SOME PRINCIPLES GOVERNING THE DESIGN AND THE OPERATION OF IRRIGATION SYSTEMS.*

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A^N irrigation system, like any other machine, must be designed to meet the requirements of efficient operation. A machine may be perfect mechanically, and built of the best material to be had, yet be worthless as a working unit because it does not fulfil the practical requirements of operation. This analogy is not sufficiently recognized by many who are responsible for the design and the operation of irrigation plants. It These three factors, together with a proper allowance for losses, determine the total quantity of water required per season, but they do not, by any means, determine the necessary rate of delivery or carrying capacity of the canal. As a matter of fact, this latter requirement is practically independent of the second and third factors, as stated above. In other words, it may easily happen that a canal serving a certain area which requires 1.5 acrefeet per acre per season may need to be fully as large as another canal serving an equal area, which requires 3.0 acre-feet per acre per season. The reason for this will, I trust, be made clear by the discussion which follows.

It is the practice in India and Egypt to express the second factor, on duty of water, in the number of acres which a flow of 1 cubic foot per second will serve, while



Diagram Showing Effect of Rainfall and Irrigation on Crop Yield.

is not the purpose of this paper to present a complete discussion of the principles of design and construction of irrigation systems, but to emphasize one or two important features which do not usually receive sufficient consideration.

The design of many irrigation canals is based on the theory that the required carrying capacity of the canal depends solely on: (1) The area to be irrigated; (2) the duty of water, or the quantity to be supplied per acre each season; (3) the length of the irrigation season, or length of period required to mature the crop irrigated.

*From the report for 1914 of the Department of the Interior, on Irrigation. the third factor, or length of period of flow, is called the "base" of the duty. Usually the "base" is the period required to mature the crop. It is sometimes used, however, in a more restricted sense to apply to the period of maximum demand, called by Buckley the "period of pressure." Likewise Parker uses the term in both ways, to express the length of the irrigation season, and also as "the interval between successive waterings." In American practice, duty was formerly expressed in acres served per second-foot, often without defining the length of period of flow. This, of course, was very indefinite. Now it is usually expressed in depth of water applied, or in acre-feet per acre per season, and the maximum demand