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ČAŠMA

ČAŠMA (spring). Although mainly characterized by dry and arid climatic conditions, Iran and Afghanistan, as well as wide parts of Central Asia, have a great variety of natural springs, especially in mountainous areas and along tectonic thrusts.

On the whole, springs are of such a variety of forms that it is hard to present a comprehensive and systematic classification. A very general classification divides all springs into (1) those produced by gravity acting on the groundwater and (2) those that have their origins in tectonic volcanic forces within the earth's crust (see ĀB-E GARM). According to Ward (1967) springs in the sense of gravity-induced springs on groundwater basis can be differentiated into the following main forms: "Depression springs (A) are those in which groundwater flows to the surface from a permeable aquifer by virtue of the fact that the ground surface falls below the level of the water table, and the relatively slow movement of water discharges from such springs, even through quite open-textured rocks, are usually low. Contact springs occur where the contact plane between a permeable and an impermeable rock intersects the ground surface in such a way that groundwater is deflected to the surface. Springs of this type are, therefore, found in a number of situations, such as the foot of a limestone or chalk escarpment (B), the foot of a scree slope (C), along a fault line which results in the appropriate juxtaposition of permeable and impermeable rocks (D), or where an igneous intrusion reaches the ground surface (E), but, again, these usually have only small discharges, except in situation (B), where the catchment area of the spring,

and the thickness of the permeable deposit, is often large. Fracture springs (F) occur when a system of interconnected minor faults leads groundwater to the surface and here, because of the size of the interstices through which water movement takes place, discharges are often quite large. For the same reason, discharges are normally high in the case of tubular springs occurring as a result of groundwater movement in lava tubes, or in solution enlarged interstices in limestone (G) . . . Although apparently flowing against the force of gravity, artesian springs must also be included as springs which result from gravity acting on the groundwater, since their discharge depends upon the difference in head between the point of spring flow and the water table in the recharge zone (H) . . . Since artesian spring flow occurs under pressure, discharge volumes are frequently high." (See Figure 2.)

On the basis of this very general differentiation, springs of all types can be found in Iran and Afghanistan. Nevertheless, some are more common and almost ubiquitous while others are less frequent. According to the statistical *Yearbook of Iran* 1986, Iran had in 1976 a total of 8,193 springs with a total discharge of 5,450 million m^3 /year as opposed to about 18,388 *qanāt* (7,539 mill. me^3 /year), 16,626 artesian and deep wells (7,470 mill. m^3 /year), and 42,546 semi-deep wells (3,883 mill. m^3 /year).

While a total of 8,193 springs seems a high number in a predominantly arid country, it should be considered a comparatively small number in view of the variety of different forms of springs. Type A, for example, is not very common because of the prevailing scarcity of the combination of sufficient groundwater flow and steeply incised valleys, type B is potentially a widespread phenomenon. Wherever cuesta landscapes occur, the interrelationships of permeable and impermeable rocks are preconditioned. Since limestone and chalk escarpments are very common in wide parts of the Zagros or the Hindu Kush, contact springs should be frequent. Wherever rain or melting snow water is available in sufficient quantities (e.g., in the mountain ranges of western Iran or northern Afghanistan) to recharge the groundwater levels, contact springs occur. Here a regular groundwater flow, however, is very often hampered through the solution of chalk and limestone by karst phenomena. As a matter of fact, karst springs (type G) are very common in the Zagros system and also in parts of Afghanistan. One of the most famous karst springs in Iran is that of Ṭāq-e Bostān near Kermānšāh, but there are numerous others, especially in the Zagros area. Probably the most common type of spring is type C. Large parts of central Iran and Afghanistan

are characterized by mountainous highlands, the bases of which are covered by more or less extended and thick masses of debris in the form of alluvial fans. It is in these alluvial fans that groundwater circulates. Most of the groundwater remains unused since it penetrates into the underground or evaporates in the endorhëic basins. Other groundwater reserves are used by *qanāt*s, while a few groundwater-bearing strata and water tables reach the surface, where they form springs either of type B or, more often, of type C. It should be noted that many of these springs are flowing only periodically or even episodically, according to the availability of groundwater.

Besides these types springs resulting from tectonic faults and fractures (types D, E, and F) are also common in Iran and Afghanistan. They are especially frequent in environments with strong tectonic activity, e.g. in the Anti-Alborz region but also in certain parts of central Iran. On the whole, however, these springs are less important than those mentioned before.

BIBLIOGRAPHY

Due to the fact that specific investigations on the hydrogeology of springs in Iran, Afghanistan, and their neighboring regions are still missing, literature is scarce. Isolated hints can be found in almost all geological reports on specific areas within the region. Besides, one may point to the following publications:

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