Current-pumps for Mining and Irrigation.

Renewed attention has been recently devoted by Messrs. F. W. Payne, H. Morgan, and Milne, Otago engineers, to the possibilities of economically utilising as a motive power the swift current of the River Clutha, which in volume of water discharged and velocity of current is exceeded by few rivers in the world, and by none in Australasia.*

As a result of such investigations, a current-wheel of greater efficiency and power has been evolved upon scientific lines, which, for operating pumps to raise water for mining or irrigation purposes and for the generation of electric power, promises to surpass all other methods that may be practicable in the valley of the Clutha, both in economical installation and in low working-cost.† This great river is eminently favourable for the successful application of current-driven machinery, the velocity of the stream ordinarily varying between five and eight miles per hour, which has been found to embrace the range within which such machines produce the most satisfactory results. The great depth and width of the stream, the absence of floating timber, and, in the upper portion of the river, of navigation also, also constitute favourable factors.

The advantages of an economical motive power within the valley of the Clutha for irrigation and mining purposes cannot well be overestimated; the configuration of the country is favourable to the reticulation of large areas of fertile land from current-pumps upon the river, and water for alluvial gold-mining may also be raised to considerable elevations in localities where a water-supply from any other source is practically unobtainable. And as a result of investigations I am satisfied that the recently evolved current-pump is capable of fulfilling these requirements within range of its operations.

At the present time there are two installations of current-pumps on the Clutha—viz., that designed and constructed by Mr. F. W. Payne at Alexandra, and that of Messrs. H. Morgan and Milne at Roxburgh—and these were examined and subjected to careful tests carried out by Messrs. Morgan, Payne, and myself, with the accompanying results.

The current-wheel pumping plant recently installed by the Alexandra Lead Gold-dredging Company (Limited) on the River Clutha, at Alexandra, by Mr. F. W. Payne (see drawings and photograph) is the pioneer current-pump of Australasia, and is probably the largest and most powerful unit of this class of machine ever constructed. The special features of this machine, designed for the purpose of obtaining greater efficiency than former types, are—

(*a.*) The curvature of the blades (of a somewhat similar form to Poncelet's undershot wheel), which form, it is claimed, offers increased resistance to the current, and both enters and leaves the water with less commotion than the straight floats of former types of wheel.

(*b.*) A movable shutter at the up-stream end of the wheel is operated by a hand-winch, and acts as a brake by restraining the current from the wheel when required.

(*c.*) The magnitude of the wheel—viz., 19·77 ft. diameter—and the depth of the floats or blades submerged. In no former machine of which there is any record has the diameter of the wheel exceeded 16·4 ft. (*Vide* "Spon's Dictionary of Engineering.")

(*d.*) The reduced number of blades or floats.

The current-wheel operates between two parallel pontoons, the stream flowing between them. This machine was installed for the purpose of raising water, which it efficiently does, to an elevation of 51 ft. 6 in. above the river-level for sluicing the auriferous gravel, river-banks, and terraces. The following is a summary of the results of a series of careful tests of this machine, together with the principal dimensions:—

Velocity of stream (8/1/09), 5·7 miles per hour.
Theoretical horse-power of stream, 69·4.
Brake horse-power of current-wheel, 35.
Horse-power in water discharged by a centrifugal pump, 14·6.
Efficiency of current-wheel, 50·4 per cent.
Efficiency of centrifugal pump, 41·7 per cent.
Combined efficiency of complete plant from river-current to discharge-weir, 21·04 per cent.
Diameter of current-wheel, 19 ft. 9½ in.
Length of current-wheel (or float), 20 ft. 0½ in.
Area of float (or blade) submerged, 67·735 sq. ft.
Depth of float (or blade) submerged, 3·38 ft.
Revolutions of wheel per minute at above velocity of stream, 3·96.
Number of blades in wheel, 12.
Length of pontoons, 55 ft.
Height of water discharged above river-level, 51·5 ft.
Quantity of water discharged, 2·5 cub. ft. per second, or 1,347,840 gallons per day.

Based upon the results of the foregoing experiments, and the fact that the power increases as the cube of the velocity of the stream, the following table has been prepared, with a view to illustrating

* The Clutha drains an area of upwards of 8,000 square miles, and discharges into the sea 1,000,000 cubic feet of water per minute ("MacDonald's Geography of New Zealand").

† The cost of construction of the principal races, including their storage-dams, varies generally in Otago and Southland between £500 and £2,000 per cubic foot of water delivered per second; but in some places, including the gorge and valleys of the Clutha below Cromwell to Roxburgh, water from races is practically unobtainable. The cost of installation of one-unit current-wheel plant, complete on a steel pontoon, would be about £1,800, and this would deliver at an altitude of 150 ft. above the river (as based upon my recent tests) from 1·20 to 2·85 cubic feet of water per second, varying with the velocity of the current. The relative average initial cost in Otago of Government races and dams per cubic foot of water delivered therefrom per second is £1,250, and by the current-pumping plant to an altitude of 150 ft. the cost would approximately be £900.