

## ARTICLE IV.

TIDAL PHENOMENA OF THE ST. JOHN RIVER  
AT LOW SUMMER LEVEL.

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## I. FREE AND FORCED VIBRATIONS.

The waters of the earth have two somewhat different kinds of motion. There are, first, the steady motions, such as the Gulf Stream, caused ultimately by the heat which we receive from the sun. Secondly, there are motions of vibration, including waves of various kinds and tides. This second class also admits of an important sub-division. Firstly we have those motions of vibration whose rates are determined merely by the properties of water (especially its mass) and by its weight, or the force which the earth exercises on it; these motions being analagous to the motion of a pendulum, whose rate is determined by its length and the earth's attraction. This kind of vibratory motion we may call the *free* or natural vibrations of the water. But there is a second class of motions of vibration whose rates are determined by the motions and attractions of bodies beyond the earth, especially the moon and sun. These motions we may call the *forced* or artificial vibrations of water masses. When we speak of tides, we are inclined at first to think of them as merely forced vibrations; but, in reality, the forced vibrations give rise to free vibrations and the two kinds of vibration are quite inseparably mixed up in tidal phenomena. For instance, the highest authority on tides (Lord Kelvin) regards the tides of the English Channel as mostly a free vibration of the water, see-sawing or teetering about a line passing from Portland to Havre; and William Ferrel (probably