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HYDRAULIC MANUAL

Hydraulic Manual. By L. D'A. Jackson. 4th Edition. Pp. xiv. + 307 Text + 184 Tables. (London : Crosby Lockwood and Co., 1883.)

THIS well-known text-book having reached its fourth edition, it is unnecessary to review it as a new work. The changes from the third edition are very great; the chief is the omission of the whole of the "Hydraulic and Meteorological Statistics" (about 224 pp. of tables); these relate chiefly to India, so that their omission is an advantage to the "Manual" as a general text-book, as it has enabled the text to be increased from 221 to 307 pp., and the general working tables from 104 to 184 pp., without increasing the bulk of the volume; the chief increase of the text is the introduction of an account of the great Roorkee hydraulic experiments.

Much stress is rightly laid on the small value of the old hydraulic knowledge; thus (p. 3) it is said, "Taken generally the mass of hydraulic science . . . prior to about 1856 may be considered superannuated. . . ." The most useful feature of this work is indeed its freedom from what is "superannuated," and its thorough adoption of recent experiment; the text is in fact in great part a short account of the great modern experiments. In detailing field operations the author has indeed preferred to give a "brief account of the modes adopted by various hydraulicians" as being "a far better guide to the engineer about to undertake the execution of gauging operations than any arbitrary advice or set of rules could possibly be." These concise accounts are on the whole well condensed; but the recapitulation—in some cases verbatim—of the several experimenters' own conclusions has the disadvantage that in several cases contradictory conclusions appear on different pages; this is inseparable from the progressive state of our knowledge of the motion of water when stated in this way; a little more discussion of the contradictory views would have been useful.

Kutter's general formula for mean velocity was early adopted by the author; its use as the formula to be preferred to all others for the case of canals (whenever velocity-observation has to be dispensed with) is now insisted on, much evidence in favour of it having been brought out by the recent large Roorkee experiments, with the very fair reservation however that Kutter's rugosity-coefficient (n) should at present be determined by actual experiment for each new channel, the data for its *a priori* determination (from the mere nature of the channel) not being as yet good enough. On the other hand it is rightly said that "to determine with accuracy the discharge of any ordinary or large river independent of velocity-observation is at present impossible."

A few minor details are worth notice. The units of measure, &c., adopted are an extremely simple and useful decimal system; they include the foot, the "foot-weight" of 1000 fluid ounces, *i.e.* the weight of a cubic foot of water at its greatest density, and a "league" of two London miles of 5000 feet each; this league is particularly suited to measurement of hydraulic slopes, a fall of 1, 2, &c., feet per league being at once seen to give a slope of 1, 2, &c., in 10,000. Two new very expressive names are introduced for two velocities, which recur very frequently in discussions on flow of water, viz. "verticalic velocity" and "transversalic velocity" for velocities past any vertical line or any (horizontal) transverse line in a channel section; these short terms will be a great relief from the wearisome periphrases hitherto in use, and merit general adoption.

A few suggestions towards improvement of the work may now be made. (1) In a purely professional work such expressions as "international recrimination," and "bureaucratic and heated with vanity" (p. 37) are surely out of place. (2) About one page of text and three of tables are devoted to the variation of gravity in different latitudes and at different heights; now the variation is so small that for the rough calculations of practical hydraulics this is an unnecessary refinement. (3) Among the "general notation" (p. 11) occurs the rather awkward phrase "g = velocity acquired by gravity in one second." (4) In finding the (trapezoidal) "section of maximum discharge" from the expression for discharge $Q = A\,V$ where $V = 100\,c\,\sqrt{R\,S}$ and $R = A \div P$, the argument used is that "under the condition of maximum discharge, A will be a maximum, so also will R; and when these are temporarily constant, P will be a minimum;" this argument might be considerably improved, somewhat as follows:—"Since $Q = 100\,c\,A\,\sqrt{R}.\,\sqrt{S}$, therefore Q is greatest (provided S be kept constant) when c, A, and R are all maxima together; now c is known (from experiment) to increase with R, and $R = A \div P$; hence Q will be greatest when A is a max. and P a min. at same time (provided of course that S is constant)": this argument is more general than that in the text; the effect of the S-variation is unknown. (5) About certain formulæ for "mean verticalic velocity," quoted from the Roorkee work, it is said (p. 209)—"The defect in these methods is evident; it consists in making the parabolic curvature dependent on one point or on two points, whereas three points are the least necessary." This last statement is a mistake; three points are necessary (for finding a mean ordinate) only if they be taken at random, but *two points are sufficient when suitably chosen*, as in the "two-velocity formulæ" quoted on pp. 87, 208 from the Roorkee work; these formulæ are in fact accurate for the parabolic form, and the proof of this (from the Roorkee work) is actually given at p. 87. The "one-velocity formulæ" are of course only approximate. It may be mentioned here that the writer has lately[1] discovered another (and far better) "two-velocity formula," also accurate for the parabola, viz. $U = \frac{1}{2}\,(v_{\cdot 211\,H} + v_{\cdot 789\,H})$, showing that the "mean verticalic velocity" is the arithmetic mean of the velocities at ·211 and ·789 (or say $\frac{2}{10}$ and $\frac{8}{10}$) of the depth: this new formula has several great practical advantages over any other yet published; among others, the two velocities can be measured at one operation with a single instrument (a compound "double-float" with two equal subfloats at the depths named), which is itself moreover susceptible of being made a more accurate instrument than any other of its class (double-float).

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[1] See *Proc. Inst. Civil Engineers*, vol. lxxi. pp. 18, 19, where the formula and instrument are both discussed.