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CLIMATIC CHANGE AND THE ELEVENTH–TENTH-CENTURY ECLIPSE OF ASSYRIA AND BABYLONIA*

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I. Introduction

After some three centuries of military strength and territorial expansion, in the eleventh century B.C. the Assyrian empire plunged into a state of weakness from which it was not to recover until a century and a half later. At the same time, Babylonia, Assyria's neighbor to the south, was also having difficulties. Textual evidence from the period is relatively scarce, but it is strongly colored by allusions to crop failure, famine, outbreaks of plague, and repeated nomad incursions into settled areas in both countries (see sec. IV and Appendix A, below).

The principal events of this troubled period in Mesopotamian history have been ably described and discussed by J. A. Brinkman in his study of the political history of post-Kassite Babylonia.[1] In considering the reasons for the disastrous nomad invasions, he suggests that they were primarily due to famines simultaneously affecting both the settled regions and the outlying nomad habitats. "The semi-nomads, whether their livelihood was derived at various times from the raising of cattle or from trade, needed to obtain at least some food supplies from the more settled areas .... These raiders were most likely to attack the settled areas of [Assyria and] Babylonia in times of famine, when they were unable to procure food by peaceful means and when the inhabitants of [Assyria and] Babylonia were apt to be weaker than usual."[2]

In this article, we shall substantiate and further develop this interpretation by considering the causality of the events from the viewpoint of climatology. We hope to show that while irregular nomad razzias into settled areas were, as rightly stressed by Brinkman, a matter-of-course phenomenon well attested throughout the history of Mesopotamia (and not only in time of famine), the massive, devastating incursions of the twelfth through tenth centuries were occasioned by long-term climatic changes

* Neumann is principally responsible for the climatological and meteorological data and discussions, Parpola for the Assyriological ones. However, the authors share the responsibility for the central thesis, which was elaborated in close cooperation and numerous discussions.

Abbreviations are those of the *Chicago Assyrian Dictionary*, with the following addition: NL = H. W. F. Saggs, "The Nimrud Letters," *Iraq* 17 (1955): 21 ff., etc., cited by text numbers. We are indebted to J. A. Brinkman of the Oriental Institute, University of Chicago; W. Karlén of the Department of Physical Geography, University of Stockholm; H. H. Lamb of the School of Environmental Studies, University of East Anglia, Norwich; D. Neev of the Geological Institute of Israel, Jerusalem; F. Röthlisberger, Kirschgarten 15, CH-5000 Aaran, Switzerland; and M. Wood of the British National Meteorological Archives for information, meteorological data, and criticism on specific points. Unless otherwise stated, all dates are B.C., except in figs. 1–5 and the passages commenting on these figures.

[1] J. A. Brinkman, *A Political History of Post-Kassite Babylonia* (Rome, 1968).

[2] Ibid., pp. 389 and 280 f.

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affecting not only the sustenance basis of the nomad population, but the economies and stability of the organized states of the region as well. In other words, we suggest that the dramatic political, military, and socio-economic setbacks of Assyria and Babylonia in these "dark centuries" were ultimately due to an adverse change in climate. The consequences of this change may have been gradual and not annually uniform, but its long-term, cumulative effects make it a factor of prime historical significance which should not be overlooked in the study of the period under consideration.

Recent studies in historical climatology strongly suggest that roughly about 1200 a notable warming occurred in Europe and, according to a few but strong items of evidence (both textual and nontextual), in the Near East as well. This warm period of European and Near Eastern climatic history lasted until about 900 and was preceded by a few centuries of comparative cool (ca. 1500–1200). Since in the Near East winters are the principal rainfall seasons and warm winters tend to produce reduced amounts of rain (see below), the change to a warmer climate in this part of the world is bound to have a negative effect on both the local agriculture and the steppe vegetation on which the nomads depend.[3] (Conversely, cool winters on the average mean increased precipitation and good crops.)

It can be estimated that a mere 1° C rise in mean winter temperatures may reduce the annual rainfall in the area by as much as 30 mm (see fig. 3 for data from Mosul). The implications of this figure for areas practicing rainfall agriculture can be gauged from rainfall statistics in present-day Iraq (50–150 mm per annum in the Jezirah and the alluvium, 200–500 mm in the piedmont regions), bearing in mind that the critical lower limit for rainfall agriculture is 200 mm of rain per annum. The southern alluvium dependent on irrigation would be correspondingly affected by reduced streamflow in the Euphrates and the Tigris. Thus, supposing that favorable climatic conditions before 1200 had boosted population growth both in nomadic and settled areas to ecologically critical limits, it is clear that even a seemingly small warming after 1200 would have been enough to set in motion the catastrophic historical processes referred to above.[4]

In reviewing below the evidence for the 1200–900 warming and drying, we shall also cite evidence for earlier and later periods of cooling and increased rainfall (ca. 1500–1200 and 900 through Hellenistic times) in order to illustrate the magnitude of the change. Some of the items of evidence to be cited relate to the Near East proper; others concern Europe and other parts of the world. For the relevance of the European data, note the following statement by Butzer: "There has been a striking correspondence between moisture trends in Europe and the Near East compared phase by phase so far. . . . *Every . . . drier or more humid fluctuation in the European*

[3] On the high sensitivity of Mesopotamian steppe vegetation to even slight variations in precipitation see R. McC. Adams, *Heartland of Cities* (Chicago, 1981), pp. 11 ff.

[4] *Mutatis mutandis,* the scenario we have in mind has a parallel in the Middle Ages, when a series of famine years both in Europe and Asia probably released the great Mongol invasions of the early thirteenth century A.D. See H. H. Lamb, *Climate, History and the Modern World* (London, 1982), pp. 175 f., and also Co-Ching Chu, "Climatic Pulsations during Historic Times in China," *Geographical Review* 16 (1976): 280 and table 6; Chu Ko-chen, "A Preliminary Study on the Climatic Fluctuations during the Last 5,000 Years in China," *Scientia Sinica* 16 (1973): 226.

climatic succession corresponded with a tendency to more arid or moister conditions respectively in this sector of the subtropics."[5] Studies by J. M. Mitchell relating to the period A.D. 1880–1958 indicate a parallel or nearly parallel variation of temperature worldwide.[6] We believe, however, that the research results of the past twenty years require a somewhat more qualified statement, viz., that there is a noticeable tendency for parallelism but that parallelism is not an absolute rule. In fact, the climatic change that set in about 1200 B.C. in Europe and the Near East was apparently not paralleled in North America; on the other hand, the cooling that set in about 1500 was a nearly parallel process in both continents and even worldwide.

An attempt to explain the demise of the Late Bronze Age civilizations of the Eastern Mediterranean through meteorological factors has already been made by B. Weiss, who investigated the patterns of drought distribution in the area with the aim of finding the particular pattern that is most consistent with the more or less simultaneous decline of those civilizations.[7] However, instability of large-scale atmospheric flow is such that the recurrence of a given drought pattern at close time-intervals is not plausible. On the other hand, given the likelihood of a climatic change to generally dry or drier conditions in the Near East around 1200, which we seek to demonstrate, the question of specific drought patterns becomes secondary. Such a change would allow for the occasional occurrence of some years of high precipitation within a period of predominantly low precipitation, as well as for rainy years in one region while a neighboring region was stricken by a severe drought. In other words, we need not postulate any major qualitative changes in the overall climatic patterns. The emphasis is on generally dry conditions over a long period of time.

II. NON-TEXTUAL EVIDENCE

The Near East

2.1 In *Ugaritica* 5, C. F. A. Schaeffer points out that the soil layer into which are embedded the destroyed buildings marking the end of Ugarit (early twelfth century) consists of fine, powdery, homogeneous particles of a light yellow, often whitish color. According to Schaeffer, this layer (in places 2 m thick), which is found everywhere in the excavated area of the city, "without any doubt whatsoever indicates a period of extreme heat and dryness at the time of Ugarit's end."[8]

The yellowish-whitish dry layer is covered by layers of medium or dark brown soil of a "normal" nonpowdery composition "indisputably indicating a period more humid than that prevailing at the time of Ugarit's end." Schaeffer notes that the same indications were also observed in his excavations at Enkomi, Cyprus.[9] Late Iron Age ("probably seventh–sixth century") sarcophagi and vestiges of Hellenistic tombs and

[5] K. W. Butzer, *Quarternary Stratigraphy and Climate in the Near East* (Bonn, 1958), p. 136. The emphasis shown is Butzer's.

[6] As quoted in A. D. Crown, "Toward Reconstruction of the Climate of Palestine 800 B.C.–0 B.C.," *JNES* 31 (1972): 138 and fig. 1.

[7] B. Weiss, "The Decline of Late Bronze Age Civilizations as a Possible Response to Climatic Change," *Climatic Change* 4 (1982): 172–98.

[8] J. Nougayrol et al., *Ugaritica*, vol. 5 (Paris, 1968), pp. 761 f.

[9] See C. F. A. Schaeffer, *Enkomi-Alasia*, vol. 1 (Paris, 1952), pp. 358 f.

edifices were found embedded in the upper strata of this brown soil. Below the yellowish-whitish layer are the strata containing the early Late Bronze (fifteenth-fourteenth centuries) and late Middle Bronze (late seventeenth-century) ruins. The soil of these strata again "has a non-powdery composition and is of a color suggesting a more rainy climate."

Thus, the dry, powdery layer of "Ugarit final" is sandwiched between two layers indicating a moist climate. Schaeffer concludes: "La constatation matérielle, dans les couches du tell de Ras Shamra, d'une longue période d'excessive sécheresse et de chaleur pendant les dernières années de la ville s'accorde avec les nombreuses informations relatives à des famines dans les pays voisins de l'Ugarit, et sans doute en Ugarit même."

2.2 Kay and Johnson have prepared estimates of the Tigris-Euphrates peak streamflow on the basis of ten regional paleoenvironmental "proxy" data (Persian Gulf sediments, pollen from five areas of the Near East, Van lake-levels, Van sedimentation rates, Van oxygen isotopes and barley-harvest dates) for the past 6,000 years.[10] From this wide set of paleodata they constructed a curve of Tigris-Euphrates peak streamflow for the 6,000-year period in question. (Actually, the "curve" is a strip into which the estimates fall.) The results indicate a sharp increase of peak streamflow setting in about 1450, with the maximum peak dating to about 1350–1250. This is followed by a sharp drop reaching the minimum peak about 1150, and then by a relatively sharp rise about 950.[11]

Several of the date estimates on which the Kay and Johnson paper is based were obtained by radio-carbon (hereafter R/C) techniques. These R/C dates are subject to an error of something like ± 100 years, and this should be taken into account when assessing the validity of our arguments. In all items of evidence cited below which involve R/C dating, this fact is indicated by the symbol "(R/C)" immediately following the serial number of the item.

2.3 It may be noted that the 1450–1250 increase in streamflow finds confirmation in an abrupt westward shift of the lower course of the Euphrates some time after the middle of the second millennium, which resulted in a rapid decline of the cities along the old channel of the river "not too long after 1225 B.C."[12] Furthermore, it would seem to agree with the tentative results obtained in Eddy's analysis of anomalies in the radiocarbon record,[13] which indicate that the years ca. 1420–1260 were a time of low solar activity and hence a relatively cold and (in the Near East) rainy period.

2.4 On the other hand, the period of reduced streamflow ca. 1200–950 correlates with one of the major episodes of salinization of Babylonian agricultural lands, dated

10 P. A. Kay and D. L. Johnson, "Estimation of Tigris-Euphrates Streamflow from Regional Paleoenvironmental Proxy Data," *Climatic Change* 3 (1981): 251–63.

11 Ibid., p. 258 (fig. 4).

12 See Brinkman, "Settlement Surveys and Documentary Evidence: Regional Variation and Secular Trends in Mesopotamian Demography," *JNES* 43 (1984): 175. On the environmental factors leading to channel alterations of the Euphrates in times of increased streamflow see Adams, *Heartland of Cities*, pp. 8 ff.

13 J. A. Eddy, "Climate and the Changing Sun," *Climatic Change* 1 (1977): 182 f. (fig. 4a); note, however, that Eddy's contention that periods of low sunspot numbers are cold periods in the climatic history of the earth has been questioned by H. E. Landsberg, "Variable Solar Emissions, the 'Maunder Minimum' and Climatic Temperature Fluctuations," *Archiv für Meteorologie, Geophysik und Bioklimatologie* 28 (1980): 181–91. Landsberg also points out (ibid., p. 182) that the "basic solar rhythms of 11 and 22 years" contribute no more than about 10–15 percent of the total variance in long series of air temperature observations.

on archaeological grounds to about 1300–900.[14] This correlation is significant since, as pointed out by Kay and Johnson, "increased irrigation, without adequate drainage, or insufficient irrigation because of shortage of water, could have promoted the salinization. Jacobsen and Adams relate at least one episode to raised water tables following the construction of major irrigation canals. The environmental forcing may be to a large extent masked by technological and social factors."[15]

2.5 J. L. Bintliff quotes results of investigations by other authors to the effect that in Middle and Late Bronze "a continued improvement in moisture [is observable] in the north [of Syria]. In Turkey, pollen diagrams show climax woodland achieved by the end of this period,"[16] i.e., at the end of the Late Bronze Age (about 1200).

2.6 In an unpublished paper, Lipschitz et al. report that just north of the Negev, a study of wood charcoal from archaeological sites indicates that about 1200 a shift took place in climate from more Mediterranean to more Saharan vegetation, "the earlier period thus being moister than now (or merely cooler?)."[17] The study makes no allowance for the possible import of wood from elsewhere,[18] but we do not feel that the importation of such bulky items as branches or even tree trunks was practicable under the conditions of the time and place.

2.7 In 1967 Neev and Emery published a curve of the course of the runoff/evaporation ratio for the Dead Sea over the past 100,000 years, as assessed by them.[19] This curve shows a moderate increase in the ratio (~ more rain) from about 3500 to 1300, after which the ratio drops off slightly. In a letter dated 29 October 1984, Neev informs us that he now estimates this particular rise of the Dead Sea level to have begun about 2000 and the high sea level to have persisted until Hellenistic times.

While this new estimate brings the rise in the sea level closer to the onset of our "cool and rainy" period (about 1500), the drop in the sea level no longer synchronizes with the onset of our "warm and dry" period (about 1200). Since other paleoclimatic evidence indicates that most of the first millennium was relatively cool and rainy, the Dead Sea data can be said to be in gross agreement with the general climatic picture of the second and first millennia, but they appear to be insensitive to "minor" (two- to three-century) climatic oscillations within the period. In any case, the results seem too tentative and inaccurate so far to be of relevance to the present study.

Europe

We shall cite only a few of the available data from Europe, but the evidence proffered by them is strong. Their relevance vis-à-vis the climate of the Near East was pointed out in the introductory section above.

14 See T. Jacobsen and R. McC. Adams, "Salt and Silt in Mesopotamian Agriculture," *Science* 128 (1958): 1,251.

15 Kay and Johnson, "Tigris-Euphrates Streamflow," p. 261.

16 J. L. Bintliff, "Climatic Change, Archaeology, and Quarternary Science in the Eastern Mediterranean Region," in A. Harding, ed., *Climatic Change in Late Prehistory* (Edinburgh, 1982), p. 146.

17 N. Lipschitz et al., "Fluctuations in the Aridity Line in Israel during the Late Bronze Age," paper given at the 1979 International Conference on Climate and History, University of East Anglia, Norwich, quoted by Bintliff, "Climatic Change," p. 147.

18 Cf. Bintliff, "Climatic Change," p. 147.

19 D. Neev and K. O. Emery, *The Dead Sea: Depositional Processes and Environments of Evaporites* (Jerusalem, 1967), fig. 16.

TABLE 1

NONTEXTUAL EVIDENCE

		2000 . . . 1500 . . . 1000 . . . 500
Near East	2.1	------------+**** --------------
	$2.2^{R/C}$	***++-------------oooooo-+******+-ooooooooooooo
	$2.3^{R/C}$	ooooo
	2.4	++++ +++++++++++++
	$2.5^{R/C}$	--------oooooooo
	$2.6^{R/C}$	--**
Europe	$2.8^{R/C}$	+++++++++--oooo
	$2.9^{R/C}$	--------------ooooooooo+++++++++
	2.10	---+++****
Asia	2.11	--------θθθθθθθθ--+++++++++++ θθθθθθθ
Africa	2.12	++++++----
	2.13	oooooooooo
North America	$2.14^{R/C}$	---------- ----------
	2.15	---------+?-+?-+?-----------

NOTE: ++++ = relatively warm/dry
**** = notably warm/dry
---- = relatively cool/rainy
oooo = notably cool/rainy
R/C = radiocarbon dating involved, at least partly

2.8 After 1500, forests decline in Europe, especially in the northwest, and yield their place to peat growth and podzolization.[20] In the Swiss Alps, pollen evidence indicates a climatic decline[21] (~ cooling) between 1400 and 1300. The farthest northerly extension of forests in continental sectors of both North America and Eurasia is dated 3000 to 1500. In the area of Spitsbergen and the Canadian Archipelago, open waters continued until perhaps 1500.[22]

2.9 "The spread of spruce forests from the east . . . as derived from pollen diagrams from sites all over Fennoscandia, was not a smooth, continuous process but took place in distinct steps."[23] One of these steps occurred between 1600 and 1300. In the Tirol, the timberline descended from about 2000 to 1300, while the rise took place from 1300 to 1000.[24]

2.10 Lakes of Central Europe show a minimum extension in a dry period about 1000, during which the chief settlements were in moist places and agriculture was carried on above the forest level, even above the Alpine passes.[25] Brooks points out

20 See Lamb, *Climate: Present, Past and Future,* vol. 2 (London, 1977), p. 416.

21 Scholars of climatic change usually refer to periods of cooling as periods of "decline" or "pessima," while periods of warming are referred to as "optima." Since in the Near East years with cool winters tend to be rainy (see below, pp. 169 f.), the relevant terminology should actually be reversed for that part of the world.

22 Cf. Lamb, *Climate,* vol. 2, p. 417.

23 Ibid.

24 See H. J. Beug, "Vegetation History and Climatic Changes in Central and Southern Europe," in Harding, *Climatic Change,* pp. 93 f.

25 See C. E. P. Brooks, *Climate through the Ages,* 2d ed. (New York, 1949), p. 300.

that there is evidence of a considerable traffic between Scandinavia and Ireland about 1200–1000, probably indicating a minimum of storminess.[26]

Mountain Regions of Asia and Africa

The published literature contains some data concerning glacial advances/retreats and/or humid/dry phases in areas which are neither in Europe nor in the Near East but close enough to the Near East to be of interest:

2.11 The Himalayas and Karakorum: at a recent symposium, "Climate and Paleoclimate of Lakes, Rivers, and Glaciers," held in June 1984 in Innsbruck, Austria, Röthlisberger and Geyh presented a paper entitled "Holocene Glacier Variations in Himalaya and Karakorum." According to their investigations, glacial advances occurred in these areas in 1750–1150 and in 750–150; in their summary, the authors add that chronologically these glacier variations are in line with those in the Alps. In a letter dated 4 December 1984, Röthlisberger kindly confirmed that in the interim period, 1150–750 was a period of retreat of these Asiatic glaciers.[27]

2.12 Saharan mountains and tropical Africa: we would have to review too many papers to do justice to research in these areas. We propose to be very brief. Geyh and Jäkel[28] say about the Tibesti area that an arid phase ended there about 3700 (C-14) years ago (B.P.), a date which Shaw gives as 2200 B.C.[29] Servant[30] reports that one of the transgressions of Lake Chad occurred shortly before 3200 B.P. (~ 1550 B.C.). Butzer et al. state that Lake Rudolf reached the high level of +70 m MSL a "little" before 3000 B.P. (~ 1300 B.C.). Since then the level has been low.[31] As for Lake Victoria, research by Messerli indicates that this lake, like Lake Rudolf, reached a high level close to 3000 B.P. (or 1300 B.C.).[32]

2.13 According to a forthcoming paper by Karlén, the Mount Kenya glacier appears to have been particularly active during the epoch before 1300 B.C. and ca. 540 B.C.–0 B.C.[33]

26 Ibid., p. 302.

27 Röthlisberger further informs us that the results for the Himalayas, Karakorum, and some other areas of the world will be published (jointly with M. A. Geyh) in a book entitled *Gletscherschwankungen der letzten 10,000 Jahre—ein Vergleich zwischen Nord- und Südhemisphäre.* Since the time we submitted this paper, two papers have been published by Röthlisberger and his colleagues which are relevant to the areas of the world we have discussed. One is by Röthlisberger and Geyh, "Glacier Variations in the Himalayas and Karakorum," *Zeitschrift für Gletscherkunde und Glazialgeologie* 21 (1985): 237; the other is by A. F. Gellatly, Röthlisberger, and Geyh, "Holocene Glacier Variations in New Zealand (South Island)," ibid., pp. 265–73.

28 M. A. Geyh and D. Jäkel, "Spätpleistozäne und holozäne Klimageschichte der Sahara aufgrund zugänglicher ^{14}C-Daten," *Zeitschrift für Geomorphologie* 18 (1974): 86.

29 B. D. Shaw, "Climate, Environment and Prehistory in the Sahara," *World Archaeology* 8 (1978): 137.

30 M. Servant, "Données stratigraphiques sur le quaternaire supérieur et récent au nord-est du lac Tchade," *Cahiers O.R.S.T.O.M.*, Série Géologie 2 (1970): 113.

31 K. W. Butzer, G. L. Isaac, J. L. Richardson, and C. Washbourn-Kamau, "Radioactive Dating of East African Lake Levels," *Science* 175 (1972): 1,070 and n. 15.

32 B. Messerli, "Die afrikanische Hochgebirge und die Klimageschichte Afrikas in den letzten 20.000 Jahren," in H. Oeschger et al., eds., *Das Klima—Analysen und Modelle, Geschichte und Zukunft* (Berlin, 1980), pp. 64-90, esp. fig. 6.

33 W. Karlén, "Glacier and Climate Fluctuations on Mount Kenya, East Africa" (forthcoming).

North America

While several of the major climatic changes appear to have taken place roughly coevally worldwide, this cannot be established as a general rule. As pointed out in our introduction, there is a remarkably good climatic correlation between the Near East and Europe, but it remains to be established whether the parallelism actually extends to North America as well.

2.14 A study by Denton and Karlén on Holocene climatic variations indicates an advance of the North American glaciers from about 1400 through 500, without showing a period of return to warmer conditions within these time limits.[34]

2.15 Similarly, the tree-ring-width data of LaMarche derived from bristlecone pine at the upper treeline in the White Mountains of California are interpreted to indicate a period of cooling about 1350 to 500, with only short-term reversals of the trend.[35] Thus, while the change to a cooler climate about 1500 clearly shows up in both North America and Eurasia, the marked European and Near Eastern warming between 1200 and 900 is (so far) not reflected in the North American data. Lamb points out in this context that the European climate between about 1100 and 800 approached the warmest post-glacial level.[36]

II. Climatic Correlation between Ugarit and Assyria

How close is the correlation between the climate and weather characteristics of the eastern Mediterranean littoral and northern Iraq? This question is important in view of Schaeffer's findings for Ugarit and Cyprus (see 2.1, above) and their potential implications for the root causes of subsequent events in Assyria and Babylonia.

Uninterrupted series of meteorological data on the basis of which one could study the degree of correlation between temperature and rainfall are available only for relatively short periods of this century for the northern littoral (~ Ugarit). Longer series (starting from 1923) exist for northern Iraq. For the littoral we chose the series from Latakia, 12 km southeast of Ras Shamra. Unfortunately, this series, which starts only in 1952, is very short.

For northern Iraq we chose the data from Mosul, whose location coincides with that of Nineveh. Mosul, with an average annual rainfall of about 400 mm in this century, represents an area where agriculture is practicable in "normal" years even without artificial irrigation. But since river flow was vital for Babylonia, and to some extent to Assyria too, we shall make a correlation between the rainfall and the discharge of the Tigris at Mosul; finally, we shall correlate the discharge at Mosul with that of the Euphrates at Hit, insofar as overlapping data are available.

34 G. H. Denton and W. Karlén, "Holocene Climatic Variations—Their Pattern and Possible Cause," *Quarternary Research* 3 (1973): fig. 1. See also U.S. National Academy of Sciences, U.S. Committee for the Global Atmospheric Research Program, *Understanding Climatic Change: A Program for Action* (Washington, D.C., 1975), fig. A.10. Note, however, that according to Karlén (personal communication, December 1984), data from the interim period in which we are interested are not available, so the possibility of a glacial retreat between 1200 and 900 exists in principle.

35 See again fig. A.10 in *Understanding Climatic Change.*

36 Lamb, *Climate, History and the Modern World,* p. 132.

The World Weather Records give temperature and rainfall data for Latakia from the years 1952–60 and 1966–70; for Mosul we have rain data from 1923 and temperature data from 1926 on. The Syrian data are listed in the volumes for Europe and the data for Iraq in the Asia volumes since 1951, but the Asia volume for the 1960s has not yet appeared. The missing data (up to the mid-1970s) were taken from the monthly climatological reports of the two countries.

Figure 1 shows the average winter temperatures in 23 successive years at Latakia and Mosul; figure 2 deals with the annual rainfall at the two sites. (The rainfall year is taken to be from September to August, although, of course, there is virtually no rain in the summer months.) The period covered is the same in both cases (1952–1975), but there is a gap of one year (1960–61) in the temperature series and two gaps (1960–61 and 1965–66) in the rainfall series.

Figure 1 indicates a high correlation between the winter temperatures of Latakia and Mosul. The correlation coefficient is +0.91, which is highly significant (better than 0.001) by any statistical significance test. A high correlation between the two sites is to be expected, for it is the traveling depressions of the winter season (in which cold air masses advance behind cold fronts) that bring cold air ("modified polar air") into the area, and these depressions generally move from west to east. Several depressions cross *both* northwest Syria and the former Assyrian area.

Figure 2 shows the correlation between the rainfall amounts of Mosul, averaged per 100 mm rainfall intervals at Latakia. This presentation was adopted because the correlation of the individual annual values shows greater scatter: the correlation coefficient is +0.34, which is not significant statistically. However, when we group the yearly rainfalls at Latakia into class intervals and take the average of the rainfalls at Mosul associated with any given rainfall class interval at Latakia, the results show a rather orderly relationship. (See also the discussion of fig. 3 below.)

A further point concerns the relationship between temperature and rainfall. Gagin deduced from cloud-physics studies of the winter season in Israel that the rain clouds of comparatively cold days on the whole yield more rain than the rain clouds formed on warmer days.[37] Later, Striem pointed out in a study of Jerusalem's long rainfall series (beginning about the middle of the nineteenth century) that there is a strong tendency for cool winters to be rainy as well.[38]

[37] See A. Gagin, "Studies of the Nature of Precipitation Mechanisms for the Physical Evaluation of Cloud Seeding Experiments," *Proceedings of the International Conference on Cloud Physics* (Toronto, 1968), pp. 730–34.

[38] H. L. Striem, "The Mutual Independence of Climatological Seasons, as Reflected by Temperatures at Jerusalem 1861–1960," *Israel Journal of Earth Sciences* 23 (1974): 55–62. See also fig. 1 and the pertinent text in J. Neumann and M. Sigrist, "Harvest Dates in Ancient Mesopotamia as Possible Indicators of Climatic Variations," *Climatic Change* 1 (1978): 239–56.

A recent paper by A. Henderson-Sellers, "Cloud Changes in a Warmer Europe," *Climatic Change* 8 (1986): 25–42, indicates that during the warm period of this century, 1934–53, precipitation *decreased* over a substantial part of Europe. The paper is based on a large body of data.

We do not know the factors that led to the warm period ca. 1200–950 B.C. in parts of Europe and the Near East. One possible factor is an increase in the solar output, at least in the visible portion of the spectrum. The use of advanced models of the general circulation of the atmosphere shows that even an increase of the order of 1 percent in what is called the "solar constant" (and we mean here a *sustained* change) leads to noteworthy changes in temperature and precipitation. While until a few years ago solar physicists precluded the possibility

We have prepared a diagram for Mosul showing the relation of annual rainfall averages as per 1°C-long winter-temperature intervals at the same station. With rainfall measurements beginning in 1923 and those of temperature in 1926, we could study the relationship for a period of 49 years. The relationship between the two is graphed in figure 3, where we adopt the "extended" winter season covering the months December through March. We make use of this "extension" because in March, Mosul frequently has relatively large amounts of rainfall. The figure indicates the tendency for larger rainfall amounts to occur in winters of lower temperature.

Figure 4 shows the correlation between the rainfall in Mosul and the discharge of the Tigris at the same city, covering the 25-year period from 1926–27 to 1950–51. The data for the Tigris were taken from the series for the years 1919–51 furnished by Clawson, Landsberg, and Alexander.[39] The correlation coefficient is +.050, which, by the t-test of statistics, is significant at the 0.01 level, i.e., the correlation is highly significant. This means that years of low rainfall in Mosul tend to be years of low streamflow in the Tigris.

For Babylonia the discharge of the Euphrates was of overriding importance. Hence, we made a correlation between the discharge of the Tigris at Mosul and that of the Euphrates at Hit. (The choice of Hit was dictated by the fact that it is the only gauging station on the lower Euphrates from which data were available.)[40] Figure 5 shows the correlation between the discharges of the two rivers in the 14 years in which the available sets of data overlap. The correlation coefficient is +0.75 which, again by the t-test, is significant at a level better than 0.01. Thus, years of low rainfall at Mosul tend to be years of low streamflow of the Euphrates at Hit.

Since both the Euphrates and the Tigris receive a very substantial amount of their water supply from the mountains of Kurdistan, we have also considered the correlation between the winter (December through February) air temperatures at Latakia and four Turkish stations, viz., Diyarbakir, Erzurum, Malatya, and Urfa, which are situated in the upper catchment areas of the Euphrates and the Tigris. The correlation coefficients are between +0.82 and +0.94. All these coefficients are highly significant statistically.

Assuming that the levels of correlation between the climatic events of the Mediterranean littoral and northern Mesopotamia in ancient times did not differ substantially from those in modern times, we can accordingly conclude that the climatic conditions in Ugarit were closely mirrored in upper Mesopotamia. Hence, Schaeffer's findings for Ugarit imply a period characterized by a high incidence of dry years, including low streamflows in the Euphrates and the Tigris, in late second-millennium Mesopotamia. These dry conditions were bound to produce years of crop failure, famine, and social and political unrest.

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of any appreciable changes in the solar constant, the last few years show a more "liberal" attitude. The last few years also saw the first measurements of the solar constant using satellites flying "above" the atmosphere, and these indicate small changes in the constant. The changes are far below 1 percent, but we must remember that the period of observations is but a few years—the time scale involved is far too short.

We wish to stress that there is no proof that the solar constant was greater during the period 1200–900. On the other hand, we do not think that volcanism can account for the warming concerned.

39 M. Clawson, H. E. Landsberg, and L. T. Alexander, *The Agricultural Potential of the Middle East* (New York, 1971), table B-2.

40 Ibid., table B-10.

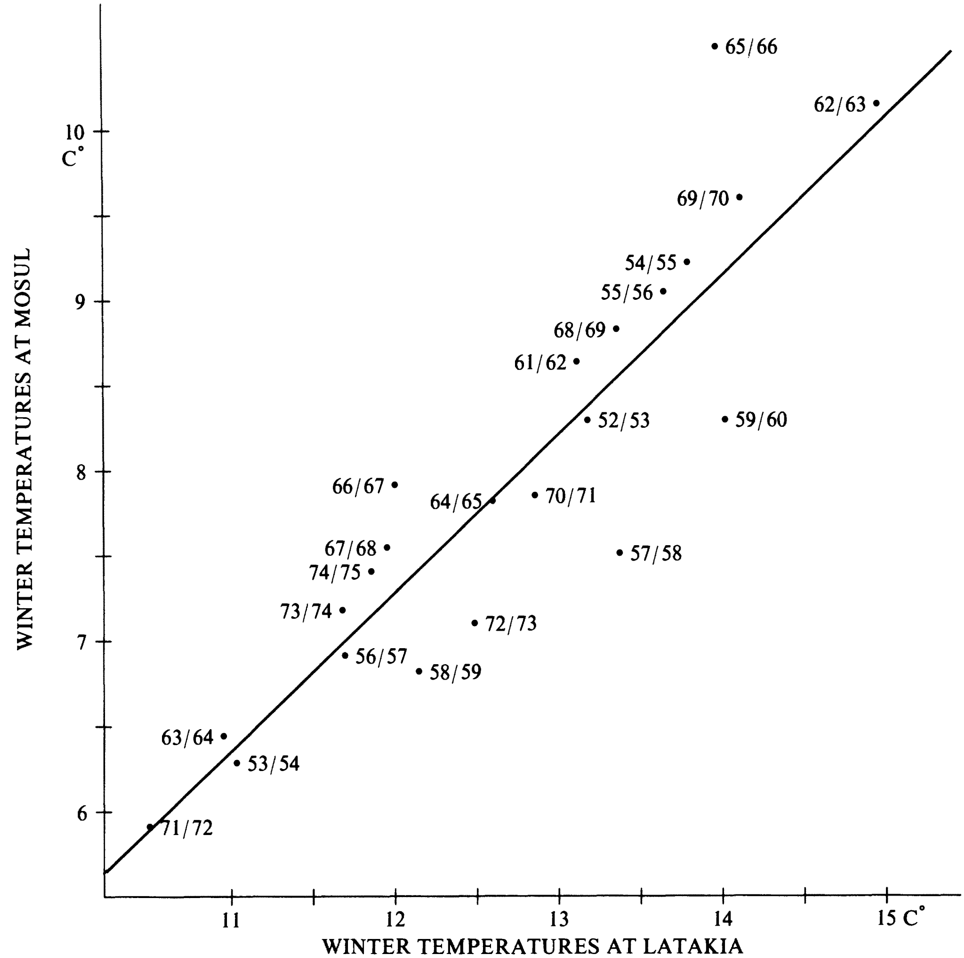

FIG. 1.—Correlation between winter temperatures at Latakia and Mosul, 1953/54–1974/75. The correlation coefficient is +0.91. The equation of the regression line is M= 0.95L - 4.1, with M= winter temperature of Mosul and L = that of Latakia; the standard error of estimate is 0.52°C. The figures adjacent to the dots in the diagram give the pertinent winter season (71/72 = December through February, 1971/72, etc.).

IV. MESOPOTAMIAN TEXTUAL EVIDENCE

As already noted at the beginning of this paper, Mesopotamian written documentation from the period under consideration is quite scanty. In particular, with the exception of a few scattered royal inscriptions, virtually no contemporary texts such as letters, administrative records, or legal documents are extant from the early part (ca. 1200–1150) and the crucial second half of the period (1050–900). Some contem-

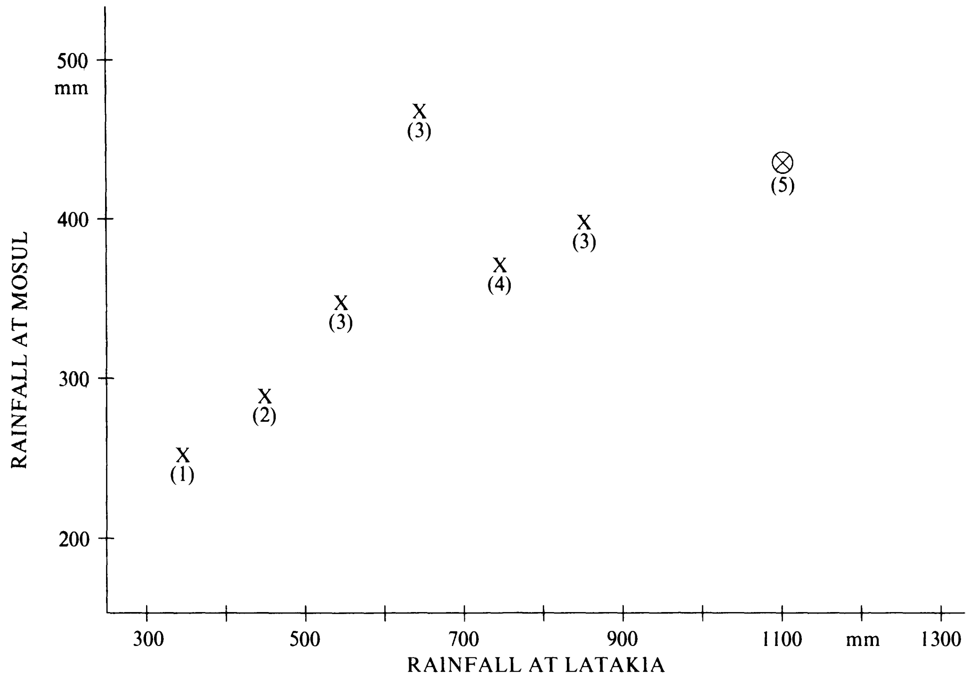

FIG. 2.—Correlation between averages of rainfall at Mosul grouped per 100 mm class-intervals of Latakia's rainfall, 1952/53 to 1974/75. Figures in parentheses give the number of years in which precipitation at Mosul fell in the pertinent class-interval of Latakia's rainfall. The average for Mosul is plotted at the center of the pertinent Latakia class-interval. The ringed-in cross against Latakia's 1,100 mm is the combined figure of five cases when Mosul's rainfalls were associated with rainfalls of between 900 and 1,353 mm.

porary political developments are elucidated by fragmentary chronicle entries preserved in later copies, but any additional data must be gathered from a variety of scattered secondary sources (omens and poetic narratives, incidental historical references in later texts, etc.).[41]

In view of such a scarcity of documentation, we find it highly significant that the sources contain remarkably numerous references to negative developments likely to result from unusually arid conditions (crop failure, famines, massive nomad incursions), while allusions to good crops, favorable grain prices and the like are almost totally lacking. What is especially important in this context is that the negative incidents are more or less evenly distributed over the whole period in question. Crop failures, grain shortages, etc., are naturally attested in other periods, too, but they are

[41] See in more detail Brinkman, *Political History,* pp. 3-36.

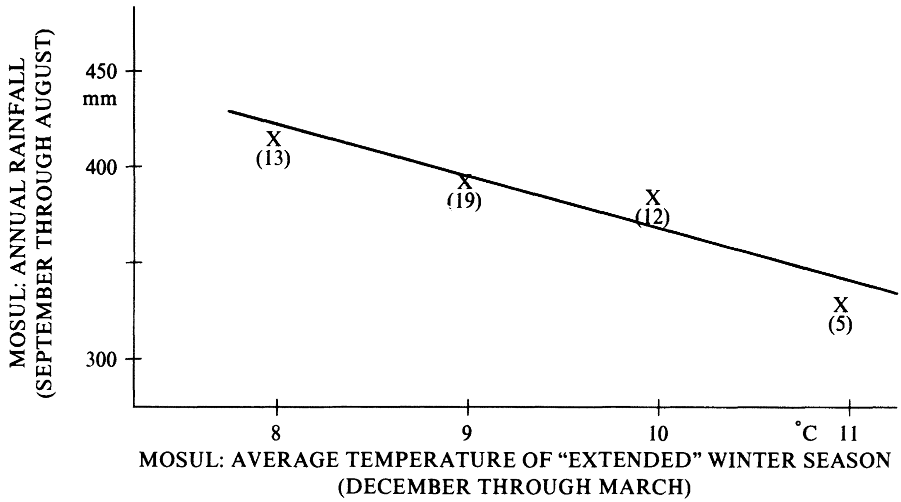

FIG. 3.—Averages of annual rainfalls at Mosul (1926/27–1976/77) grouped for 1°C class intervals of temperature of the "extended" winter season, plotted against midpoints of the 7.5–8.4°, 8.5–9.4°C . . . , class-intervals. The figures in parentheses denote the number of years in which rainfalls were associated with a given temperature class-interval.

generally of transient nature and/or restricted to exceptional situations such as times of civil war.[42] By contrast, many of the famines, crop failures, and food shortages in 1200–900 certainly occurred under stable central governments. The implication is that the social and political instability of the period largely was a function of inadequate agricultural output (bad crops → troubles and disorder) rather than the other way round (social disorder → bad crops), as is usual in more "normal" times. Of course, such a setup easily leads to a vicious circle (bad crops → disorder → bad crops → . . .).

Direct meteorological evidence from the period is almost nonexistent, but in compensation we have a long poetic description of the general conditions in Babylonia after 1150 (see Appendix A, no. 10, below). A prominent place in this description is, not unexpectedly, taken by divine personifications of arid earth and fiery sun.

Since the textual evidence, scanty as it is, is important in providing a touchstone to the climatological reconstructions proposed in this paper, we present the relevant data

42 A classic example is the Babylonian famine 650–648 caused by the civil war between Assurbanipal and Shamash-shum-ukin, on which see G. Frame, "Babylonia 689–627 B.C.: A Political History" (Ph.D. diss., University of Chicago, 1981), pp. 133 ff.; and ibid., p. 64 for the famine resulting from the siege of Babylon in 690–689, and see n. 70, below. Similar conditions seem to have resulted from the 762–759 civil war in Assyria, since the eponym-canon $C^{b}2$ contains the entry "pestilence" for the last of these years (see *RlA*, vol. 2, p. 432; note that according to the same source, normal conditions had already returned by the following year). The poor harvests in Assyria before the fall of the empire, reflected in high grain prices (see K. Deller, "Getreidekursangaben in neuassyrischen Rechtsurkunden," *Or.*, n.s. 33 [1964]: 257–61), were certainly due to political and not to climatic conditions.

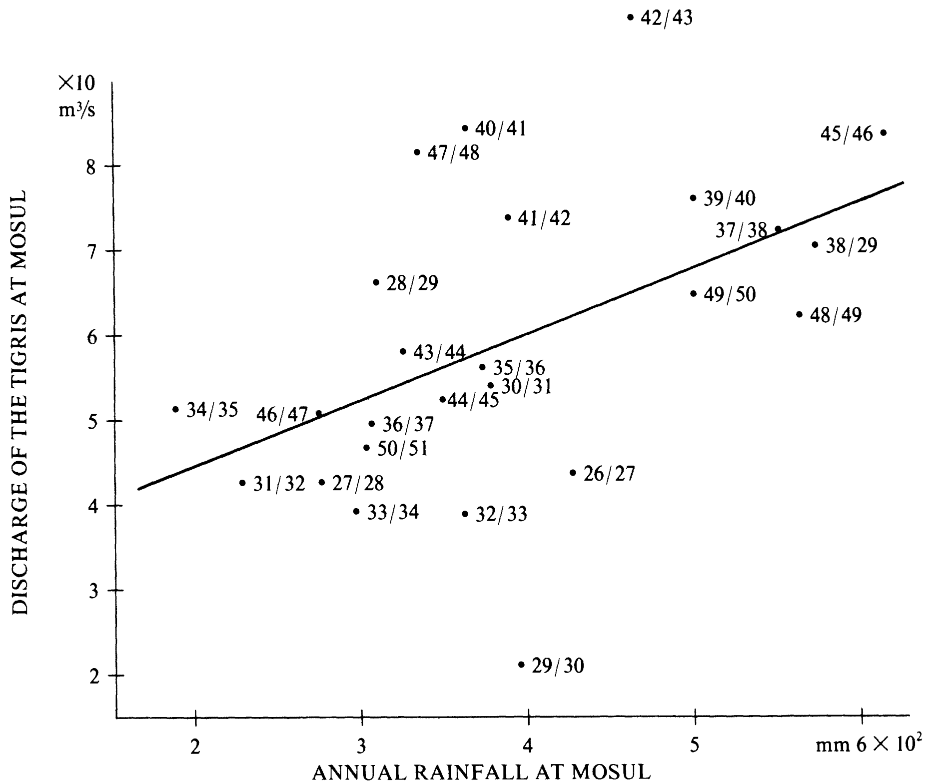

FIG. 4.—Correlation between annual rainfall at Mosul (in units of 100 mm) and discharge of the Tigris at Mosul (in units of 100 m^3/s), 1926/27 to 1950/51. For both sets, the year is from September to August. The correlation coefficient is 0.50. The equation of the regression line is $T = 0.76M + 292$, where T is the discharge of the Tigris in m^3/s and M the annual rainfall in mm. The figures against the dots indicate the hydrological year (1900 + n).

in a separate appendix (App. A; see also table 2, p. 176, below). In addition to references to famines, crop failures, high grain prices, and nomad incursions, we have also included contrary evidence (insofar as available) so as to present a balanced picture. To keep subjective interpretations to a minimum, we have refrained from merely paraphrasing and instead give the relevant passages throughout in annotated translations. The order of presentation is chronological.

Much potentially pertinent but less direct evidence has been omitted from this appendix. For instance, the rapid decline of Assyria first and then Babylonia soon after 1200 and the simultaneous comparative strengthening of Elam[43] is quite likely to

[43] See Brinkman, *Political History,* pp. 86 ff., and W. Hinz, *Das Reich Elam* (Stuttgart, 1964), pp. 100 ff.

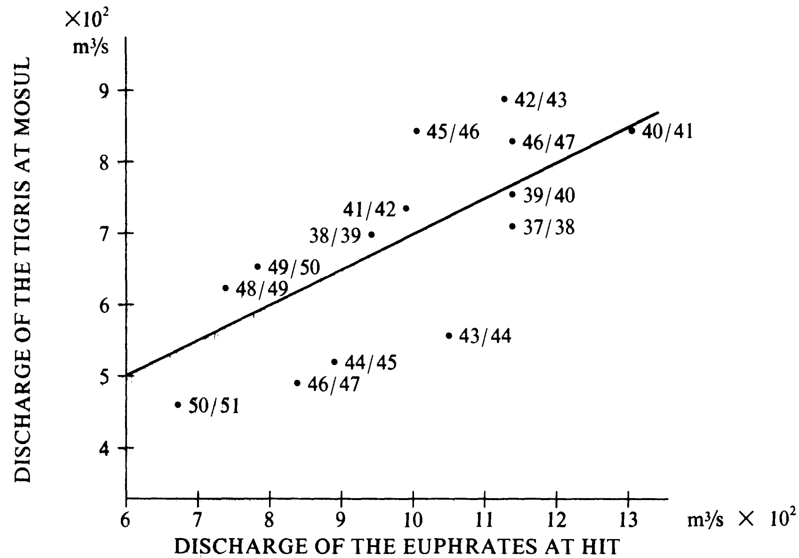

FIG. 5.—Correlation between the discharges of the Euphrates at Hit and the Tigris at Mosul (in units of 100 m^3/s), 1937/38 to 1951/52. The correlation coefficient is 0.75 and the equation of the regression line $T = 0.46E + 231$, where E is the discharge of the Euphrates and T that of the Tigris. The figures against the dots give the hydrological year (1900 + n).

reflect the onset of a drier climate (which would have affected the rainier mountain areas of Elam less than the two Mesopotamian states). However, political developments may, and usually do, result from many different and/or converging factors, not just from economic and/or climatic realities. Hence this kind of evidence, while potentially significant, must be left out of consideration in the present context.

Appendix B provides a glimpse of the "cool and rainy" period, which we reckon to have started about 900, lasting through most of the millennium. The period is too long and the available written evidence too abundant to be systematically surveyed here, and we have therefore focused on a well-documented subperiod of 70 years (735–665), which can be considered representative for the entire period. The data presented are taken from a corpus of some 2,000 letters from the royal archives of Nineveh, which covers three separate phases of this subperiod (ca. 735–726, 715–705, and 675–666).[44] These letters, largely written by Assyrian administrators, contain many climatologically interesting details (such as references to exceptional rainfall, extreme temperatures, crop prospects, and prices of grain), but they are of course not meteorological diaries and unfortunately can largely be dated only approximately. Even though the evidence offered by them thus is far from being complete and partly

[44] See S. Parpola, "Assyrian Royal Inscriptions and Neo-Assyrian Letters," in F. M. Fales, ed., *Assyrian Royal Inscriptions: New Horizons* (Rome, 1981), pp. 118–21 and 135 f. The bulk of the texts come from the period 715–705.

TABLE 2

TEXTUAL EVIDENCE

Year B.C.	Social conditions	Economic conditions	Climatic conditions	App. A no.
1190				
1180				
1170				
1160				
1150				
1140	widespread			
1130	nomad unrest			1 and 6
1120				
1110	perennial			
1100	nomad unrest			2 and 6
1090			severe drought	3
1082	serious nomad	severe famine		
	incursions	(cannibalism)		4
1080	serious nomad	total crop		
	incursions	failure		5
1070	nomads defeated	prosperity		7 and 8
1060	rebellions and			
1050	nomad invasion		drought	9 and 10
1040	troubles and disorder		drought	10 and 11
1030			drought	10
1020			drought	10
1010	plague		drought	10
1007	distress	famine	drought	10 and 12
1000		grain shortage		12
980				
970	perennial nomad			
960	incursions			13
954		famine		14
940		hunger and famine		15
930	Assyrian			
	recovery begins			15
920				
910				
900				
890	Babylonian			
880	recovery begins			10

NOTE: there is no evidence for the period between 1190 and 1150 B.C.

pertains to mountain areas (Kurdistan, Zagros), not to Mesopotamia proper, the contrast to Appendix A is clear. References to droughts, crop failures, and famines are conspicuously few,[45] and, instead, the texts often speak of abundant rains, heavy snow, excessive floods, high water level, good crops, and favorable grain rates (even obtaining through several years; cf. nos. 13, 18, and 21).

All things considered, the textual evidence, with all its limitations, clearly supports, or at least agrees well with, the nontextual evidence indicating that the years 1200–900 were relatively dry and the period after 900 comparatively moist.

V. CONCLUSION AND FURTHER PERSPECTIVES

The purpose of this paper is to draw attention to the fact that the political, military, and economic decline of Assyria and Babylonia in the twelfth through tenth centuries appears to coincide with the period of notable warming and aridity which set in about 1200 and lasted till about 900. Although the relevant evidence still needs to be substantiated, we feel justified in concluding that this type of climatic change very likely took place in the Near East.

It would be simplistic to attribute all adverse developments in contemporary Mesopotamia to this change. Nevertheless, we find that a knowledge of the change does make the associated long-term historical processes easier to understand.

The pivotal role of environmental and climatic factors in the genesis and development of Mesopotamian civilization has already been stressed several times in recent years.[46] The present study adds to this discussion a further aspect in underlining the great sensitivity of Mesopotamian societies to climatic change at large. We believe, in fact, that the particular episode in Mesopotamian history we have been focusing upon is not the only one in which climate may have played a role in shaping history. For example, the nomadic movements of ca. 2300–1900 precipitating the fall of first the Akkadian and then the Sumerian Ur III empires coincide remarkably with a period of increasing aridity marked by salinization and reduced Tigris-Euphrates streamflow. Thus, the fall of these empires may on the surface have been the work of man but, in the final analysis, "written in the stars" long before the actual events took place. To pursue the matter further would, however, go beyond the scope of this paper.

[45] With the exception of the letter cited in Appendix A 3 (which falls outside the period considered), the only reference to drought in this letter corpus is found in *ABL* 506 r. 4 ("this Tammuz, waters have become scanty"), and this is irrelevant since there is hardly any rain in Tammuz (June/July) in any year, dry of rainy. Cf. also *CT* 53 213:9 ff. ("it has neither rained nor snowed, so there is no water in the river," unknown month). The corpus contains two references to Arab raids in the lower Jezirah (*ABL* 88 and 547, both ca. 715–705, the latter associated with *bu-bu-ti* "hunger"), but these two references are counterbalanced by several letters referring to peaceful conduct of the nomads (e.g., *ABL* 224, 414, 953, *CT* 53 10).

[46] See, for example, H. Helbaek, "Ecological Effects of Irrigation in Ancient Mesopotamia," *Iraq* 22 (1960): 186–96; M. Gibson, "By Stage and Cycle to Sumer," in D. Schmandt-Besserat, ed., *The Legacy of Sumer* (Malibu, 1976), pp. 51–58; W. Nützel, "Kann Naturwissenschaft der mesopotamischen Archäologie neue Impulse geben?," *ZA* 66 (1976): 120–34; Adams, *Heartland of Cities*, pp. 52 ff. and passim.

APPENDIX A. TWELFTH THROUGH EARLY NINTH CENTURY TEXTUAL DATA

1. [1132–1115] "... murderer of the widespread hordes of the *ahlamû* and scatterer of their forces" (epithet of Ashur-resh-ishi I;[47] see discussion under no. 2).

2. [1111–1084] "I have crossed the Euphrates twenty-eight times, twice in one year, in pursuit of the *ahlamû* Arameans" (inscription of Tiglath-Pileser I).[48] We maintain, with Brinkman, that these campaigns were undertaken to check nomad unrest resulting from hunger or reduced pasturage, and their frequency implies a permanent change for the worse in the living conditions of the nomads. The earliest reference to Assyrian military action against the *ahlamû* is the passage cited under no. 1. However, as Assyrian historical inscriptions between Tukulti-Ninurta (d. 1207) and Ashur-resh-ishi are very scanty and fragmentary, it is not excluded that the deterioration of the nomad habitat had started considerably earlier. This is in fact implied by the adjective "widespread" (*rapšāti*) qualifying the *ahlamû* hordes in the Ashur-resh-ishi passage cited.

3. [1090] "As to the rains which have been so scanty this year that no harvests were reaped, it is a good omen for the life and vigor of the king, my lord. Perhaps the king, my lord, will say: 'Where did you see (this)? Tell me!' In a report by Ea-mušallim which he sent to his lord Marduk-nadin-ahhe (1099–1082), it is written: 'If a portent that cannot be canceled occurs in the sky (and) if it happens to you that rains become scanty, make the king undertake a campaign against the enemy: he will be victorious wherever he goes, and his days will be long'" (Assyrian letter, written May 657).[49] Two considerations suggest that this historical allusion pertains to 1090. First, Marduk-nadin-ahhe is known to have scored a military victory over the Assyrians either in 1090 or 1089.[50] Secondly, the context implies that the celestial portent mentioned in the older report had a parallel in the letter, and hence very likely was a (nearly) total solar eclipse (reference, ibid., ll. 28 ff.). Such eclipses were visible on three occasions in the reign of Marduk-nadin-ahhe: in December 1091 and 1090 and March 1084.[51] The last of these can hardly be in question, since Marduk-nadin-ahhe was then considerably weaker than earlier and could hardly have been "victorious" during the year.

4. [1082] "[In king Tiglath-Pileser's thirty-second year, a famine (so severe) occurred (that) peop]le ate one another's flesh; [. . .] Aramean 'houses' plundered ([*i*]*h*!-*tab-bu-tu*) [the land], seized the roads, and conquered and took [many fortified cities] of Assyria. [Citizens of Assyria fled t]o the mountains of Habriuri [to save their] lives; [the Arameans] took their [. . .], their money, and their property; [Marduk-nadin-ahhe, king of] Babylonia, passed away . . ." (Assyrian chronicle).[52]

5. [ca. 1080] "[In (the following?) year], all crops of Assyria were [rui]ned;[53] [. . .] increased and took [. . .], Aramean 'houses' [penetrated] the area around Nineveh and Kili[zi; Tiglath-Pil]eser, king of Assyria, [retreated] to the land of Katmuhi" (Assyrian chronicle).[54]

47 R. Borger, *Einleitung in die assyrischen Königsinschriften* (Leiden, 1964), p. 103:6.

48 See A. K. Grayson, *Assyrian Royal Inscriptions*, vol. 2 (Wiesbaden, 1976), §97. On the dating of the Euphrates crossings, see Brinkman, *Political History*, p. 127. Other sources indicate that the nomads were pursued "over a wide area ranging from Carchemish and the foot of the Lebanon to Rapiqu on the northwestern border of Babylonia" (ibid.).

49 See S. Parpola, *Letters from Assyrian Scholars*, pt. 2 (Neukirchen, 1983), pp. 377 and 307 ff.

50 See Brinkman, *Political History*, p. 126.

51 Cf. M. Kudlek and E. Mickler, *Solar and Lunar Eclipses of the Ancient Near East* (Neukirchen, 1971), p. 26.

52 Grayson, *Assyrian and Babylonian Chronicles* (Locust Valley, 1972), p. 189. Cf. H. Tadmor, "Historical Implications of the Correct Rendering of Akkadian *dâku*," *JNES* 17 (1958): 133–35; and Brinkman, *Political History*, p. 387. Habriuri is the Harir plain in Iraqi Kurdistan (northeast of Erbil).

53 It has been speculated that the crop damage in this year was caused by excessive rains or storms (Tadmor, "Akkadian *dâku*," pp. 133–35, hesitatingly followed by Brinkman, *Political History*, p. 387. However, the verb restored by Tadmor as [*ra-hi*]-*iṣ* "was ravaged" (i.e., by the storm god) can equally well be read [*ma-hi*]-*iṣ*, which simply means "was ruined" (by any agent, e.g., by locusts).

54 Katmuhi is the mountainous region near modern Midyat in Turkish Kurdistan. See again

This entry immediately follows no. 4 in the original and thus may refer to the immediately following year; the absolute terminus ante quem is Tiglath-Pileser's last year (1076).

6. [Ca. 1130–1080] "If (the crescent of) the moon is sighted on the thirtieth of Sivan, the *ahlamû* will eat up the abundance of Amurru (Syria); if the moon is sighted on the thirtieth of Tebet, the *ahlamû* will eat up Subartu (Assyria), and a foreign tongue will rule over Amurru" (astrological omens).[55] Even though these omens cannot be dated exactly, they certainly refer to the twelfth/eleventh-century nomad incursions, and being repetitive omens, they imply that these incursions had become a well established (yearly?) pattern. Note the time of the first omen (Sivan = May/June).

The astrological omen corpus contains numerous references to crop failures and famines which, for linguistic reasons, very likely pertain to conditions in the twelfth through ninth centuries. However, we leave these references out of consideration, since there is no way of pinpointing them to any particular phase within these broad time brackets.

7. [1081–1069] "Marduk-shapik-zeri, son of Marduk-nadin-ahhe, rebuilt the wall of Babylon and defeated [1]05 'kings' of the lands. During his reign the peoples of the land enjoyed abundance and prosperity" (Babylonian chronicle).[56] We take this entry to imply a contrast to the conditions under earlier and later kings (see below) and thus to reflect a temporary deviation from the otherwise generally adverse (climatic) conditions of the period.

8. [1072–1069] "In that year, in the month Iyyar, he defeated a 'caravan' of Arameans . . . at the foot of Mt. Kashiyari. In that year, in the same month, he defeated a 'caravan' of Arameans at the citadel of Nabula. In that year, in the month Sivan . . . he defeated a 'caravan' of Arameans at the city of [. . .] which is on the Tigris. In that year, in the month Ab, he defeated a 'caravan' of Arameans . . ." (Broken Obelisk of Ashur-bel-kala).[57] In addition to the passage cited, the text records at least twelve more "campaigns" against the Arameans, all of them undertaken within a period of five years at the beginning of the king's reign. The geographical names mentioned indicate a gradual extension of the campaigns further and further from the Assyrian heartland, which suggests that the king was systematically reconquering territories earlier lost to the nomads. Thus the text probably does not refer to famine-related clashes with nomads but, rather, like no. 7, attests to a temporary strengthening of Assyria under more favorable (climatic) conditions.

9. [1068–1047] "(Under) Adad-apla-iddina, descendant of Itti-Marduk-balatu, the Arameans and a usurper rebelled, destroying all the sanctuaries of the land and laying waste the cities of Der, Duranki, Sippar, and Parsâ. The Sutians invaded and took to their country spoils from all over Sumer and Akkad" (Babylonian chronicle).[58] This entry is important in showing that the woes of Babylonia described in the Erra epic (see below) pertain to the reign of Adad-apla-iddina and its aftermath.[59]

10. [1060–890] The Erra epic[60] is a politico-religious composition whose purpose is to provide a theological explanation for Babylonia's resurgence to the status of a major power after a long period of paralysis. As just noted, the beginning of that period of distress lies in the reign of Adad-apla-iddina, but the epic itself must be dated considerably later, in the reign of

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Grayson, *Chronicles*, p. 189; Tadmor, "Akkadian *dâku*," pp. 133–35; and Brinkman, *Political History*, p. 387.

55 For references, see F. Gössmann, *Planetarium Babylonicum* (Rome, 1950), p. 155.

56 See C. B. F. Walker, "Babylonian Chronicle 25: A Chronicle of the Kassite and Isin II Dynasties," in G. van Driel et al., eds., *Zikir šumim* (Leiden, 1982), pp. 401 and 416.

57 Grayson, *Royal Inscriptions*, vol. 2, §§239–41.

58 Walker, "Chronicle," pp. 401 and 416.

59 Cf. the reference to the Sutian invasion and the destruction of Der, Sippar, and Parsâ with Erra IV 50–85, and see the studies mentioned in n. 61, below.

60 Edited by L. Cagni, *L'epopea di Erra* (Rome, 1969); English translation, idem, *The Poem of Erra* (Malibu, 1977).

Nabu-apla-iddina (ca. 887–855), who in his inscriptions (cf. nos. 11 f.) claims to have overthrown the Sutians and restored Babylonia to its former glory.[61]

From the viewpoint of the present study it is significant that the name of the god Erra, to whom the author of the poem ascribes the plagues of Babylonia, means "scorched (earth)," and that this god is in the epic accompanied by a deity named Išum "fire" (an aspect of Nergal probably personifying the fiery midsummer sun) and followed by a band of disease-causing demons named Sibitti (the Pleiades). As pointed out by Cagni,[62] Erra is portrayed as a "warrior whose main weapon is famine"; thus, in casting the actors for his drama, the poet clearly identifies the fatal chain heat → scorched earth → famine → epidemics → death as the ultimate source of Babylonia's woes. Furthermore, the fact that the poem so prominently revolves around Erra, Išum, and Sibitti suggests that arid earth, heat, and epidemics were prominent features of the period covered by the epic and thus supports the central thesis of this article. Such a picture of the period agrees with the results of recent archaeological surface surveys, which indicate a strong post-Kassite trend towards ruralization and a simultaneous sharp decline in the population level of lower Mesopotamia.[63]

Many passages in the poem could be cited as further support for our thesis, but we will content ourselves with the words by which Erra sets about his war of destruction:

"I shall quench the glory of the beams of the sun (with sandstorms) . . . to Adad (the weather god) I shall say: remove the clouds, do away with sn[ow and rain!] I shall bring to Ea (the water god) the ne[ws of M]arduk: [he who] extolled himself on the days of pl[enty will be] bu[ried] on a day of drought; he who came water-borne, will be forced to go back on a dusty road . . . . I shall devastate reed and rush thickets and [burn them] like fire . . . . "[64]

11. [1060–1020] "The Sutians, the evil foe, had overthrown and destroyed the temple of Shamash in Sippar during the troubles and disorders in Babylonia, and his cult had fallen into oblivion . . . his regular offerings were re-instituted only under Simbar-Shipak king of Babylon (1025–1008)" (kudurru inscription of Nabu-apla-iddina).[65] (Cf. the discussion in no. 12, below.) This passage is important in showing that the chaotic conditions that had started under Adad-apla-iddina went on for several decades, until a (futile) attempt to restore order was made towards the end of the millennium.

12. [1007–988] "During the distress and famine under king Kashshu-nadin-ahhe (1007–1005) regular offerings were discontinued, and the drink-offering ceased. In the reign of king Eulmash-shakin-shumi (1004–998) . . . the priest of Sippar went before the king and said: 'The temple-offerings of Shamash have ceased', so he assigned for Shamash one liter of flour and one liter of date wine from the temple-offerings of Bel" (kudurru inscription of Nabu-apla-iddina).[66]

The amounts of flour and wine mentioned in the passage are very modest, and the very fact that these offerings had to be assigned from the revenues of the chief god of Babylonia is a revealing token of the economic distress of the country at the time concerned. The offerings in question were properly reinstituted only a century later.[67]

13. [972–959] "In Nisan of the seventh year, the Arameans were belligerent so the king could not go to Babylon. Neither did Nabu come nor Bel [come out]. In Nisan of the eighth year of

[61] See W. G. Lambert in his review of F. Gössmann, *Das Era-Epos* (Würzburg, 1956) in *AfO* 18 (1958): 400; and Brinkman, *Political History*, pp. 191 and 285.

[62] Cagni, *The Poem of Erra*, p. 16 citing J. J. M. Roberts.

[63] See Brinkman, "Settlement Surveys," pp. 172–75. The data cited by Brinkman, derived from the Diyala, Nippur, Ur, and Uruk surveys, "suggest that relative losses in population in [the Post-Kassite] period may have ranged from about one person in four in the far south (Ur) to three persons in four in the northeast (Diyala)" (ibid., p. 173).

[64] Tablet II C 14 ff.

[65] L. W. King, *Babylonian Boundary Stones* (London, 1912), p. 123.

[66] Ibid.

[67] See Brinkman, *Political History*, pp. 189 f. and 388.

king Nabu-mukin-apli (978–943), the Arameans were belligerent and captured the crossing gate at Kar-bel-matati (near Babylon). So the king could not cross . . . nor offer sacrifices at the akitu festival in Esangil. In Nisan of the nineteenth and twentieth year, ditto . . . . For nine years in succession, Bel did not come out, nor did Nabu come" (Religious Chronicle).[68]

While there is no absolute proof that the disturbances recorded in this text were caused by famine, the time of the year (spring, when the cereal stocks of the nomads would be depleted) does favor such an interpretation. Moreover, the perennial nature of nomad unrest attested by the text is hard to explain without assuming a period of perpetual food shortage (see no. 14, below).

14. [954] "At that time one shekel of gold purchased 2 seahs of barley in Babylonia" (Babylonian kudurru inscription).[69] The exorbitantly high grain price mentioned in the passage implies a state of famine at the time concerned[70] (cf. Appendix B, nos. 3 and 20, below).

15. [934–920] "I brought back the exhausted [people] of Assyria who had abandoned [their cities and houses in the face of] want, hunger (and), famine (and) [had gone up] to other lands, and settled them in their [proper] cities and homes" (annals of Ashurdan II).[71] Since the immediately preceding section of this text deals with the reconquest of Habriuri (see no. 4), it is possible that the passage refers to descendants of Assyrians who had left their homes during the famines under Tiglath-Pileser I, some 160 years earlier. If so, the implication is that the conditions in Assyria had meanwhile been so adverse that an earlier return had simply not been feasible.

16. [881] "I brought back the enfeebled (var. exhausted) Assyrians who, because of hunger (and) famine, had emigrated to the land of Shubru" (annals of Ashurnasirpal II).[72]

APPENDIX B. EIGHTH THROUGH SEVENTH CENTURY TEXTUAL DATA

Years 735–726

1. "The blanket of snow is very thick" NL 29:15 (letter from Tušhan near Diyarbakir in Turkish Kurdistan).

2. "It rained very heavily in the night of the twenty-seventh until daybreak, the whole twenty-seventh day, and the whole night of the twenty-eighth day. The rain poured down very much water, the amount of water is great indeed. The crops are doing very well" NL 56:1′ ff. (Zagros piedmont).

3. "The rate of exchange in the country is very good: one mina of copper buys one homer of barley in Nineveh, one homer and five seahs in Halahhu, and two homers in the desert" NL 52:4 ff. These rates correspond to 0.8 to 1.6 kor of barley for one silver shekel in Babylonian terminology and indicate a very good harvest year (see n. 70, above) (Mosul region).

4. "As to the farmers who appealed to the king saying: 'Our seeded fields have been flooded', they have now reaped a very good harvest" NL 24:3 ff. From Kilizi near modern Erbil.

68 Grayson, *Chronicles,* pp. 137 f.

69 King, *Boundary Stones,* p. 67:14 f. For the date, see Brinkman, *Political History,* p. 389.

70 In the first millennium, one gold shekel was worth about ten silver shekels (see *RlA,* vol. 4, p. 513), so the rate mentioned in the text corresponds to about 0.2 seah of barley for one silver shekel. This is a very high grain price otherwise attested only in times of grave famine; cf., for example, "there was severe famine in the land, one shekel of silver (could buy only) 0.3 seah of barley," YBC 11317:55 ff. The normal rate was 1 kor (= 30 seahs) for one silver shekel, and even rates as favorable as 2 to 2.5 kors (= 60 to 75 seahs) for 1 silver shekel are attested (e.g., *AOB* 1 24 iii 18 f. [OA], *ARM* 13 35:23 [OB Mari], NL 52:13 [NA], *BBSt.* no. 38:6 [NB], Peiser, *Verträge* no. 106:9 [NB]). It may be noted that even the best Babylonian grain rates attested so far for the period 1200–900 remain under the normal rate (cf. 7.5 seahs for 1 silver shekel, *BBSt.* no. 7 i 21 [ca. 1099–1082]; 15 seahs for 1 silver shekel, ibid. no. 9 ii 35 [year 986]).

71 Grayson, *Royal Inscriptions,* vol. 2, §368.

72 Ibid., §550.

Years 715–705

5. "It has been raining very heavily, the crops are fine" *ABL* 157 r. 8 ff. (letter from Arrapha [now Kirkuk]).

6. "In the night of the fifth, a rain set in with hail and kept pouring down through the night, the dawn and the whole day" *ABL* 707:5′ ff. (same provenance as no. 5).

7. "A very heavy rain set in on the eighteenth and . . . on the twenty-third" *ABL* 1453 + *CT* 53 104 r. 9f. (Zagros piedmont).

8. "It is raining co[ntinually], [the crops are doing] very [well]" *ABL* 1086 r. 9 f.

9. "The crops . . . are doing very well, . . . it is raining continually" *ABL* 128 r. 10 ff. (from Harhar near modern Kermanshah).

10. "We examined the crops the king wrote us about: they are very good" *CT* 53 422:1′ ff.; also ibid. 341:4′, 479 r. 2′ ff., and 725 r. 4′.

11. "Very much flooding has occurred in the province of Kurbail" *ABL* 731 r. 5 ff. (Mosul area).

12. "There is very much water in the Diyala river; since there is so much water . . ." *ABL* 503 + *CT* 53 331 r. 20 ff.

13. "We try to keep the roads open, but snow is filling them; there is very much snow. . . . The year before last year there was the same amount of snow and the rivers swelled up; the men and horses that were with me died in the snow" NL 61 + 63:10 ff. (same provenance as no. 7).

14. "I had to leave my chariot in Bit-Hamban because of snow; the king knows there is very much snow (here)" *ABL* 242:8 ff. (Zagros area).

15. "I have not been able to bring the oxen and sheep because of the cold and (swollen) rivers" *ABL* 241 r. 10 f. (same provenance as no. 14).

16. "There is much snow and ice" *ABL* 544 r. 5 f. (Iraqi Kurdistan, vicinity of modern Zakho).

17. "Snow has blocked all the roads (so I cannot bring the tribute)" *ABL* 768:7 f. (Iraqi Kurdistan, northeast of modern Aqra).

Years 675–666

18. "In the days of Sargon (710–705) and the king's father (704–681), when the river of Borsippa was narrow, they built a bridge over it. . . . Under the king, my lord (681–669), the river has swollen greatly. . . . This year, the waters have (again) increased . . ." *LAS* 291:4 ff. (June 669). The river of Borsippa was a branch of the Euphrates.

19. "When the strong flood [came] . . ." *LAS* 294:14. As detailed in the relevant commentary, the flood (of the Tigris) referred to in this letter probably occurred in 669, the same year in which no. 18 was written. This exceptional flood also seems to be alluded to in Borger, *Esarhaddon,* p. 7 iii 8.

20. "After I had ascended the throne of my father (late 669), Adad released his rains and Ea let loose [his floods]" Streck, *Assurbanipal,* p. 212. See also Piepkorn, *Asb.* 5, p. 28: "Adad released his rains and Ea let loose his floods; the grain grew five cubits tall in its furrow and the ear of the barley reached ⅚ of a cubit in length; . . . in my reign there was prosperity aplenty . . . . [One shekel of silver bought] 12 homers of barley." For the extremely good rate of exchange mentioned in the text, see n. 70 above (1 homer = ca. ⅘ kor); the letter to be cited next shows that the rainy period alluded to covered at least the three first years of Assurbanipal (668–666).

21. "The (king's) reign is good: years of justice, copious rains, mighty floods, and a good rate of exchange" *LAS* 121:9 ff. For the date of this letter (April 666), see the relevant commentary (Parpola, *LAS,* vol. 2, p. 104).