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CANAL AND RIVER ENGINEERING

The Principles and Practice of Canal and River Engineering. By David Stevenson. Revised by his Sons, D. A. and C. A. Stevenson. Third Edition. Pp. xiv. + 406, and 18 Plates. (Edinburgh: A. and C. Black, 1886.)

THE fact of this work having reached a third edition shows its appreciation by the public. The title, however, indicates a wider scope than that actually embraced. Thus only 65 pages are given to canals, and these only for navigation; no mention is made of the very large subject of irrigation-canals (surely a passing notice of the reason of this omission was required). In this short compass (30 pages given to barge canals, 35 pages to ship canals), part of which is an historical sketch, it is of course impossible to give much constructive detail. Thus no details or sketches are given of most of the appliances needed for canals, *e.g.* locks, turbines, lifts, waste-weirs, &c. The two chapters on canals are otherwise unsatisfactory; *e.g.* 14 pages devoted to the Suez Canal consist chiefly of extracts from Reports made in 1863 and 1870: much of this now purely historical matter might have been with advantage replaced by later information.

The remainder of the work (331 pp.) is devoted to river improvement. And this part of the work is of great value and interest, especially where accounts are given of some of the numerous successful instances of improvements of estuaries effected by the author and the revisers themselves. The great help of a large rise and fall of tide to a commercial port situate in the tidal portion of a river, *viz.* in aiding vessels coming to and leaving the port, is first explained; the pre-eminent importance of this tidal action to England is evident. As might be expected, then, the greater part of the work is devoted to the improvement of the tidal portion of rivers such as those of the British Isles.

Two useful chapters (92 pp.) are given to the observations required for a project for such work, *e.g.* tidal phenomena, soundings, current-velocities, discharges, salinity, &c. In quoting Cunningham's instrument (twin balls, sunk one to 211 and one to 789 of the depth) for measuring mean velocity past a vertical *at one operation*, it should be stated that the two balls should be *alike in all respects*. Fourteen pages are given to the subject of "under-currents"; one instance is quoted (p. 135) of a velocity of 4 miles per hour at 50 feet depth measured with a "double-float," when the surface-velocity was only 1.8 miles per hour. This is one of the best instances (known to the reviewer) of the excellence of the "double-float" (when well designed) for sub-surface velocity-measurement; several other good instances are quoted. These should surely convince those who condemn the "double-float" as useless for such work. The natural defects of most (tidal) rivers in their tidal reaches are detailed as the presence of a "bar" at the mouth, of hard veins of gravel, rock, &c., obstructing the water-way, of extensive mud or sand flats through which the deep channel is ever shifting, &c.

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The explanation of the cause of a "bar" at a river mouth now generally accepted, *viz.* as being really a submerged part of the "beach" of the outer shore-line, produced from the sea by the action of the waves (not from the alluvium brought down by the river), appears to have been first proposed by the author of this work in 1842. This suggests the treatment usually found successful in tidal rivers, *viz.* prolonging the fairway of the river, by piers, seawards into the deep water beyond the reach of the waves which produce the beach. And it is seen that this will fail in effecting a permanent cure in deltaic rivers, in which the gradual advance of the delta will reproduce shoal-water outside the ever-advancing mouths, in which the waves will therefore reproduce a bar.

The ideal improvement to be aimed at in the tidal part of a river is explained to consist chiefly in introducing increased tidal scour by removing obstruction to it (such as bars, &c.), and by confining its action under half-tide to a definite channel. These changes accelerate the propagation of the tidal wave, and decrease the tidal current, thereby giving (sometimes greatly) increased depth of water, not only over the bar at the mouth, but throughout the tidal reaches, and also prolong the duration of the tidal effect. The benefit of these results to navigation is obviously very great.

It is shown that jetties, groynes, &c., projected from the banks of a stream for confining the fairway to a defined channel are very uncertain in their effects. The course recommended in general is the use of low parallel training walls for confining the course of the river under half-tide to a single definite channel, low enough to be covered at half tide. Several interesting instances are given of the failure of the jetties, &c., and success of the low parallel wall system. After this treatment silting will generally occur in places behind the training walls, increasing gradually till marsh-land is produced; after which it is often possible to reclaim some of the raised land; but it is stated that it seldom pays to do this in British rivers until the silting has raised the land to the level of ordinary spring-tides. A most useful practical rule is proposed, that reclamation work should only be undertaken as part of a large general scheme of improvement of a navigation, and never be permitted to the desultory self-interested efforts of private riparian proprietors.

A short chapter (9 pp.) is given to the effect of bridge on navigable rivers. In highly civilised countries this is now a question of rapidly increasing importance. It is shown that the interests of the bridge constructors, especially in the case of railways, are generally adverse to those of the navigation. Of course the subject cannot be much developed within 9 pages. But a short description (with plate) of the railway swing-bridge over the Ouse has been included.

An excellent account is given (31 pp.) of the various processes of dredging and excavating, with a description of some of the most recent machines, and an analysis of the cost of the work.

It will be seen that on the whole this treatise is an excellent account of the principles and practice of river engineering, to the successful practice of which its able authors have so largely contributed.

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