66 BULLETIN OF THE NATURAL HISTORY SOCIETY.

the chief authority in America) thinks that the tides of the deep water of the North Atlantic may be an eastward and westward swinging motion, like the "wish-wash" of water in a wash-bowl. In one case only have we a motion of vibration that belongs to one only of these two classes, namely, the case of moderate sized lakes; for their motions are nearly altogether free vibrations, and it is only in very great lakes that forced vibrations can be discovered; for instance, the tides of Lake Michigan only amount to between two and three inches.*

II. TIDES IN RIVERS.

Remembering this distinction between free and forced vibrations, let us apply it to the case of a river. Are there any forced vibrations in rivers; that is, any motions produced by the direct attractions of sun or moon on the waters of the rivers? Reason will be adduced later for believing that, in the case of the St. John river at least, there is nothing such; but it cannot be denied that in the case of a very large river like the Amazon, whose course is directly east and west, there may be such a direct forced vibration. But there is in most rivers that enter the ocean a secondary forced vibration; that is, a fluctuation of the level of their waters produced by a periodical rise and fall of the level of the ocean at the mouth. This distinction is sometimes put in this form, that there is no true tide in the St. John river, only a "backing-up;" but such a way of putting it is hardly justifiable. It is true that as the level of the water at the mouth rises, the speed of the stream must decrease, and as there is still practically the same supply of water from the parts of the river farther up, the level must in consequence rise progressively up stream. This is what is meant by a "backing-up." But there is also a flow of salt water up stream for a considerable distance from the mouth, a flow that differs in no respect from the flow of water up the Bay with the incoming tide. Now we have seen that we cannot limit the word tide to direct forced vibrations

* T. D. Graham, Vol. xiv., A. A. A. S., 1860.

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