HYDROMETRICAL OBSERVATIONS.

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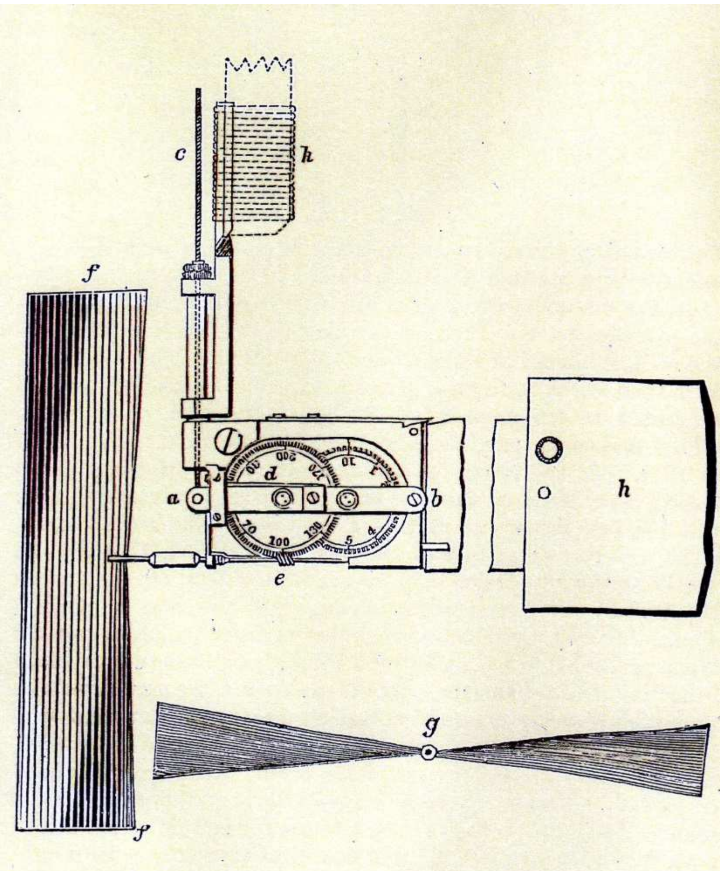
VELOCITIES OF CURRENTS.—For the purpose of ascertaining the surface velocities of currents, various methods may be employed. The most common, but by no means the most satisfactory mode of proceeding, is to throw into the water a float composed of some small body (whose specific gravity is merely great enough to sink it to a level with the surface), at a point about 30 or 40 feet above the line of section, so as to insure its acquiring the full velocity of the current before it reaches the cord. An observer, stationed at the cord, notes exactly the moment at which the float passes, and follows it down -the stream till he reaches the line of two poles, which have been fixed in reference to the observations, when he again notes the exact moment of its transit at the lower station. The elapsed time between the two transits is then noted in the book, along with the distance between the two places of observation' which, owing to the irregularity of most rivers, with regard to width, depth, and velocity, can seldom be got to exceed 100 feet. This operation has, of course, to be repeated for every compartment of the cross section.

Certain disadvantages attend this method, which render it not generally applicable. For example, it is only adapted to rivers of limited breadth, owing to the impossibility of an observer being able to discover with sufficient accuracy when the float passes the station lines, if it be viewed from a distance, as from the bank of a broad river. There are, however, greater objections than this, which, when pointed out, will be sufficiently obvious to every one. In any part of the river passed over by the floats, the slightest irregularity of the bottom produces a disturbance in the motion of the stream, and alters the velocity of the current, so that the result indicated by the elapsed time is more or less vitiated ; and the mean velocity deduced from such data is not, in almost any case, that which exists at the line of cross section. It is also impossible, by this method, to obtain a sufficient number of distinct and independent observations, applicable to each division of the stream ; as the eddies and irregularities of the current, which exist in all rivers, generally cause the lines passed over by the floats to cross and interfere with each other, in such a manner as to destroy all connection between any given series of observations, and the several compartments of the river, whose mean velocity they were intended to ascertain.



The superiority of the method which I am about to describe, consists in ascertaining the velocity of each portion of the stream, in the exact line in which the cross sectional area is taken. The instrument employed for this purpose is a modification of the tachometer of Woltmann, which is in general use in France and Germany, both as an anemometer and a hydrometer, being made of the degree of delicacy suited to the purpose to which it is to be applied. In this instrument, the velocity is measured by the current impinging on a vane and causing it to revolve, the number of revolutions made by the vane being registered on an index, which is acted on by a set of toothed wheels.

The construction of this beautiful instrument, and the manner in which it acts, will be best described by a reference to the accompanying figure—which is taken from a tachometer or stream-gauge made by Mr. Robinson, optician, London, and is drawn to a scale of one-third of the full size. In this view, *f f* represents what may be termed the driving vane, which is acted on by the stream, and of which *g* is a plan. The plane of this vane is twisted, as represented by the dark shading in the cut, so as to present, not a knife-edge, but an oblique face to the action of the current, which, by impinging on it, causes it to revolve exactly in the same way that the wind propels the sails of a wind-mill. On the spindle or shaft of this vane an endless screw is fixed at *e*, which works in the teeth of the first registering wheel, and causes it to revolve when the vane is in motion and the screw in gear. Letters *a* and *b* represent a bar of brass, to which the pivots on which the registering wheels revolve are attached. This bar is moveable on a joint at *b* ; and at the point, *a*, a cord, *a c*, is fixed, by pulling which, the bar and wheels can be raised, and on releasing it, they are again depressed by a spring at *d*. When the bar is raised, the teeth of the wheel are taken out of gear with the endless screw, and the vane is then left at liberty to revolve, the number of its revolutions being unregistered ; but when the cord is released, the spring forces down the wheels, and immediately puts the registering train into gear, in which state it is represented in the cut. Letter *h* is a stationary vane (which is shown broken off, but measures about nine inches in length), for keeping the plane in which the driving vane revolves, at right angles to the direction of the cur-rent, and *k* is the end of a wooden rod to which the tachometer is attached when used. The different parts of the instrument itself are made of brass.

The moveable bar for the registering wheels, and the application of the cord and spring which have been described, afford the means of observing with great accuracy, in the following manner :—The instrument having been adjusted by setting the registering wheels at zero, or noting in the field-book the figure at which they stand, the cord is pulled tight, so as to raise them out of gear, and the instrument is then immersed in the water. The vane immediately begins to revolve from the action of the current, and is permitted to move freely round until it has attained the full velocity due to the stream. When this is supposed to be the case, a signal is given by the person who observes the time, and the registering wheels are at that moment thrown into gear by letting the cord slip. At the end of a minute another signal is given, when the cord is again drawn, and the wheels taken out of gear, and on raising the instrument from the water, the slumber of revolutions in the elapsed time is read off. This operation being completed in the centre of each division of the cord, the number of revolutions due to the velocity at each part of the very line where the cross section is taken, is at once obtained.

Before using the tachometer, it is obvious that the value of a revolution of the vane must be ascertained ; and although this is done by the manufacturers, it is proper that the scale of each instrument should be determined by the person who uses it, and that it be tested, if the instrument has been out of use for some time, before being again employed in making observations. A scale sufficiently accurate for most hydrometrical purposes (though not for the instrument when used as an anemometer), may be obtained by applying it to some regular channel, such as a mill-lead formed of masonry, timber, or iron, where the velocity is nearly the same throughout, and noting the number of revolutions performed during the passage of a float over a given number of feet, measured on the bank. In this way it was found, by the mean of 62 observations, that each revolution of the vane in the instrument, of which a drawing has been given, indicated the passage of the water over 46 inches. The number of revolutions, at several parts of the stream, was ascertained to be the same in equal times, at both the commencement and the end of the experiments. This number, therefore, becomes, in the instrument alluded to, a constant multiplier of the number of revolutions indicated by the vane ; and hence, the number of feet passed over by the water in the given interval of time is ascertained.

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