*\*\*\*\*\*\*∕ wh*

, , ... , VNo\* *w* 4- 2A , .

city in the canal will be 2-√g—i ‘ le \*,eιS\*lt

which will produce this velocity is (-^g⅛)∙ Now this is the slope at the entry of the canal which produces the velocity that is afterwards maintained against the ob­structions by the slope of the canal. It is therefore = H — *h.* Hence we deduce

\*\*\*\*.--['√2⅞ + l)-2tl]

4

√8‰+ [κ'(lfs+l)-211]2 + H

If there be no contraction at the entry, *g* = G and *g*/2G = 1/2.

Having thus obtained the depth *h* of the stream, we ob­tain the quantity of water by combining this with the width *w,* and the velocity V.

But as this was but an approximation, it is necessary to examine whether the velocity V be possible. This is very easy. It must be produced by the fall H —*h. We* shall have no occasion for any correction of our first assumption, if *h* has not been extravagantly erroneous, because a small mistake in *h* produces almost the same variation in *d.* The test of accuracy however is, that *h*, together with the height which will produce the velocity V, must make up the whole height H. Assuming *h* too small, leaves H — *h* too great, and will give a small velocity V, which requires a small value of H — *h.* The error of H — *h* therefore is always greater than the error we have committed in our first assumption. Therefore when this error of H — *h* is but a trifle, such as one fourth of an inch, we may rest sa­tisfied with our answer.

Perhaps the easiest process may be the following: Sup­pose the whole stream in train to have the depth H. The velocity V obtained for this depth and slope by the table requires a certain depth *u.* Make √H + *u* : H = H : *h,* and *h* will be exceedingly near the truth. The reason is obvious.

*Quest.* 2. Given the discharge (or quantity to be fur­nished in a second) Q, the height H of the basin above the bottom of the canal, and the slope ; to find the dimen­sions of the canal.

Let *x* and *y* be the depth and mean width. It is Q/xy = √2G√H-*x* will give a value of *y* in terms of *x.* Compare this with the value of *y* obtained from the equation \*\*\*\*\*—=—⅛⅛∕ ——■ ∙

*j λ xy* √S w *y + lx*

This will give an equation containing only *x* and known quantities. But it will be very complicated, and we must have recourse to an approximation. This will be best un­derstood in the form of an example.

Suppose the depth at the entry to be 18 inches, and the slope 1/1000. Let 1200 cubic feet of water per minute be the quantity of water to be drawn off for working ma­chinery, or any other purpose; and let the canal be sup­posed of the best form recommended in the article River, where the base of the sloping side is four thirds of the height.

\*\*\*V2

The slightest consideration will show us, that if be taken for the height producing the velocity, it cannot exceed

three inches, nor be less than one. Suppose it two inches, and therefore the depth of the stream in the canal to be sixteen inches ; find the mean width of the canal by the \*\*\*\*\*Q . ,. , λ .

equation *w — —*  , in which Q is

A(√d-0∙l)g¾-0∙s)

twenty cubic feet (the sixtieth part of 1200), √S is = 28·153 = √1000—L√1000+1∙6, and *h=* 16. This gives *w* = 5∙52 feet. The section *n* = 7∙36 feet, and V = 32∙6 inches. This requires a fall of 1∙52 inches instead of two inches. Take this from eighteen, and there remains 16∙48, which we shall find not to differ one tenth of an inch from the exact depth which the water will acquire and maintain. We may therefore be satisfied with assuming 5∙36 feet as the mean width, and 3∙53 feet for the width at the bottom.

This approximation proceeds on the consideration, that when the width diminishes by a small quantity, and in the same proportion that the depth increases, the hydraulic mean depth remains the same, and therefore the velocity also remains, and the quantity discharged changes in the exact proportion of the section. Any minute error which may result from this supposition, may be corrected by in­creasing the fall producing the velocity, in the proportion of the first hydraulic mean depth to the mean depth cor­responding to the new dimensions found for the canal. It will now become 1∙53, and V will be 32∙72, and the depth will be 16∙47. The quantity discharged being divided by V, will give the section = 7∙335 feet, from which, and the new depth, we obtain 5·344 for the width.

This and the foregoing are the most common questions proposed to an engineer. We asserted with some confi­dence that few of the profession are able to answer them with tolerable precision. We cannot offend the professional gentlemen by this, when we inform them that the Academy of Sciences at Paris were occupied during several months with an examination of a plan proposed by M. de Parcieux, for bringing the waters of the Yvette into Paris, and after the most mature consideration, gave in a report of the quantity of water which Μ. de Parcieux’s aqueduct would yield ; and that their report has been found erroneous in the proportion of at least two to five ; for the waters have been brought in, and exceed the report in this proportion. Indeed, long after giving in the report, M. Perronet, the most celebrated engineer in France, affirmed that the di­mensions proposed were much greater than were necessary, and said that an aqueduct of five and a half feet wide and three and a half deep, with a slope of fifteen inches in a thousand fathoms, would have a velocity of twelve or thirteen inches per second, which would bring in all the water fur­nished by the proposed sources. The great diminution of expense occasioned by the alteration encouraged the com­munity to undertake the work. It was accordingly begun, and a part executed. The water was found to run with a velocity of near nineteen inches when it was three and a half feet deep. M. Perronet founded his computation on his own experience alone, acknowledging that he had no theory to instruct him. The work was carried no farther, it being found that the city could be supplied at a much smaller expense by steam-engines erected by Boulton and Watt. But the facts which occurred in the partial execution of the aqueduct are very valuable. If M. Perronet’s aqueduct be examined by our general formula, *s* will be found = and *d* = 18·72, from which we deduce the velocity = 182/3, agreeing with the observation with astonishing precision.

The experiments at Turin by Michelotti on canals were very numerous, but complicated with many circumstances which would render the discussion too long for this place. When cleared of these circumstances, which we have done with scrupulous care, they are also abundantly conformable