substantially, twice that of a single trip. Under these conditions, the results obtained for the trip east — except the last — must be multiplied by $\frac{2}{4} = \frac{8}{4} = 1.6$, and we shall have the following :

Cost per ton moved 495 miles.....	\$1 47 $\frac{78}{100}$
Cost per ton moved 1 mile.....	2 $\frac{88}{100}$ mills.
Cost per bushel of wheat, Buffalo to New York.....	4 $\frac{48}{100}$ cents.
Cost per bushel of wheat, including tolls.....	7 $\frac{63}{100}$ cents.

Comparing this last result with the results obtained, under like conditions as to cargoes east and west, for the horse-boat and for the steamers Baxter and Newman, we have :

Cost of movement proper per bushel of wheat, from Buffalo to New York.

By horse-boat.....	6.87 cents = 100
By steamer William Newman.....	5.08 cents = 74—
By steamer William Baxter.....	4.97 cents = 72+
By cable towing.....	4.43 cents = 64+

Thus it appears that the cost of movement proper, between Buffalo and New York, by the Newman, by the Baxter and by the cable, as compared with that by the present horse-boat, is 26 per cent less by the Newman, 28 per cent less by the Baxter, and 36 per cent less by the cable.

In considering these results, it is to be remembered that the practicability of operating the cable, throughout the entire length of the canal, is not yet demonstrated; that there are yet other practical difficulties which remain unsolved; that the duration of a trip of cable-towed boats, between Buffalo and New York, must be considerably greater than that of a steamer; and finally, that the elements of interest upon cost of cable, the uncertain extent of its annual depreciation and cost of repairs, have been omitted from our estimate.

Respectfully submitted,

ALBANY, *February* 17, 1874.

D. M. GREENE,
Engineer.

CHAPTER 868 — LAWS OF 1871.

AN ACT TO FOSTER AND DEVELOP THE INTERNAL COMMERCE OF THE STATE BY INVITING AND REWARDING THE PRACTICAL AND PROFITABLE INTRODUCTION UPON THE CANALS OF STEAM, CALORIC, ELECTRICITY, OR ANY MOTOR OTHER THAN ANIMAL POWER, FOR THE PROPULSION OF BOATS.

PASSED April 28, 1871; three-fifths being present.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

SECTION 1. GEORGE B. McCLELLAN, HORATIO SEYMOUR, ERASTUS S. PROSSER, DAVID DOWS, GEORGE GEDDES, VAN R. RICHMOND, WILLIS S. NELSON, GEORGE W. CHAPMAN, WILLIAM W. WRIGHT and JOHN D. FAY, are hereby appointed a commission to practically test and examine inventions, or any and all devices which may be submitted to them for that purpose, by which steam, caloric, electricity, or any other motor than animal power, may be practically and profitably used and applied in the propulsion of boats upon the canals; said examination and tests shall be had by the said commissioners at such time or times during the season of canal navigation, for the years eighteen hundred and seventy-one and seventy-two, as they may order and direct; said commissioners shall have the right, and they are hereby expressly required, to reject all such inventions or devices, if, in their opinion, none of the said inventions or devices shall fully and satisfactorily meet the requirements of this act; but said commissioners shall demand and require: *First*, The inventions or devices to be tested and tried at their own proper costs and charges of the parties offering the same for trial. *Second*, That the boats shall, in addition to the weight of the machinery and fuel reasonably necessary for the propulsion of said boat, be enabled to transport, and shall actually transport, on the Erie canal, on a test or trial exhibition, under the rules and regulations now governing the boats navigating the canals, at least two hundred tons of cargo. *Third*, That the rate of speed made by said boat shall not be less than an average of three miles per hour, without injury to the canals or their structures. *Fourth*, That the boat can be readily and easily stopped or backed by the use and power of its own machinery. *Fifth*, That the simplicity, economy and durability of the invention or device must be elements of its worth and usefulness. *Sixth*, That the invention, device or improvement can be readily adapted to the present canal boats; and, lastly, that the commissioners shall be fully satisfied that the invention or device will lessen the cost of canal transportation and increase the capacity of the canals. Any means of propulsion or towage other than by a

direct application of power upon the boat, which does not interfere in any manner with the present method of towage, on the canals, and complying in all other respects with the provisions of this act, may be entitled to the benefits thereof; but this shall not be construed to apply to the system known as the Belgian system, or to any mode of propulsion by steam-engines or otherwise upon either bank of the canals.

§ 2. No such test shall be made if the same shall in any manner retard, hinder, or delay the passage of boats navigating the canals under the present system.

§ 3. If the commissioners herein appointed shall, upon such examination and test, as is provided for in the first section of this act, conclude and determine at any time, that one or more inventions or devices as aforesaid, but not to exceed three in number, shall be in all respects a full and satisfactory, practical and profitable adaptation to the wants of the canals by reason of a new, useful and economical means of propulsion for boats within the meaning of this act, it shall then, and not otherwise, be their duty to grant unto the owner or owners of such inventions or devices, his or their attorney, their certificate or certificates, under their hands as such commissioners, that they have so determined and adjudged to the owner or owners of the invention or device which, in the judgment of the said commissioners, possesses in the greatest degree of perfection the requisites mentioned in the first section, they shall grant a certificate which shall be known as certificate number one; and to the owner or owners of the next best invention or device, they shall grant a certificate as aforesaid, which shall be known as certificate number two; and to the owner or owners of the third best invention or device, they shall grant a certificate as aforesaid, which shall be known as certificate number three.

§ 4. Before entering upon the duties of his office, each of the commissioners herein named shall take and subscribe an official oath, which shall be filed at once in the office of the Secretary of State. Any vacancy arising from any cause in said commission, may be filled, on the application of the remaining commissioners, by the Governor.

§ 5. The reasonable expenses of the said commission, not exceeding in all the sum of five thousand dollars, to be determined by the said board, shall be paid out of any sum which may be awarded to the person or persons receiving the certificates mentioned in the third section of this act, in proportion to the amount awarded to the holders of said certificates, providing such certificates shall be granted, and, if no such certificates shall be granted, then the same shall be paid by the Treasurer on the warrant of the Comptroller out of any moneys in the treasury not otherwise appropriated.

§ 6. Upon the production by the owner or owners, or his or their attorney, of such certificate or certificates as may be granted under the provisions of this act, to the Comptroller, he shall draw his warrant upon the Treasurer of the State of New York for the sum of fifty thousand dollars, payable to the said owner or owners of said invention, device, his or their attorney, out of any money in

the treasury not otherwise appropriated, in case but one certificate shall have been granted by said commissioners. If two certificates shall have been granted and no more, then the said Comptroller shall draw his said warrant upon the said Treasurer for the sum of thirty-five thousand dollars, payable to the owner or owners of certificate number one; and said Comptroller shall also draw his said warrant upon the said Treasurer for the sum of fifteen thousand dollars, payable to the owner or owners of certificate number two. If three certificates shall be granted by said commissioners, then and in that case the said Comptroller shall draw his said warrant upon the said Treasurer for the sum of thirty thousand dollars, payable to the owner or owners of certificate number one; and one of fifteen thousand dollars, payable to the owner or owners of certificate number two; and one of five thousand dollars, payable to the owner or owners of certificate number three.

§ 7. If on or before the first day of November, eighteen hundred and seventy-three, the commissioners hereinbefore named shall, upon due examination, find and determine that the said invention or device has been successfully operated upon the canals, and has been or will be largely adopted as a motor on said canals, by reason of its superiority over any other known method of propulsion, then and in such case they shall grant a further certificate of that fact, and the Comptroller, upon its presentation to him, shall draw his warrant upon the Treasurer of the State for the further sum of fifty thousand dollars, payable to the said owner or owners of the said device, his or their attorney, out of any money in the treasury not otherwise appropriated; but in case of the granting by said commissioners of more than one certificate, as stated in section six of this act, then and in that case the sum of fifty thousand dollars, mentioned in this section, shall be divided among and paid to the owners of the said certificates in the proportion and in the manner as stated in section six of this act.

CHAP. 480 — LAWS OF 1873.

AN ACT TO AMEND AN ACT ENTITLED "AN ACT TO FOSTER AND DEVELOP THE INTERNAL COMMERCE OF THE STATE, BY INVITING AND REWARDING THE PRACTICAL AND PROFITABLE INTRODUCTION UPON THE CANALS OF STEAM, CALORIC, ELECTRICITY, OR ANY MOTOR OTHER THAN ANIMAL POWER, FOR THE PROPULSION OF BOATS," PASSED APRIL TWENTY-EIGHT, EIGHTEEN HUNDRED AND SEVENTY-ONE.

PASSED May 9, 1873; three-fifths being present.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

SECTION 1. Chapter eight hundred and sixty-eight of the Laws of eighteen hundred and seventy-one, entitled "An act to foster and

develop the internal commerce of the State, by inviting and rewarding the practical and profitable introduction upon the canals of steam, caloric, electricity, or any motor other than animal power, for the propulsion of boats," is hereby amended so as to continue the powers of the commissioners appointed therein one year beyond the time limited by sections one and seven of said act.

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