BĀRĀN
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BĀRĀN “rain.” The words for “rain” and “to rain” in Iranian languages are all derived from the OIran. root *wār-*, though the stem formation of the noun varies. The thematic form **wāra–* is found both in Old Iranian: Avestan *vāra-*, Middle Iranian: Khotanese *bāra-*, Sogdian *wʾr,* and in modern Iranian: Parachi *ḡār*, Sanglichi *bōr,* and Wakhi *wïr* (also *boronrawī*); a derived form in *–iš* is found in many dialectal variants of NPers., *bāreš*, and in Baluchi, *gwāriš* (beside *gwārag*); a derived form in *–ān* is found in Mid. Pers. *wārān*, NPers. *bārān*, Munji and Ishkashmi *boron* (from Pers.? Ishkashmi also *urnaduk*); cf. also Ossetic Digor *warun*, Iron *warịn* (= infinitive); forms derived from stems in *aka* are found in Baluchi *gwārag* (= infinitive), Yidgha *wäriḡo*, Pashto *(w)oryā* or *(w)əryā*, and Shughni *wareyj*. Ōrmuṛi has only the Persian loanword *bārān*, but has preserved the verb *ḡōr–* (Barakī Barak), *ḡwar–* (Kāṇīgrām). (See, e.g., Bailey, *Dictionary*, p. 278.)

It is interesting to note that in modern Iranian languages violent and dangerous rainfall events are often designated by borrowings from Arabic (*ṭūfān* for typhoon, *barq* for lightning, *raʿd* for thunder, *sayl* for sudden deluge), whereas for phenomena considered beneficial a terminology of Iranian origin has been preserved: Rain is described as beneficent in the *Dādestān ī dēnīg* 37.31; and hail, Persian *žāla*, Pashto *ž´aləy*, despite the damage that it can cause to crops, particularly after the blossoming of fruit trees in the spring, enjoys a favorable reputation, doubtless because it does not run off on the ground and thus saturates the earth with moisture. In the Iranian-speaking world, Pashto is unique in having an abundant vocabulary of

Indian origin for the different, typically tropical rainfall manifestations that occur in the eastern portion of Irano-Afghan territory (*paršakāl* “summer rain, monsoon,” also called *wasə* and *bāresāt*; *šēba* “deluge”; *pūna* “drizzle”; and so on).

Although lying between the fortieth and twenty-fifth parallels north, the Irano-Afghan area is far from presenting the regular decrease in precipitation from north to south that characterizes the Mediterranean zone: Ahvāz (31° 20’ N) and Mazār-e Šarīf (36° 42’ N) receive exactly the same annual rainfall (187 mm); Bandar-e ʿAbbās (27° 11’ N) is hardly less well watered (139 mm) than Saraḵs (157 mm at 36° 32’ N). The topography, on one hand, and the presence of marine expanses, on the other, are responsible for these anomalies. They are the principal geographic factors in the territorial distribution of precipitation.

1. Geographical factors in the distribution of precipitation.

The influence of the mountains on the distribution of precipitation has less to do with altitude than with their orientation in relation to the prevailing middle-latitude westerly cyclonic movements, which bring the greater part of the annual rainfall. The presence of the oblique Zagros and Hindu Kush ranges at the western and eastern extremes of Irano-Afghan territory introduces great contrasts between the relatively humid piedmonts and slopes exposed to the winds, on one hand, and the much more arid piedmonts and slopes of the sheltered sides, on the other. Dezfūl (143 m above sea level), on the western piedmont of the central Zagros, thus receives 358 mm, whereas Isfahan (1,570 m), on the eastern piedmont, receives only 108 mm, though both cities lie in the same latitude, which is also that of Ghardaïa in the Algerian Sahara. The highest peaks of the two ranges receive about 1,000 mm (982 and 1,018 mm respectively, falling in 100 days at North Sālang and South Sālang in the central Hindu Kush, the only permanent meteorological stations located at altitudes higher than 3,000 m). At their low points, the intramontane basins are islands of relative aridity, growing progressively drier the farther to the east they are located: Whereas in the Azarbaijan and Fārs basins 300 mm or more are recorded (Urmia, 360 mm in 93 days; Shiraz, 304 mm), those of the Hindu Kush receive less than 300 mm (Bāmīān, 138 mm in only 37 days; Zēbak, 125 mm; see Figure 19).

That the broad saddle extending between the Zagros and the Hindu Kush does not present a zonal organization in bands of decreasing rainfall toward the south is owing to modifications introduced into the regional atmospheric circulation by the presence of the Indian Ocean to the south and the Caspian Sea to the north. These two marine expanses have a humidifying influence, which can be correctly understood only if its two components are clearly distinguished. On one hand, they ensure the formation of new fronts within the turbulent air currents that cross them from west to east, which explains the abnormally high humidity of their eastern shores, which is much greater on the Caspian (Gorgān, 696 mm) than on the Persian Gulf (Būšehr, 221 mm) because of the decreasing frequency of cyclonic circulation toward the south. On the other hand, the seas moisten some of the convergent winds that are generated by every cyclonic event. On the Persian Gulf the process affects southwesterly winds coming from Arabia but nevertheless carrying some humidity to the Iranian coast. On the Caspian the northeasterly winds account for the superabundant rainfall on the southern Caspian shore and the northern slopes of the Alborz. Rainfall increases steadily from east to west, proportional to the maritime reach of the northeasterly winds striking the coast (Šāhī, 761 mm; Rāmsar, 1,212 mm in 136 days; Anzalī, 1,810 mm in 138 days). It seems to reach its maximum (doubtless more than 2,000 mm) at the level of the medium-altitude beech forests on the Alborz, at about 1,500 m.

This exceptionally high humidity makes the Caspian provinces, especially Gīlān, which is the best watered among them, unique in a country as generally arid as Iran. Aridity is obviously greatest in the center of the great inland basins, which combine all possible handicaps: low altitude, position sheltered from the dominant winds, continentality. Mean annual precipitation there is always below 100 mm (Zaranj, 53 mm in only nine days; Ḵūr, 36 mm; and doubtless even less in the center of the Dašt-e Lūt, considered unable to support life). It is more difficult to define the upper limits of aridity. It can be assumed that they coincide with the lower limits of rainfall agriculture. It has thus been shown that dry-farmed winter wheat disappears when annual precipitation is below 210 mm in southern Iran and below 230 mm in northern Iran—a difference that arises from the lateness of the growing season caused by intense winter cold in the north (Perrin de Brichambaut and Wallén, p. 15). The 230-mm limit can be extended to the greater part of Afghanistan, where research into agricultural climatology is less advanced but where continentality is at least equal to that of northern Iran. At this level of analysis, then, nearly two-thirds of the Irano-Afghan area are unsuitable for unirrigated agriculture because of excessive aridity. Nevertheless, it should be noted immediately that even the remaining third offers very uneven conditions, because the seasonal distribution of precipitation is far from homogeneous.

2. Rainfall patterns.

The seasons of maximum and minimum rainfall, and sometimes also the frequency of such extremes within the year, show important regional variations, which, however, follow a relatively simple pattern (Figure 19 and Table 31).

In general maximum precipitation occurs in winter south of latitude 34° N and in spring north of it. This [major] boundary line is breached at only two points, on the Tehran piedmont and in northwestern Afghanistan, where the winter maximum prevails as far north as 36° and 37° N respectively. More specifically the average monthly maximum south of 34° N falls in January and north of it in April, although in the latter instance it sometimes occurs in March (in the eastern Alborz, Bādḡīs, and Bactria) or in May (at some intramontane stations in Azarbaijan and the Hindu Kush). A part of the cold season precipitation falls in the form of hail and especially snow (in the Hindu Kush the number of days with snowfall exceeds the number of rainy days at elevations above 2,700 m; see barf).

The general determinants of winter and spring rainfalls are those of the middle latitudes, with polar disturbances and Mediterranean frontal depressions playing the major role (Table 32). The southernmost advance of the former and the path of circulation followed by the latter are both determined by the latitude of the subtropical jet stream. In the last analysis, then, it is seasonal latitudinal shifts in the jet stream that account for the contrast between patterns with maximum winter rainfall and those with maximum spring rainfall.

Furthermore, all else being equal and within the limits already defined, conditions are more favorable for dry farming of cereals when maximum precipitation occurs later in the year. Regions with predominant spring rainfall are more favorable than those with the maximum in winter, and among the former those with the maximum in April (or better still in May) are more favorable than those with the maximum in March. In Afghanistan, where the length and intensity of winter cold over the greater part of the territory impose rainfall cultivation of spring wheat sown in April and harvested in September, instead of winter wheat, the preferred growing zone is thus north, rather than south, of the Hindu Kush, despite annual rainfall totals that hardly differ (Table 33 and Figure 20, graph D). Misunderstanding of the fundamental role of seasonal precipitation patterns in the geography of dry farming has often led to incorrect paleoclimatological reconstructions, especially by archeologists (e.g., Jaguttis-Emden, 1981).

The Caspian climate is an exception here, too. Maximum precipitation falls in the autumn (October). It is linked to strong cyclonic activity over the Caspian Sea at that season, reinforced by the fact that at the same time the waters reach their highest temperature and consequently their maximum potential for humidifying the overlying air masses. During that period it rains, on the average, more than two days out of five. On the other hand, spring, the other season of intense cyclonic activity in the Caspian latitudes, is only third in rainfall, after winter, for there is very little evaporation from the cool sea.

Minimum precipitation uniformly falls in the summer, the season during which the Irano-Afghan latitudes experience tropical high-pressure cells, which are stable and dry. Precipitation then is slight (less than 5 percent of the annual total) and often totally absent for several months, from June to September-October in the north, from April to November in the south. There is thus a very simple overall pattern, with a single dry season in summer, which means that the Iranian environment is part of the Mediterranean bioclimatic area.

The Caspian region and the Pakistani borders are nevertheless exceptions to this rule. In the first instance, the particular conditions of atmospheric circulation above the Caspian Sea ensure that the summer minimum, though always marked, is still quite substantial (more than 10 percent of annual precipitation), sufficient, for example, to jeopardize the drying of the harvest. The Caspian climate thus does not include a dry season.

In the east westward penetration of the Indian summer monsoon current under the ridge of barometric high pressure causes a rainy season between mid-June and the beginning of September. Although this thin layer of humid eastern tropical air can move north across the crest of the Hindu Kush (e.g., the September, 1972, rains at Bāmīān; Rathjens, 1978, p. 24) or advance west as far as Fārs, it is strong and regular only in three limited areas: upper Badaḵšān around Zēbak, southeastern Afghanistan south of the Spīnḡar, and Iranian Baluchistan (Figure 19). Only in those areas do clearly defined bimodal rainfall patterns occur, characterized by a primary maximum in the cold season (a

Mediterranean feature), a secondary maximum in the summer (a tropical feature), and displacement of the primary minimum toward autumn. Summer rainfall, which decreases from east to west, reflecting the thinning out and drying up of the monsoon current, is on the average insufficient (only 20-30 mm in eastern Afghanistan, about 10 mm in Iranian Baluchistan) to interrupt the bioclimatic aridity of summer. Only in the extreme east, in the Ḵōst basin (Paktīā province), is the summer wet enough to produce a climate with two dry seasons, characterized not only by an almost perfect balance between spring and summer rainfalls (35 and 34 percent respectively of the 476 mm that fall at Ḵōst in sixty-three days) but also by a significant reversal of monthly rhythms, with the primary maximum occurring in July (79 mm in eight days) and a secondary maximum in April (65 mm in nine days; averages calculated over a twenty-year period). This very special situation, in which both subtropical (or western) and tropical (or eastern) climatic influences operate, explains the finely differentiated mosaic of precipitation patterns on the Solaymān mountains and their approaches, in contrast to the great monotony of such patterns over the rest of the Irano-Afghan area. The mean that can be established among these conflicting influences nevertheless masks an extremely changeable reality: Sometimes the monsoon rains are almost entirely absent (less than 40 mm was received at Ḵōst during the whole summer in 1968 and 1969); sometimes they are torrential (more than 250 mm in the summers of 1964, 1973, and 1979). Sometimes the Mediterranean rains are deficient (1970); sometimes they are overabundant (1965, 1972).

Variability from year to year is, in fact, a fundamental feature of precipitation in the entire Irano-Afghan area. It affects both the amount and the pattern of rainfall.

3. Variability of precipitation.

This variability can be measured on several scales, the first of which is that of annual totals. Calculated on the basis of data from 112 stations scattered over the entire territory studied, the average index of absolute annual variability (i.e., relation between the annual maximum and minimum registered) is 3. That means that, from one year to the next, the amount of precipitation can vary from one to three times. In fact, normally, the lower the average rainfall, the greater the variability (Table 34).

Taking into account the fact that at best available rainfall data cover only a few decades, secular variability is doubtless always higher than the estimates.

Very informative in this respect are the Persian Gulf stations, for which we have an almost continuous series of data since the nineteenth century, thanks to the diligence of British consular officials in the region. For example, in the period 1955-74 Būšehr registered annual extremes of 79 and 412 mm, providing an index of variability of 5.2, yet earlier clues suggest that there was a much greater range of variation, from absolute aridity (0 mm) in the year 1877 to the 676 mm experienced in 1894 (Bobek, 1951, p. 11).

Figure 22 represents the irregularity in annual precipitation cartographically; it is based on fluctuations of the 200 mm isohyet, considered the absolute lower limit for dry farming. It shows a clear three-part division of the area: an arid core, where rainfall is always less than 200 mm and in which agriculture can be conducted only by means of irrigation, in oases; scattered humid areas on the periphery, which always receive more than 200 mm and are thus to be considered prima facie safe for rainfall agriculture (the western slopes of the central Zagros, the northern slopes of the Alborz, the Caspian plain, and the northern slopes of the mountains of Afghan Turkistan and the Hindu Kush); and, finally, a semiarid transitional zone, which straddles the 200-mm isohyet and thus falls into the arid zone in some years and into the humid category in others. Obviously it is in this last zone, by far the largest of the three, that agricultural risks are greatest and variations in rainfall the most fraught with consequences.

Detailed examination of annual rainfall data from thirty-one Afghan stations, each having been in operation for more than ten years, sheds further light on the nature, magnitude, and significance of annual variations in the recent period. Of a cumulative total of 645 recorded years, 341 have fallen below the local average (53 percent) and 304 above it. Following the usual hydroclimatological definition, which designates as abnormal any year that shows a deviation from the average exceeding one standard deviation, only ninety-five instances of abnormal aridity and ninety-two instances of abnormal humidity can be identified. And, if only years deviating from the mean by a value greater than two standard deviations are taken into account, only seven instances of severe aridity can be identified, versus twenty-two instances of really superabundant humidity. The conclusion is, then, that very wet years have been more frequent than very dry years but that a moderately dry year is the most frequent anomaly (Figure 21). A further regional analysis of the data clearly demonstrates that stations situated north of the Hindu Kush diverge from those in the far south in recording relatively moderate annual variability (their average index does not surpass 2.3) and a slight predominance of wet years over dry years. This kind of climate, with relatively moderate variability and prevalence of wet years over dry years, doubtless favors dry farming and must be taken into account in explaining the remarkable extent of such farming north of the Hindu Kush.

Variability in total precipitation from year to year is in fact only a result of variability in short-term rhythms—whether seasonal, monthly, or daily—which are more crucial for the peasant. At this level, for example, a very large fluctuation in the date of maximum precipitation can be observed (Table 35). Except in the narrow zone of monsoon influence, the only truly stable feature is the summer dryness. Without pushing analysis of the data farther, it appears that there is a fundamental distinction between two types of precipitation hazard, the effects of which are of different magnitude both in duration and in extent of the area affected.

Droughts correspond to absence of rainfall during the usual rainy season. They can thus be viewed as extensions of the normal summer dryness to the greater part of the year, even to the entire year. The inhibitory mechanisms capable of thus blocking normal precipitation rhythms are linked to global, or at least supraregional, meteorological events. For example, an abnormal cyclonic wave may push the subtropical jet stream too far north, or, conversely, an unusual anticyclonic surge may oppose the penetration of the westerlies. In either instance the area affected is large: Droughts are never local, and their consequences are proportionally broad, sometimes dramatically so. A series of rather dry winters triggered a great famine in Iran in 1870-72, sparing only the northwestern and western regions of the country. A century later the drought of 1970-71 in Afghanistan brought an 18 percent decline in cereal production, the loss of forty-two percent of the herds, and a rise in human mortality from famine that is impossible to measure. Its reverberations were such that it might be considered the indirect cause of the fall of the monarchy in 1973. Not all precipitation deficits reach this magnitude. But an early cessation in rainfall during the cold season is sufficient to curtail the subsequent harvest to some extent. Variability in precipitation directly determines the levels of national agricultural production. It thus has considerable economic impact.

Aside from widespread and long-lasting disasters like droughts, which always have deferred effects, there is a second type of precipitation disaster that is brutal and short-lived. It consists of heavy rainstorms, some of which approach or even surpass 100 mm in twenty-four hours. Various weather conditions, generally quite localized, can cause them: There can be sharp thermo-convectional instability following prolonged heating of the ground, a strong surge in the summer monsoon, or even the vertical superposition of a cold upper tropospheric trough on a surface frontal depression; the last is by far the most frequent. It is in the coastal and subcoastal areas, which are bathed in warm, humid, and thus very unstable air, that the heaviest deluges are experienced. Of ten Iranian stations having recorded daily rainfalls above 100 mm during recent decades, five are located near the Persian Gulf and four in the Caspian provinces. In the first region, the rainstorms typically occur in winter, and the measured maximums do not exceed 200 mm (196 mm at Ḵārg and Gačšārān, 121 mm at Dezfūl). In the second, they can occur in any season except spring; in frequency and violence—both aggravated by the formidable barrier of the Alborz—they are unequaled elsewhere (353 mm in twenty-four hours were recorded at Anzalī, 260 at Rāmsar). In a continental environment, on the other hand, this type of torrential rainfall is much rarer and less severe and tends to be concentrated in the spring. In Afghanistan, for example, the daily maximum recorded up to the present is only 96 mm (at Darwāz, on March 24, 1973). In the zone of influence of the summer monsoon it does not exceed 64 mm (at Sardeh, near Ḡaznī, on July 6, 1978, and August 7, 1983).

Whatever the regional deviations may be, everywhere torrential rains cause damage, both direct (diffuse rainwash erosion on the slopes and sheet flooding on the piedmonts, destruction of buildings) and indirect (flash floods). In extreme instances they can be fatal. A recent example is furnished by the exceptional monsoon of the summer of 1978 in eastern Afghanistan: Two rainy episodes (on July 5-6 and August 17-19), as short-lived as they were violent, caused the death of 173 people and several thousand head of livestock and the destruction of some 2,000 houses, several dozen nomad camps, and more than 400 underground channels (*kārēz*). Furthermore, several thousand hectares of agricultural land were washed away. This catastrophe has had many historical precedents, some of which have been even more devastating, for example, the floods at Qom (spring, 1636), Qazvīn (April, 1851), Shiraz (January, 1908), and Rafsanjān (March, 1910; Melville, pp. 140ff.). Because the areas affected are always rather limited, this type of event, however spectacular it may be, does not really have an impact equal to that of a drought. But, whereas the death-dealing effects of the latter have been mitigated (in Afghanistan) or eliminated (in Iran) as governments have set up apparatus for rapid and effective relief (communications networks, food stockpiles) while conducting prevention policies based mainly on development of irrigation, rainstorms continue to be as dangerous to human life as ever.

Whether prolonged or sudden, spectacular or insidious, these natural precipitation catastrophes are an aspect of regional climatic normality that is too often little understood. They are not indicators of climatic change but merely recurrent events, the retrospective study of which, though still in its infancy, has already led to recognition of a frequency ranging between five and fifteen years (all rainfall hazards included), as well as of the role of social and political context in determining the magnitude of famines.

Paleoclimatic variations, particularly studied in Iran by geomorphologists and archeologists, have been the subject of contradictory observations and interpretations. The main difficulty in such reconstructions in fact is to determine whether a well-attested arid phase has resulted from a decrease in rainfall or from a rise in temperature that causes evaporation to increase and, conversely, whether a “rainy” phase has resulted from heavy precipitation or from a decrease in temperature and evaporation. The possibility that such variations have not occurred simultaneously over the whole of the Irano-Afghan territory cannot be excluded and would partly explain some of the contradictions among researchers.

See also ĀB iii; BARF.

Bibliography : The basic data are furnished by the national climatic yearbooks published regularly at Tehran and Kabul. The most significant of them (extending through 1974 for sixty-two Iranian stations and through 1977 for forty-two Afghan stations) have been conveniently brought together in M. Alex, *Klimadaten ausgewählter Stationen des Vorderen Orients*, TAVO, Beiheft A14, Wiesbaden, 1985. The basic data on Iran used in the present article have been drawn from this work. As for Afghanistan, where in general the meteorological network has been more recently established, the archives and yearbooks of the Meteorological Institute of Kabul through 1983 have also been consulted.

The records are not always as precise and consistent as one could wish. It must be emphasized, first of all, that the observation periods are of very unequal length for the different stations; rarely does any of them approach the thirty-year span necessary for calculating climatological “norms.” Many have been in operation for only a few years, especially in Afghanistan, where, after a

remarkable expansion in the 1970s, the meteorological network was severely curtailed in the 1980s. Second, the figures systematically combine rainfall and snowfall, which is why total precipitation, rather than rainfall proper, has been discussed in this article. Finally, the recording of rainy days (understood here as those days that receive 0.1 mm or more) has been rigorous only in Afghanistan. In Iran often only days receiving at least 1 mm are recorded. Any systematic treatment of this important aspect of rainfall is thus impossible.

The principal studies dealing with precipitation in Iran are H. Bobek, “Beiträge zur klima-ökologischen Gliederung Irans,” *Erdkunde* 6/2-3, 1952, pp. 65-84; Ch. Djavadi, *Climats de l’Iran*, Monographies de la Météorologie Nationale 54, Paris, 1966; M. H. Ganji, “Climates of Iran,” *Bulletin de la Société de Géographie d’Ēgypte* 28, 1955, pp. 195-299; and idem, “Climate,” in *Camb. Hist. Iran* I, pp. 212-49. For Afghanistan, the basic works are H. M. Herman, *Le climat de l’Afghanistan*, Monographies de la Météorologie Nationale 52, Paris, 1965; V. I. Titov, *Klimaticheskie usloviya Afganistana*, Moscow, 1976; and ʿA. Wāḥed and ʿA.-Ḥ. Ḡaffārī, *Režīm-e bārandagī dar sāḥa-ye jomhūrī-e demōkrātīk-e Afḡānestān*, Kabul, Rīāsat-e hawāšenāsī, 1360 Š./1981; these recent titles do not at all supersede the pioneering publication of H.-E. Iven, *Das Klima von Kabul*, Geographische Wochenschrift, Beiheft 5, Breslau, 1933; and especially those of E. Stenz, the virtual originator of the Afghan meteorological service: “The Climate of Afghanistan: Its Aridity, Dryness and Divisions,” *Bulletin of the Polish Institute of Arts and Science in America* 4, 1946, pp. 1-16; and “Precipitation, Evaporation and Aridity in Afghanistan,” *Acta Geophysica Polonica* 5/4, 1957, pp. 245-66.

Detailed cartographic representations of precipitation (corrected here on several points) can be found in Ganji, ed., *Climatic Atlas of Iran*, Tehran, 1965; P. Lalande et al., *Cartes climatiques de l’Afghanistan*, Publications of the Meteorological Institute 4, Kabul, 1974; and in Maps A IV 4 (“Mean Annual Rainfall and Variability, 1984”) and A IV 5-6 (“Rainfall Reliability and Seasonal Rainfall Patterns 1985”), both by Alex, op. cit.

Daily rhythms, especially the occurrence of heavy rains, have attracted the attention of some researchers: A. H. Gordon and J. G. Lockwood, “Maximum One-Day Falls of Precipitation in Tehran,” *Weather* 25/1, 1970, pp. 2-8; and C. Rathjens, “Hohe Tagessummen des Niederschlags in Afghanistan,” *Afghanistan Journal* 5/1, 1978, pp. 22-25.

Synoptic aspects have been dealt with in B. Alijani and J. R. Harman, “Synoptic

Climatology of Precipitation in Iran," *Annals of the Association of American Geographers* 75/3, 1985, pp. 404-16 (a study that would have been more instructive had its authors taken into account the precipitation totals instead of drawing conclusions entirely from the number of rainy days); A. Khalili, "Precipitation Patterns of Central Elburz," *Archiv für Meteorologie, Geophysik und Bioklimatologie*, Ser. B., 21, 1973, pp. 215-32; C. De Rycke and V. Balland, "Une région de contact climatique majeur: Les confins indo-afghans," in P. Pagney and S. Nieuwolt, eds., *Ētudes de climatologie tropicale*, Paris, 1986, pp. 103-21; T. R. Sivall, "Synoptic-Climatological Study of the Asian Summer Monsoon in Afghanistan," *Geografiska Annaler* 59A, 1-2, 1977, pp. 67-87.

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Recent rainfall disasters and some of their human and economic consequences have been the subject of special analyses. On the drought of 1970-71 in Afghanistan see D. Balland and C. M. Kieffer, "Nomadisme et sécheresse en Afghanistan: L'exemple des nomades Paštun du Dašt-e Nāwor," in Ēquipe Ēcologie et Anthropologie des Sociétés Pastorales, ed., *Pastoral Production and Society*, Cambridge and Paris, 1979, pp. 75-90 (Persian translation in *Īlāt wa ʿašāyer*, Majmūʿa-ye ketāb-e āgāh, Tehran, 1362 Š./1983, pp. 303-19, without the bibliography); N. T. Clark, "Some Probable Effects of Drought on Flock Structure and Production Parameters in Northwestern Afghanistan," *Nomadic Peoples* 15, 1984, pp. 67-74; and Rathjens, "Witterungsbedingte Schwankungen der Ernährungsbasis in Afghanistan," *Erdkunde* 29/3, 1975, pp. 182-88. On the exceptional importance of the 1978 monsoon rains in the same country, see De Rycke, "Ētude climatologique d'une invasion de mousson en Afghanistan central et oriental en juillet 1978," in *Climatologie tropicale et établissements humains/Tropical Climatology and Human Settlements*, Acts of Symposium 23 of the 25th International Congress of Geography, Dijon, 1984, pp. 89-101.

Paleoclimatic variations have been treated in several publications, which cannot all be enumerated here. For the Pleistocene, an attempt at synthesis has been presented in Ganji, "Post-Glacial Climatic Changes on the Iranian Plateau," in W. C. Brice, ed., *The Environmental History of the Near and Middle East Since the Last Ice Age*, London, 1978, pp. 149-63. An excellent survey of the various conflicting theories can be found in E. Ehlers, *Iran: Grundzüge einer geographischen Landeskunde*, Darmstadt, 1980, pp. 125-27.

Historical climatology, for a long time ignored, has been the subject of an initial survey of sources from the Islamic period in C. Melville, "Meteorological Hazards and Disasters in Iran: A Preliminary Survey to 1950," *Iran* 22, 1984, pp. 113-50 (which also deals with Afghanistan, though marginally).

Search terms:

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