occurring in the Indus Plain. The model is described in detail in the Appendix Report "Indus River Basin Studies", Harvard Water Resources Group (1963).

The following sections contain a concise description of the salient features of the computer model and a discussion of its application to important general questions relating to the strategy of our plan. Among these are the cost of tubewell water, the economics of mining of groundwater, the optimal size of project areas, the proper spacing of wells and the cost and benefits associated with use of asphaltic emulsion sealants, to control leakage from the canals.

The model is constructed in two parts that are joined in the final optimization process: The first part, the "technological function", permits of the simulation of the characteristic movements of water in the hydrologic regime such as canal inflows, drainage ditch outflows, rain, leakage, pumping, evaporation. These interrelated movements constitute the technological function and in principle contain the entire set of physically feasible designs involving different blends of pumps, drains, and linings. This part of the model is intended to simulate the physical response corresponding to any given set of structures and operating rules. The second part consists of the cost and benefit functions that are needed and used in the evaluation and ranking of various alternative designs according to appropriate economic criteria such as prices, discount rates, economic time horizons, and budgetary constraints.

With reference to Figure 7.20 the various flow vectors (volume of water per unit of time) are defined as follows:

Q = canal flow
x = water course flow
z = tubewell-to-irrigation flow
$y-z$ = tubewell-to-drain flow
w = canal leakage
u = irrigation water applied
u' = irrigation water through-put
r = rainfall
r' = rain-to-groundwater flow
r'' = overland runoff-to-canal flow (flood damage vector)
r''' = overland runoff-to-drain flow
s = groundwater seepage to drain
v = evaporation from the groundwater
p = groundwater inflow
p' = groundwater outflow