

APPENDIX A—*Continued.*

The outflow is instantly affected by a changed inflow, provided there is enough such to increase or reduce the head. If we have a rainfall of 1 inch over the lake area (and such are not uncommon events) there is a head of 1 inch to run off. But if there are two outlets to run out of, instead of one, this inch must run off sooner than through the one. If the new outlet should reduce the levels of Lake Michigan and Huron about 6 inches, this effect will be produced in full in about two years; it is not then a question of many years, as some suppose.

We may feel very sure, therefore, that in this question two points are certain: 1. The drainage canal is not solely a state affair, but a national one. 2. The tapping the lakes must affect their levels. But it is said, first, that the changes in levels do not concern shippers, and then that, at most, the effects will be trifling.

If one watched carefully the course pursued by shippers one would see that, as a rule, each vessel carries all that it can take and get out of its port or into that it intends to reach. Vessel owners and managers are very shrewd, watchful men; they know what they can safely carry, allowing for storms and short detentions arising from passing causes; they average pretty well the practicable depths, and carry all the channels will stand. They are as conversant as are theorists about the effects of storms, but they keep good watch on ruling depths. Now, should it be certain that these average depths were reduced 3 inches, or 6 inches, they must load accordingly. And not only the large boats, but also the small ones using the small harbours that the large ones cannot go into. All must lose the 3 or 6 inches, as it may be; and not for one or more trips, but for all trips, and for all time; a diminution of capacity is not a single tax, but a continuous one. A vessel that when light draws 6 feet and loaded 12 feet must lose 3 inches out of 72, say 4 per cent in capacity, each loading; a vessel drawing 12 feet light and 20 feet loaded would lose somewhat over 3 per cent in capacity at each and every loading.

Should the loss of levels be 6 inches, instead of 3 inches, then these figures become doubled. Will the loss be six inches or will it be three inches? This is an important question, and we have only the Niagara River discharge observations from which to answer it. These cover a range of about 1·8 feet. There were scattering observations outside these limits, but the mass of results was secured between gauge readings, mean lake level, the highest, and 1·85 feet. The "smooth curve" as published enables us to note the fall of 0·53 feet on the gauge per 10,000 cubic feet per second for the first foot of fall, and 0·44 feet for the whole.

These observations, especially at the lower readings, are erratic, and indicate a need for more measurements, especially at these levels. This lower portion of the gauge should be studied and additional observations made, and the board is a unit in suggesting the importance of a series of gaugings of the St. Clair River at the present time for this purpose, and to furnish additional knowledge of the relation between gauge readings and discharge. The subject is of such general bearing upon the navigation of the lakes that it demands careful treatment and full data. The Niagara data do not show how much Lake Huron and Michigan would be lowered, even if 0·53 feet were the net loss to Lake Erie. The opinion expressed by Mr. Johnston that the effect on the two upper lakes would be some 15 per cent greater than upon Erie would seem to point to a probable loss of, say, 0·61 feet. This possible loss of 7 inches certainly is important enough to justify careful measurements of the discharge through the St. Clair. It is true that the law as it stands, and the intention of the trustees, contemplate the abstraction of only 300,000 cubic feet under present conditions; but after the canal is opened measurements will not be so instructive, and we must assume that ultimately the entire 600,000 cubic feet per minute will be drawn from Lake Michigan, as required by the state law.

The abstraction of 10,000 cubic feet of water per second from Lake Michigan will lower the levels of all the lakes of the system except Lake Superior, and reduce the navigable capacities of all harbours and shallows throughout the system to an extent that may be determined, if at all, by actual measurements only. Under the laws of the United States these changes in capacity cannot be made without federal authority, and