SOME ASPECTS OF POSTGLACIAL CLIMATIC VARIATION IN THE NEAR EAST CONSIDERED IN RELATION TO MOVEMENTS OF POPULATION

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FOREWORD

The central purpose of this thesis is the establishment of a postglacial climatic chronology in the Near East, extending in detail from approximately 10,000 B.C. to the present. However, an historical outline of the climate in this area is, in effect, closely related to a number of allied problems, such as the origins of agriculture, the genesis of the ancient civilizations, and the long sequence of nomadic eruptions. Consequently, the climatic succession delineated here on the basis of physical evidence has been applied to a short survey of the climatological aspects of some of these questions.

The specific advice and criticism of my supervisor, the Chairman of the the Geography Department, Professor F. Kenneth Hare, who has afforded constant stimulus by his breadth of interest and clarity of thought, are most gratefully acknowledged. I also owe recognition to Professor R.B.Y. Scott of the Faculty of Divinity, for the profitable suggestions and criticisms derived from a discussion of the general associated problems. Thanks are further due to Professor Howard A. Reed, Dr. Muhammad Da'ud Rahbar and Dr. Burton Benedict, all of the Islamic Institute, for advice and information concerning the relevant literature. Lastly, the indefatigable assistance of Mr. B. Stuart-Stubbs, Reference-Librarian of the Redpath Library, in obtaining the many out-of-the-way books and periodicals necessary for such a study, is highly appreciated.

OUTLINE MAP
OF THE
NEAR EAST
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CHAPTER I

INTRODUCTION

The purpose of this thesis is essentially a delineation of the climatic history of the Near East, particularly in recent geological and historical times. The area here considered under the term 'Near East' comprises Asia Minor, Persia, the Arabian Peninsula and Egypt. On the other hand, the time span designated by 'recent geological time' and 'historical time' are taken to mean the period 10,000 - 500 B.C., and 500 B.C. to the present respectively. For the former period, the evidence used is almost exclusively derived from geology, whereas historical sources supplement the geological and allied evidence for the latter.

It is difficult to study the climatic succession in the Near East without somehow bringing a number of cognate problems into focus. These related questions can be resolved into two major groups: (1) theories involving the use of climatic deterioration as a stimulus intimately connected with the origins of agriculture and the genesis of the Near Eastern civilizations, and (2) theories related to the general problem of human migrations in that area.

The former group of hypotheses should be of considerable interest to the student of palaeoclimatology, as certain climatic data have long been presented as their scientific basis. In this thesis a number of chapters will be devoted to an investigation of the physical background of these well-known theories.

Similarly a detailed study of the relationship between climatic fluctuations and the migrations of peoples is by no means irrelevant. A number of prominent authors such as Ellsworth Huntington and Leone Caetani have drawn undue attention to the subject, with the unfortunate consequence that their theories have become entirely discredited in the eyes of many authors. On the other hand, respectable historians of climate, such as C.E.P. Brooks, have made an almost unqualified use of nomadic migrations as evidence of a diminishing rainfall. Consequently, an extensive section of this thesis has been devoted to this specific problem, which has long become a notorious theme in the eyes of historians and sociologists. In order to present an impartial conclusion, if any, in this matter, it is essential to divorce all migrations from the essential body of climatic data, at the price of sacrificing numerous superficial details in many a climatically obscure century. In this thesis, a precedent has been broken, in that the climatic history of the Near East has been outlined without recourse to evidence of migrations. Admittedly, the detail often appears sketchy and inconclusive as a result, but the benefits from refraining from use of such questionable evidence is more than compensating. It has thereby been possible to make an objective and impartial study of the relationship between climate and migrations which does not need to fit into any deterministic pattern or rhythm of history.

No recourse has been made to sociological principles. Aside from a brief survey of the ecological balance of the nomad's economy, the second part of the thesis has been limited to an historical outline of the migrations and relevant political conditions. Subsequently, the contemporary climatic trends have been indicated and any possible climatic implications mentioned. In the concluding chapter of this section, some tentative suggestions are offered.

With respect to the climatic chronology proper, which is designed to be the essence and principal contribution of the thesis, a number of problems must also be pointed out. Aroused by the long outdated work of Huntington, and very unfortunately, unaware of all subsequent work in the matter, such as the scientific and sophisticated studies of C.E.P. Brooks, A. Wagner and others, a large number of Orientalists, historians and other authors have indiscreetly meddled with the principles of palaeoclimatology. Huntington's theory has been "refuted" over and over again, and that amusing theory of a static climate "since glacial times" dramatically anunciated. In the first place, such authors seem to lack the slightest rudiments as to the distinction between climatic fluctuations and progressive desiccation. Secondly, they appear to be unaware of the prodigous literature that has accumulated in the last decades, about small and large-scale variations of climate which extend throughout geological time up to the present day. The theories of a static climate, as presented by Hann, Angot and Berg, have long become antiquated, and a thorough modification of their ideas has been made Naturally, the changes of climate in the last three millenia have not been overwhelming, but they have nevertheless existed, and were by all means tangible. A variation of a few inches of rainfall (or even in its annual distribution) in an area of scanty precipitation, is no negligale matter. De Terra[1] has shown the vital importance of even year-to-year variations in connection with crop failures and the incidence of malaria during the last dedades, and there is no reason to believe that this relationship has been any less spectacular in the past, rather, the opposite.

The previous palaeoclimatological studies of the Near East can be reviewed briefly here. The earliest and still invaluable work done was that of R. Sieger (1888) and E. Brückner (1890). Despite the inadequacy of many of Huntington's conclusions, his field work still retains considerable merit,

1 De Terra, Helmut (1945) Science, vol. 101,pp.629-31

and appeared in a long series of publications between 1904 and 1945. The first modern scientific synthesis of the material available was admirably executed by C.E.P. Brooks (1926, 1931, 1949). Unfortunately his latest work neglects many of the publications of the last twenty years, and much of the earlier evidence requires revision. His continuous use of migrations as climatic evidence is at times indiscreet and misleading. The work of A. Wagner (1940) also deserves especial mention for a wealth of information. A.S. Huzayyin's prodigous work (1941) on the geological climate of the Near East ranks well with Brooks' synthesis of the climate of the historical period. Lastly, G.W. Murray's outline of the climatic sequence in Egypt (1951), although incomplete, should be paralleled elsewhere in these latitudes.

It will appear obvious to the reader that the climatic succession in the Near East is by no means conclusively established. Many centuries are very obscure and only seldom is a particular period known in satisfactory detail. On the other hand, our knowledge of the general trends is gratifying and enlightening. It should however, be stressed that this climatic history, although it represents an up-to-date and reliable synthesis with suggestions as to possible interpretations, is only tentative. It is sincerely hoped that new detail will be forthcoming, even at the price of rendering large sections obsolete.

PART I. CLIMATIC VARIATION IN THE NEAR EAST

CHAPTER II

AN OUTLINE OF THE DYNAMIC CLIMATOLOGY OF THE NEAR EAST

The essence of the Mediterranean climate in general is a disturbed westerly circulation in winter, which is replaced by a subtropical desert climate associated with the subtropical high pressure belt in summer.[2] With the shrinking of the cells of the subtropical high in winter, the planetary westerlies of the troposphere strengthen considerably and range further equatorwards. As a consequence, a subtropical winter rainfall zone lies athwart the Mediterranean Basin and radiates as far afield as Turkestan and northwestern India. In summer, the weakening of the westerly circulation permits the establishment of a cellular high pressure belt associated with a trade wind circulation.[3] There is commonly a slight pressure gradient towards the east in the eastern half of the Basin, which gives occasion to the persistent northerly and northwesterly ('Etesian') winds, which are part of the great monsoonal circulation of Asia.[4]

I. THE WINTER RAINY SEASON

During the winter season, from October to May, disturbed cyclonic developments associated with general low pressure

2 Hare, F.K. (1953) The Restless Atmosphere, pp. 172-3

3 Flohn, Hermann (1950a) Erdkunde, Bd. IV, p. 156

4 Hare, loc. cit.

are characteristic of the Levant. The temperature contrasts between mPK and cP airmasses over Europe proper and warm mPW air over the Mediterranean favour frontogenesis.[5] When the cold front of a polar trough enters the Basin, sufficient energy is released for cyclogenesis, and in mid-October cyclones of this origin penetrate into the Levant.[6]

The principal cyclones of the Mediterranean can be classified as (1) Genoan Lee Depressions, (2) Saharan depressions forming south of the Atlas mountains, (3) Depressions originating in the Gulf of Sirte which strongly effect Cyrenaica and the Nile Delta, and lastly, (4) Cyprus Lows, small rapidly moving disturbances which are prominent throughout the rainy season.

The maritime air of the westerlies is very moist and considerable condensation brings heavy rainfall upon uplift or on admixture with other masses. The rainfall is almost entirely from cold fronts, especially when the instability is increased while crossing the coastal mountains and plateau edges. However the fronts are rapidly weakened by a slight adiabatic warming after passing into the lee of the hill country, while the air is becoming progressively drier.[7] During mid-winter, European cP is occasionally drawn into the rear of Atlantic depressions moving along the Mediterranean. The lower layers of this modified cP are fairly warm and moist

5 Ibid. p. 175

6 Ibid.

7 Fisher, W.B. (1950) The Middle East, pp. 36-7

from passage over the warm sea, and the differential heating produces a marked instability. Much of the rainfall and the greater part of the snowfall comes from such outbursts of cold, damp air from central and eastern Europe.[8]

At the earliest, a few short showers may bring relief to the drought of the Levant in September, but heavy, prolonged falls seldom occur before the end of October. The real rainy season reaches the Levant only by Christmas or even New Year's, and the maximum is increasingly delayed towards the east. For whereas January has the maximum rainfall in Lebanon, the Damascus maximum is in February, and that of Iraq and Iran often in March. In the spring, rain ceases south of the Anatolian Plateau and the Elburz Mountains by mid-June.[9]

Topography and the disposition of land and sea being the most important factors regulating the rainfall, precipitation can be said to occur chiefly under conditions of instability, and is correspondingly, often very heavy, of short duration and very capricious.[10] The rainfall is unreliable and highly variable from year to year, as the first rains in the autumn (the 'former rains') and the last rains of the spring (the 'latter rains') have a wide range of variability, depending on the relative strength of the jet stream. Years with excessive rainfall show increases of 30 to 50% of the general rainfall mean, and up to 70% from one year to the other.[11]

8 Ibid. pp. 39-40 9 Ibid. pp. 48-9 10 Ibid. pp. 49-50

11 De Terra, loc. cit.

As a consequence, rainfall statistics give a very poor and misleading picture of the situation.

On the other hand, while the planetary westerlies invade the Mediterranean, the great Siberian anticyclone develops over Central Asia. By November this great high dominates Iran, and by January an anticyclonal axis lies across Iran, Arabia and the Libyan Desert. The development of this high occasionally brings a relatively moist airmass from the southeast into Mesopotamia during January and February. In southern Kurdistan, the strong temperature gradient and high relief lead to strong rainfall. Such intensive, uniform anticyclonic winter rainfall is confined to the Assyrian region, decreasing sharply toward the south and northwest, and is a sharp contrast to the thundery, showery rainfall of the westerly type.[12]

Between December and February this high tends markedly to reduce the eastward penetration of cyclonic disturbances. Only in March or April, as the anticyclone begins to disintegrate, does frequent showery weather penetrate into the northeast.[13] Consequently, the eastern half of the region in questionalternates between cyclonic and anticyclonic conditions.

Meanwhile the anticyclonal circulation over Arabia brings a dry stable, desert climate to Yaman, which becomes known as the North-East Monsoon as it penetrates into East

12 Boesch, H.H. (1941) Das Klima des Nahen Ostens, pp.19

13 Ibid. p44

Africa.

Lastly, it should be mentioned that short outbursts of cT air under the various names of Gibli, Khamsin, Shlouq and Simoon penetrate the Near East during the autumn and particularly the spring season. Generally they develop when cT air is drawn into the warm sector of a rapidly moving Mediterranean depression.[14] The high temperatures and excessively low humidities are very destructive to the vegetation cover.

2. THE SUMMER DRY SEASON

During the summer, the cyclonic disturbances take a more northerly route across the northern Balkans as the planetary westerlies weaken and bring rainfall to the eastern coastlands of the Black Sea, and even to the northern Elburz Ranges, which have a late summer or early autumn maximum.

As the southwest Asiatic cyclone develops, constant northwesterly winds tend to move southeast with increasing velocity into the secondary pressure minimum over Arabia. These winds are derived from the North Atlantic anticyclone, and passing from Anatolia as fallwinds, the adiabatic warming tends to a strong temperature gradient, lending a distinct föhn zone character to the north Mesopotamian piedmont.[15]

Due to the high relative humidity and great diurnal range of temperature of the Levant coast, northwesterly and

14 Fischer, _loc. cit._ pp. 37-39

15 Boesch, _loc. cit._

westerly winds bring dewfalls many miles inland, especially in the region of Gaza.

The depressions which do arise, form homogeneous air-masses and lack frontal conditions, as in the case of the Cyprus Lows in summer.[16] The warm air originating over continental areas is initially very dry, fronts are very rare and poorly developed, some almost entirely lacking in clouds.[17] As a result their influence on the rainfall is slight, and the absence of any cold fronts leads to several months of almost uninterrupted drought in the continental interiors.

An exception to this is met in the areas affected by the monsoonal circulation. The Southwest Monsoon, which is part of the equatorial westerly stream, is relatively unstable and brings rainfall to both sides of the intertropical front, in areas of both easterly and westerly circulation. In particular, the associated thunderstorms and showers affect Southwest Arabia which enjoys its rainy season at this time.[18]

The air entering from the Southeast Monsoon is almost completely devoid of moisture on its arrival in Iran. Other than an occasional shower on uplift over the Makran Plateau and the Eastern Zagros Ranges, it brings no rainfall. While descending into the Syrian Desert, its stability is even increased by a slight adiabatic warming.[19]

16 Fisher, op. cit. pp. 40-42   17 Ibid.

18 Flohn, H. (1950b) Ber.dt.Wetterdienstes US Zone Nr.18

19 Fisher, op. cit. p. 36

CHAPTER III

GENERAL ATMOSPHERIC CIRCULATION PATTERNS

Recent experience in synoptic and aerological work has shown that there are two types of atmospheric circulation patterns which in general replace each other suddenly and almost simultaneously everywhere -- the high index or zonal, and the low index or meridional circulation.[20] Following H. Flohn,[21] these patterns may be described briefly as follows.

In periods of low index circulation, the planetary westerlies and the subpolar low range far equatorwards, and are dominated by very extensive quasi-stationary wave movements which are connected with intensive warm air thrusts to the north, and cold air thrusts to the south. The subtropical high is pushed equatorwards; its cells are weak and separated by discernable troughs, along which the cold air penetrates into the tropics.

During periods of predominantly high index circulation the planetary westerlies, the associated subpolar lows, and the subtropical highs are strengthened and shifted polewards. The rapidly travelling waves of the westerlies extend only moderately far south and north, and the trade wind circulation suffers few disturbances from higher latitudes.

H.C. Willett [22] emphasizes that: "the nature and the

20 Flohn, op. cit. p. 150   21 Ibid.

22 Willett, H.C. (1949) Jour. of Met. Vol. 6, p.46

sense of these changes of the general-circulation pattern during geological epochs is essentially the same, on a larger scale, as that which occurs in the climatic, secular and anomalous variations of the general-circulation pattern."

He consequently identifies the 'interglacial climatic pattern' with a high index circulation. During such interglacial periods the westerly belt contracts towards the ice-free, warmer poles, while fairly storm-free dry weather of a subtropical nature prevails in middle latitudes. While the zonal climatic belts maintain their basic characteristics and relative positions, they contract polewards.[23] Further, Flohn[24] points out that periods of high index circulation in the last decades have led to northward shifts of the subtropical high cells of as much as 5 to 10 degrees of latitude, with resulting droughts over wide areas in Europe, Asia and North America.

Again, the 'glacial climatic pattern' is identified with a pronounced low index circulation. One of its primary characteristics is an acceleration of the condensation cycle which is manifested in "the extremely pluvial conditions that prevail in the lower middle latitudes, and in the greatly increased rainfall in the belts of equatorial tropical convergence and between intensified tropical easterlies."[25]

The weakening and separation of the cells of the subtropical high pressure belt during periods of low index circu-

23 Willett, op.cit. p.46   24 Flohn, op.cit. p. 159

25 Willett, H.C. (1953) in Shapley, Climatic Change, p.57

lation permits increased cold front penetration into the trade wind belt, which increases the rainfall activity along the intertropical front. This links the equatorial pluvials and glaciation with the ice-ages, while the aridity of the subtropical high is limited to a narrow belt closer to the equator.[26]

This identification of the equatorial pluvials, as well as the pluvials of the lower middle latitudes, with the ice-ages shall prove to be of great importance in identifying periods of low index circulation in the climatic succession of the Near East. Furthermore, it gives an overall picture of the mechanism continually eperating in the climatic fluctuations which affect the Near East as well as elsewhere.

When a sequence of years tends to reflect a high index or zonal circulation pattern, the westerly winds of the eastern Mediterranean weaken in intensity, make their appearance later in the autumn and disintegrate earlier in the spring, while the amount of precipitation they carry into the parched interior decreases. Similarly, the monsoonal-type circulation of East Africa and Yaman weakens with corresponding aridity and lower Nile levels.

A period of low index or meridional circulation on the other hand, will be reflected by an intensified westerly circulation in the eastern Mediterranean, appearing earlier, persisting longer, and bringing rainfall far into the interior of

26 Flohn, op. cit. p. 160

Asia. The precipitation of the equatorial zones of convergence is likewise increased and the Nile levels are correspondingly high. The winters associated with such a low index circulation would be somewhat cooler in the northern half of the Near East, and a phenomenally cold winter could be expected occasionally.

CHAPTER IV

A SURVEY OF PLEISTOCENE CLIMATE IN THE NEAR EAST

Generally speaking, the known physical evidence from the glacial-pluvial phases of Pleistocene time points to (1) a penetration of temperate forests into Anatolia, and of at least a number of temperate species into the Levant, (2) considerable precipitation in the Levant, Persia, Egypt, southwestern Arabia, and a steppe vegetation in large areas which are true deserts to-day, but, (3) the persistance of a desert barrier in the Sahara and Arabia, at least since Middle Palaeolithic times. It will be seen that the evidence strongly supports the general characteristics assigned to the glacial-low index circulation pattern.

The evidence of the pluvial epochs will be treated on a regional basis, and as far as possible, the various pluvial phases are correlated to the various European glacial phases, particularly the last, or Würm glaciation. This survey will serve two purposes, namely, to validate the previous theory of atmospheric circulation for this area, and to provide a starting point for the postglacial climatic chronology in the Near East.

1. A REGIONAL SURVEY

Anatolia

The vegetation of the coastal belt during the Würm ice-age consisted of a temperate, maritime mixed-forest containing some subtropical species.[27] The existence of such a forest shows that the summer drought of to-day didn't exist, and that the Etesian winds must have been much weaker, and that moist westerlies were predominant.[28] The more elevated sections of the interior displayed a vegetation of mountain tundra, while the higher peaks harboured glaciers.[29] In general, the iso-chiones (snowline altitudes) of Asia Minor were 1000 meters lower during the Würm than to-day.[30] This latitude was marked by a cold continental climate at the time of the second Würm maximum, and a temperate climate during the last maximum.[31]

Dating indefinitely from Pleistocene time are strand-lines at 200 feet above the present level of Lake Van, at 250 feet above Lake Tuz, and 300 feet above Lake Buldur. The obvious inference is that the steppe climate which characterizes Central Anatolia to-day was largely replaced by a moister climate.

Persia

Sven Hedin[32] believes that the flatness of the Persian salt kevir floors can be accounted for only by the action of

27 Büdel, J. (1949) Naturwissenschaften p.109   28 Ibid. p.133

29 Frenzel, B. and Troll, C. (1952) Eiszeitalter, p.168
30 Büdel, op. cit. p.109   31 Zeuner, F.E. (1949) p.204
32 Hedin, Sven (1910) Overland to India vol.2, p.211-24

a large lake, which is substantiated by the discovery of extinct marine shells. The exceedingly fine material in the kevir basins was deposited in lakes fed by numerous silt-laden rivers. The numerous drainage channels of large dimensions entering the Dasht-i-lut Basin point to a glacial lake as well.

In Seistan alternations of red and green clays as evidence of dry and wet periods may account for as many as 14 or 15 oscillations in glacial-pluvial times. At Kogneh lake, river and lake terraces indicate a similar alternation. At Kulberenj, there are terraces at 50 and 25 feet, and at Bereng on the Hamun, terraces at 25 and 15 feet.[33] The 250 and 150 foot Pleistocene strandlines of the Caspian Sea[34] are now generally accepted. At the time, the Aral Sea was probably connected intermittantly by the Uzboi Depression to the Caspian, and the Caspian to the Black Sea by the Manytch Depression.

During Würm time, a mixed deciduous forest grew along the eastern shores of the Caspian, but it was probably not very dense, judging by the fossils of boar, hare and camel.[35] Mazanderan and the Kur Delta were covered by a moist mixed-forest, while the Elburz Range, Azerbaijan, Kurdistan and the higher ranges of Luristan and Farsistan consisted of mountain tundra.[36] Although the higher Elburz was glaciated, G.R. Falcon has[37] pointed out that there is no evidence for any extensive glaciation in southwestern Persia other than small niche glaciers

35 Frenzel and Troll, op.cit. p.164 36 Ibid. facing p.160

37 Falcon, G.R. (1945-6), Geog. Jour. pp.78-9

33 Huntington, E. (1919) Pulse of Asia p.333 34 Ibid. p309

and snow-drift ice. The 'moraines' found by Desio appear to be merely normal talus deposits.

<u>The Levant</u>

L. Picard[38] has outlined some of the Pleistocene features of the Levant, in particular for the Jordan Valley. The molluscs of the inland waters point towards a more temperate climate, however, not a single boreal-type animal has been verified. The brecciated gravel beds on the higher slopes of the Lebanon represent not old moraines, but deposits of genuine pluvial torrents mixed with a river-bed loam of reddish colour.

The flora has been badly preserved and only a few genera are known, namely oak, beech, elm and hazel-nut. These temperate species supposedly still exist to-day in Syria, but nevertheless are exceedingly rare.

The widely distributed terra rossa deposits and their association with pluvial gravel, point towards a Mediterranean climate with a heavier and more lasting precipitation than enjoyed by the same region to-day. The main Pluvial 'A' can be correlated to the Riss glaciation, or both Riss and Mindel. Subsequently the Pluvial 'B' was only slightly developed, and probably connected with the Würm. The remaining features, summarized in Table I below, belong to a more recent period.

38 Picard, L. (1937) Proc. Prehis. Soc. pp. 58-70

TABLE I

GEOLOGICAL SEQUENCE IN THE LEVANT

Recent /	Terra rossa formation
Early Holocene /	Greyish-black marshy loam
Pluvial C ? /	Block-streams
Interpluvial C ?/	Terra rossa formation
Pluvial B /	Gravel beds: strong erosion followed by deposition and then alternating layers of sands and clays
Main Interpluvial B /	Sub-aerial weathering, terra rossa formation and extensive vulcanism.
Main Pluvial A /	Gravel beds: strong erosion followed by large-scale deposition.
Interpluvial A /	Terra rossa formation.

F.E. Zeuner[39] would assign pluvial phases to the first two maxima of the Würm in Palestine, judging by the relative frequency of desert Gazelle and Fallow Deer remains in the Mt. Carmel caves. Unfortunately, a break in the sucession does not permit any conclusive association with the last submaximum.

Lastly, the well-known strandlines at 1430, 540, 430, 300, 250 feet, as well as ten minor strandlines, of the Dead Sea indicate numerous high lake levels during the Pleistocene.[40] There is no evidence that the Dead Sea has overflowed into the Gulf of Aqaba since the formation of the rift valley in late Tertiary times. The highest, 1430-foot strandline of the Dead Sea is still 650 feet below the watershed between the Wadi Araba and the Gulf of Aqaba.

39 Zeuner, op.cit. pp.229-231

40 Huntington,E. (1911) Palestine and its Transformation p. 305

Egypt

The main pluvial phase associated with the Riss, or Riss and some of the earlier Pleistocene phases, was the longest and most important. Unfortunately, the details are little known. A.S. Huzayyin[41] has summarized the salient facts well. Wadis were cut into the limestone plateau, and the abundant material carried down into the Nile Valley indicates running water in the Eastern Desert. On the plateau of the Kharga, tufa formation also points to a pluvial phase. Presumably the 50, 30 and 17 meter terraces of the Nile date from this time.

During the subsequent interpluvial, the formation of breccia in the valley bottoms of the Kharga Scarp, and the loess-like aeolian formation in the Depression point to great aridity, especially in the southern half of Egypt.[42]

The second pluvial phase, connected with the Würm glaciation, was characterized by a strong water-flow in the wadis of the Eastern Desert, the building of the 10 and 3 meter terraces of the Nile, and the facility of the faunal migrations over what is now dry desert plateau.[43] However the moisture of the more southerly regions should not be overemphasized, as the pluvial vegetation of the Kharga Scarp consisted of a poor steppe in contrast to full desert.[44]

41 Huzayyin, A.S. (1941) Mém. Inst. d'Egypte, pp.107-11

42 Ibid. 43 Ibid.

44 Caton-Thompson,G. & Gardner,E. (1932) Geog.Jour. p.407

TABLE II

SEQUENCE OF THE WUERM GLACIATION IN THE KHARGA[45]

Tufa, gravel and silt on breccia	some rain	Upper Acheulian
Intense erosion	1st. rainfall maximum	Acheulio-Levalloisian
Silt and gravel followed by tufa	less rain	
Erosion	2nd. rainfall maximum	
Silt and gravel followed by tufa	less rain	Late Levallois
Erosion (weak)	3rd. rainfall maximum	Levalloisian-Khargan
Formation of 7 meter terrace	dry	

Although the rainfall of the last submaximum of the Würm (c. 25,000 years ago) permitted Middle Palaeolithic hunters to live in the heart of the Libyan Desert, it was insufficient to support forests, perennial streams, or to dissolve the rock salt in the Qattara Depression.[46] At this time Lake Moeris fluctuated at 260 to 278 feet above its present level, and in later Palaeolithic times, thick deposits and very ancient erosional features point to a lengthy pause at 222 feet A.L. which lasted to very roughly 15,000 B.C. Subsequently contact with the (pluvial) Nile was lost and a long period of desiccation followed.[47]

After very approximately 20,000 B.C. [probably later] G.W. Murray[48] believes desert conditions prevailed till c. 8000 B.C. He bases his argument on the absence of flint implements of Late Palaeolithic and Mesolithic age in desert Cyrenaica, and on the permanent clogging of the Libyan tributaries of the Nile by immense deposits of Nile silt. On the

45 data derived from Zeuner, op.cit. p.246
46 Murray, G.W. (1951) Geog. Jour. p. 418
47 Caton-Thompson & Gardner (1929) Geog. Jour. pp.41-2,48

48 Murray, G.W. (1951) Geog. Jour. p.420, vol.117

other hand, the eastern tributaries have been occasionally revived by spates from the Red Sea Hills. This makes it probable that the western slopes of these mountains enjoyed a greater precipitation at the time. At the Kharga, there is evidence of periodic storm rain associated with implements dated very roughly at 12,000 B.C. After this conditions of severe aridity set in.[49]

Arabia

The evidence from desert Arabia is very scanty, although it is generally recognized that there were a number of major rivers, possibly perennial at one time, flowing across the peninsula from west to east. The Wadi Hauran and Wadi Sirhan flowed from the Jabal Hauran across the present Syrian Desert into the extended Persian Gulf. The Wadi al-Rumma originating in the Hidjaz, and the Wadi Dauasir draining the highlands of Asir and northeastern Yaman, flowed through the heart of the Nadjd into the Persian Gulf as well.

In southwest Arabia, where A.S. Huzayyin has established a respectable sequence[50] for Yaman, the information concerning the Pleistocene is more complete: (1) considerable erosion and lateral wash cut out deep V-shaped valleys which were subsequently filled with coarse gravels. The sloping valleys rise to about 100 feet in 2 or more terraces. Huzayyin identifies this phase with a prolonged, major pluvial, which had

49 Caton-Thompson & Gardner (1932) Geog. Jour. pp. 403-4

50 Huzayyin, A.S. (1937) Nature, vol.140, pp. 513-4

at least two submaxima. The extensive volcanic activity following this phase suggests a correlation of this major pluvial with the Pluvial 'A' of the Levant, which is associated with the Riss, or both Riss and Mindel, glaciation. (Similar volcanic strata stretch intermittently from the Hauran in Syria through the western highlands of Arabia to the Arabian Sea in Hadramaut.[51]) A similar major erosional phase has been identified in the Hadramaut.[52] (2) A phase of fairly regular deposition with very little lateral wash and discharge, along with the cutting of new steep-sided valleys emboitées in the older gravels and subsequent filling of these with soft silt sediments. A similar major depositional phase, probably subdivided into minor episodes, was observed in the Hadramaut.[53] This phase represents a major interpluvial.

(3) Renewed erosion by which new torrential beds were cut into the silts, sometimes forming a series of erosional terraces. In the Hadramaut[54] this lesser pluvial can be subdivided into 3 parts, the 10, 5 and 3 meter terraces, which are of palaeolithic age. If the previous parallelism could be extended, the three submaxima of this last pluvial show a remarkable correlation with the submaxima of the Würm glaciation.

2. CONCLUSIONS

Although there is only evidence of two major pluvials

51 v.Wissmann, H (1941) in Lebensraumfragen, vol.2, p.378

52 Caton-Thompson & Gardner (1939) Geog. Jour. p.18-35

53 Ibid.

54 Ibid.

in the Near East, there is no necessary contradiction involved with the four European glaciations of the Pleistocene. The first and major pluvial is yet little known, and has implicitly been identified with at least two of the earlier glaciations.[55] With the present stage of information, no conclusions can obviously be drawn.

However, the evidence relating to the Würm is much more satisfactory. The available information supports a glacial - low index circulation pattern in all its aspects: (1) both Egypt and Hadramaut clearly had 3 submaxima, and in Yaman and the Levant at least 2 can be identified; (2) there is at least a strong possibility that the pluvials of southwestern Arabia are chronologically equivalent to those of the Levant and Egypt; (3) the survival of a desert belt throughout this period is also suggested from anthropological evidence. C.S. Coon[56] is able to remark: "Although what are now the edges of deserts may have been breeding grounds of white humanity during the Pleistocene, the great deserts themselves have always been racial frontiers." Just as the mid-Sahara served as a dividing line between whites and negroes in this remote period, so did the Rub al-Khali act as a barrier between Veddoid and Mediterranean. In conclusion, it is suggested that the general atmospheric circulation theory, outlined above, is valid in Egypt and the Levant, and there is every reason to believe that it is applicable to the entire Near East.

55 Blanckenhorn, M. (1921) Land der Bibel, vol.3, pp.8-9

56 Coon, C.S. (1939) The Races of Europe, p. 46

CHAPTER V

THE CLIMATE OF RECENT GEOLOGICAL TIMES

The climate of recent geological times, which is here arbitrarily assigned to the millenia between about 10,000 and 500 B.C., showed a number of extensive and important fluctuations. From a decidedly dry phase in Late Palaeolithic times there was a reversal to minor pluvial conditions during the Mesolithic and Neolithic periods, lasting well into the 3rd millenium. The 'Climatic Optimum' only appears very late in the Near East as a period of great aridity in the 2nd millenium. In how far and at what time a 'Thermal Maximum' was reached, remains a matter of conjecture.

1. THE MESOLITHIC AND NEOLITHIC PERIODS

This section is devoted to a detailed survey of that salient feature in the early postpluvial climate of the Near East, the oscillation from an arid to a moist climate, in which the ancient civilizations of the Near East germinated. This latter moist era, variously called the 'Neolithic Wet-Phase' and the 'Mesolithic Moist Interlude', will be studied from its beginnings until the unmistakable onset of the postglacial 'Climatic Optimum' in the 3rd.millenium. Contemporary literature is still very incomplete in the matter, and the interpretations are only in their initial stages and at variance with one another.

A Regional Outline of the Evidence

Egypt. By far the most complete and detailed evidence for both Egypt and elsewhere comes from the investigations of Miss Caton-Thompson and Miss Gardner at the Faiyum Depression.[57] By about 10,000 B.C. the Nile had ceased degrading and had begun aggrading its bed, with a result that the inflow into Lake Moeris (Birket Qarun) was interrupted, and the lake subsequently fell and nearly dried up. Thereafter a new inflow of the Nile brought the level of Lake Moeris up to 206 feet A.L. in the early eighth millenium. The geological evidence precludes any long stay at this level, and the connection with the Nile was apparently severed shortly afterwards. As soon as climatic conditions became the dominant factor in determining the level, the lake sank gradually by about 30 feet. An equilibrium between rainfall and evaporation was achieved at 180 feet A.L., and at this time the arrival of large numbers of Neolithic peoples took place (6th millenium). Subsequently there was another drop to a brief stay at 160 feet A.L. and eventually to 140 feet A.L. The formation of a salient beach at this level points to a prolonged equilibrium between precipitation and evaporation for a period of perhaps 1700 years. From geological evidence,

57 Caton-Thompson, G. and Gardner, E. (1929) op.cit.p49,53-5
______, and ______, (1937) Bull.Inst.Egypt. p.245-8

the drop from the 180 to the 140 foot level took place between about 5300 and 4800 B.C. On the other hand, radiocarbon dates of the Faiyum 'A' material, belonging to the period preceding this fall, give 4440 B.C. (±180) and 4144 B.C. (±250) [58] Following the method established in Europe by Hugo Gross, we may take a mean of the geological and radiocarbon dates.[59] Taking such a mean between 4100 B.C., which is a reasonable approximation of the radiocarbon date, and 5300 B.C. as suggested from the geological evidence, we could give an approximation of 4700 B.C. as the beginning of the desiccation which permitted Lake Moeris to drop by 40 feet in about 500 years. The 140 foot A.L. shoreline remained static throughout pre-dynastic times, extending at least into the period of the 4th Dynasty (c. 2400 B.C.), whose settlements were found along it.

Elsewhere in Egypt, there is further evidence of an arid period in Upper Palaeolithic times, which appeared earlier in the south.[60] During this time the amount of gravel, sand and silt brought down by the wadis from the Eastern Desert point to only very occasional rainfalls. Subsequently, G.W. Murray[61] identifies a 'Mesolithic Rainy Interlude' between about 8000 and 4000 B.C. Shells of snails which lived on a now extinct vegetation exist over large stretches of the Eastern Desert, and the floor of the Wadi Qena is covered with mounds of humus and the trunks of dead tamarisks. There are also great

58 Arnold, J.R. and Libby, W.F. (1951) Science p. 111
Libby, W.F. (1951) Science p. 291
59 Gross, Hugo (1954) Eiszeitalter Bd. IV, pp. 190-3
60 Huzayyin, loc. cit.
61 Murray, loc. cit.

great hummocks of clay resembling the 'fossil springs' of Kharga, as well as signs of human occupation down to about 3000 B.C. in the utterly uninhabitable desert at Sheb and Tarfawi. East of the Nile, the northern Red Sea Hills were wooded and the climate of the high limestone presumably resembled that of Palestine, while northern Egypt west of the Nile probably resembled modern Cyrenaica.

Besides the evidence of Lake Moeris, there are further indications that this moister period persisted into the late 3rd millenium, at least in Lower Egypt. The high ground at about 2000 feet, both west and east of the Nile, was fairly well inhabited, probably till 2500 or 2000 B.C.[62] There was pasturage for herds of great magnitude in the western Delta region as late as the 5th Dynasty, an area which is largely desert to-day.[63] However, moister conditions ceased earlier in Upper Egypt, and there has apparently been no continuous rainfall in Lower Nubia since about 3500 B.C.[64]

It may be profitable to review the Egyptian evidence briefly. There is every evidence in favour of a moist phase with rainfall conditions midway between those of the last Würm submaximum and the present, and this evidence suggests a time span between the early 9th and late 3rd millenia. The original rise of Lake Moeris was due to a new inflow of the Nile, but thereafter the lake can be regarded as a most valu-

62 Murray, op.cit. p. 431

63 Caton-Thompson & Gardner (1929) op.cit. p.408

64 Murray, op.cit. p. 430

able indicator of climate. The particularly high Nile levels at the time would also be a further substantiation of a glacial circulation pattern, which is born out by evidence of greater moisture in the Sudan and in East Africa, where LS.B. Leakey[64a] correlates his Nakuran Wet-Phase to the Faiymm 'Neolithic Wet-Phase'. In general, increased rainfall and decreased evaporation, and vice versa, are contemporaneous in the Near East, and in all probability, every drop in the level of Lake Moeris will have been chiefly a result of decreasing precipitation. A drop followed by a new halt at a lower level could well indicate a slight increase of rainfall, following the initial decrease. However it is more likely that the reduced evaporation from a reduced surface area permitted the decreased rainfall to balance the evaporation once more. The rainfall between about 4700 and 4200 B.C. may have been a little less than it was when stable conditions were restored with a 140 foot level, but it is reasonably certain that the rainfall at the time of the 180 foot level was greater than at the time of the 140 foot level. An even more important deduction is that we may assume a more or less stable rainfall in Egypt between c. 8000 - 4700 and c. 4200 - 2500 B.C.

In further support of this 'Faiyum Moist-Phase', as it can be called with greater accuracy, we have the famous petrographs of the western Sahara region, depicting a varied savanna

64a Leakey, L.S.B. (1936) Stone Age Africa, table facing p. 136

R. Vaufrey[65] classifies the industry associated with these rock carvings as 'neolithic of Capsian tradition.' The numerous varieties of fish, with river turtles, crocodiles, hippopotami and marsh-haunting antelope which were plentiful here at the time, could only exist in areas with permanent waters such as large rivers or lakes.

Even in Arabia H. St.J. B. Philby[66] has found gravel spreads and similar water deposits containing fresh-water shells. These deposits in the northern fringes of the Rub al-Khali contained innumerable stone implements classified as 'neolithic'. The implications are apparent.

Palestine. From a study of prehistoric mollusca in Palestine, B. Avnimelech[67] suggests the 'early part of the Mesolithic' was characterized by a climate both warmer and drier than to-day, causing the whole of Palestine to exhibit semi-desert conditions.

On the other hand, Miss D.M.A. Bate[68] points to a faunal change among elements of the widely differing biological requirements in Natufian-Mesolithic times. The disappearance of a half dozen species of gazelles, a hedgehog, and a species of hyaena apparently suggests the oncoming of a more humid phase, probably with no appreciable difference in temperature.

A similar sequence is recognized by L. Picard[69] from

65 Vaufrey cited by Bate, D.M.A. (1940) Geol.Mag. p.441
66 Philby, H.St.J.B. (1933) Geog.Jour. p. 11
67 Avnimelech,B. (1937) Jour.Pal.Oriental Soc. p.81-92
68 Bate, D.M.A. op.cit. p. 427-43
69 Picard, loc. cit.

geological evidence in the Jordan Valley. Following the Pluvial 'B' associated with the Würm there was a period of terra rossa formation, signifying a return to arid conditions Subsequently there was an indefinite and less significant Pluvial 'C' characterized by the erosion of block-streams. Lastly Picard identifies a grey-black marshy loam in various alluvial deposits, which may have been connected with a moister and warmer climate. Chronologically this is classified as 'Early Holocene', and it may be equivalent to the second stage of the 'Faiyum Moist-Phase'. However it remains to be seen whether this horizon is general.

Although the evidence from Palestine lacks a conclusive identification in time, the detail is of great value,[69a] and the sequence is identical with that of Egypt.

Persia. Recent evidence from Persia has helped to establish the universality of the Egyptian sequence. In the Belt Cave [70] on the Caspian Sea, a lense of coarse, apparently wind-blown loess containing few artifacts was radiocarbon dated at 10,320 B.C. ± 825. Subsequently a Mesolithic level containing many seal bones and every evidence of a moister climate has been dated at 9525 B.C. ± 550 and 6048 B.C.± 900 by different investigators. A weighted mean of the intermediate limits of the two dates would give 8000 B.C.± 700 which should be a closer approximation. This was followed by

70 Coon, C.S. (1954) The Story of Mankind, p. 143-5
Ralph, E.K. (1955) Science pp. 150-51

69a There is substantial evidence that the Syrian Desert was well inhabited in Neolithic times, and had abundant water, pasture and game. C.F.Passarge,S.(1951) Geographische Völkerkunde,p.473-4 a Mesolithic layer, dated at 6615 B.C.± 380, containing numerous gazelle bones, a fact allegedly indicating a drier climate. We may discount any serious deterioration in climate as similar gazelle bones were also found in the earlier Seal Mesolithic layer of the neighbouring Hotu Cave.[71]

Lastly, a few further Persian items may possibly be related. Both the large salt crusts in the interior of the Kevir, and the small, low terraces at Kulberenj and elsewhere in Seistan indicate a period of more abundant precipitation, which Sven Hedin[72] assigns to the 'most recent period'.

General Interpretations

From both Egypt, Palestine and Persia there is similar evidence pointing towards a well-defined and identical sequence.

Initially there was a pronounced dry period in Late Pleistocene times, with conditions of greater aridity than the present. This 'Mesolithic Desert' phase, as it will be called here[73], was fully established about 10,000 B.C. and lasted at least one millenium after this date. The striking reversal from these arid conditions to the semi-pluvial 'Mesolithic Savanna' climate appears to have taken place during the 9th millenium. Even as far south as the Kharga Oasis, rain-water accumulated in solution-pans on the now entirely dry plateau.[74] The initial onset of this period seems to have been characterized by condi-

71 Ralph, loc. cit.

72 Hedin, op. cit. pp. 212-3, 231

73 The terminology suggested in this thesis for the various climatic phases is employed solely for the purpose of convenience, and is designed to describe conditions in Lower Egypt. The terms 'Mesolithic', 'Neolithic', etc. used to identify these climatic periods in time are intended to be descriptive and not necessarily precise.

tions a little moister than those experienced shortly afterwards, judging by the replacement of the Seal Mesolithic by the Gazelle Mesolithic culture in Persia, as well as the more circumstantial fall of Lake Moeris from 206 to 180 feet A.L. From the Egyptian and Persian evidence a very tentative date of about 8500 - 7500 B.C. aould be suggested for these maximum moisture conditions.

There *may* have been a slight deterioration in rainfall during the 8th millenium, but the evidence is by no means conclusive. The disappearance of a small species of seal from the southern coast of the Caspian Sea was more likely due to increasingly unfavourable temperature conditions, which also saw the disappearance of a number of northern plants in Egypt.[75] Similarly the fall of Lake Moeris from 206 to 180 feet A.L. may have been entirely due to its isolation from the Nile, as has been suggested by Miss Gardner.[76]

Giving conditional credence to such a 'Mesolithic Savanna' period, we can identify a generally uniform 'Neolithic Mediterranean' climate lasting untill about 4700 B.C. The rainfall during this period was considerably greater than that of the present, and what are now marginal lands were presumably well inhabited. The northern coastline of Egypt exhibited a Mediterranean vegetation and Neolithic peoples were able to live on the desert plateau around the Kharga

74 Caton-Thompson and Gardner (1932) *op. cit.* pp.371-2

75 ______, and ______.(1934) *The Desert Fayum*, p.17

76 ______, and ______.(1929,1937) *Loc. cit.*

Oasis.

Excepting a brief improvement about 4400 B.C., the rainfall of the eastern Mediterranean Basin declined appreciably between about 4700 - 4200 B.C. with the onset of a 'Prehistoric Moist Steppe' climate. After regaining its equilibrium, the rainfall remained remarkably uniform till at least 2500 B.C.

It would be interesting to compare the Near Eastern climatic succession obtained so far with the European sequence. The aridity of the Near East and the extremely low Nile levels during the Mesolithic Desert period imply an interglacial or high index atmospheric circulation pattern, and in Europe this period was characterized by a warmer interlude prior to the final retreat of the ice. This Allerød Oscillation has been recently dated at c. 10,000 - 8800 B.C.[77] and thus corresponds fairly well with our Mesolithic Desert phase.

The tentative Mesolithic Savanna period with its bountiful rainfall and high Nile levels indicate a return to a pronounced glacial or low index circulation pattern. The ? Upper → Lower Dryas period in Europe, which saw a return to arctic conditions, has been similarly dated at 8800 - 8100 B.C.[78] After this, conditions gradually improved in Europe, and parallel to our Neolithic Mediterranean, Europe enjoyed a dry, cool climate known as the Preboreal and Boreal. The

77 Gross, Hugo (1954) Eiszeitalter, vol. 4, pp.191-4

78 <u>Ibid</u>.

apparent contradictions between the Prehistoric Moist Steppe and Atlantic climates will be considered in the subsequent section.

2. THE CLIMATE OF THE BRONZE AGE

Unfortunately, the climate experienced in the Near East during the Late Chalcolithic and the Bronze Ages has not left much tangible evidence, and this lack of information is only remedied with the appearance of historical evidence after the 5th century B.C.

A Regional Survey of the Evidence

Egypt and the Levant. The greater part of the evidence within the Near East proper comes from Egypt and Palestine.

The history of Lake Moeris, which served as an absolute criterion of Near Eastern rainfall for over 6000 years, becomes obscure after c.2500 B.C. There are indications that the level began to sink after that date, but it may still have been high at the time of the 12th Dynasty (c.2000 B.C.). It is clear, however, that it began to fall somewhere between 2500 - 2000 B.C. and that this fall had amounted to about 45 feet in the 3rd century B.C., when Ptolemy Philadelphus began the systematic project of reducing the lake to its present low level.[79]

79 Caton-Thompson and Gardner (1929,1937) *loc. cit.*

A definite break in the continuity of occupation in Palestine and Jordan becomes evident after c.2100 B.C. During the next two or three centuries numerous towns were abandoned, and only in the 19th century B.C. did Palestine once again become repopulated. Significantly, sedentary life was almost non-existant in the marginal areas of Jordan until the 13th century B.C.[80] The objections to the use of such evidence are, of course, immediate. It would be absurd to bring up the charge of accelerated soil erosion at this stage, but the strong connection of the above phenomenon with the great Amorite invasions cannot be denied. The decisive point, however, is that the resettlement of this area in southern Jordan, in the 13th and 12th centuries B.C. by sedentary peoples, took place at the height of the Aramaean migrations, which were by no means more peaceful than those of the Amorites. Consequently, we may with some logic deduce a pronounced arid phase from this semi-permanent depopulation of the marginal lands between the 19th and 13th centuries B.C. The onset of this dry period can be tentatively dated at 2100 B.C. and the maximum aridity may have been achieved between c.1800 - 1300 B.C.

Even as late as 1000 B.C. there may have been a greater scarcity of water than the present, judging by the Old Testament description of the siege of Jerusalem by King David.[81]

80 Albright, W.F. (1946) Stone Age to Christianity, p.103

81 II Samuel 5; I Chronicles 11.

<u>A Crimean Rainfall Curve</u>. An invaluable criterion to Near Eastern climate has been provided by W.B. Schostakowitsch's study of the annual mud layers of the west Crimean salt lake Saki.[82] Although subject to a different rainfall regime and in a higher latitude, this sequence of varve-like layers serves well as an indicator of the general atmospheric circulation pattern. The annual variations in thickness of these layers refer primarily to rainfall intensity and have provided a graph c.f. Figure I extending to approximately 2294 B.C. The striking correlation between the sharp drop in rainfall

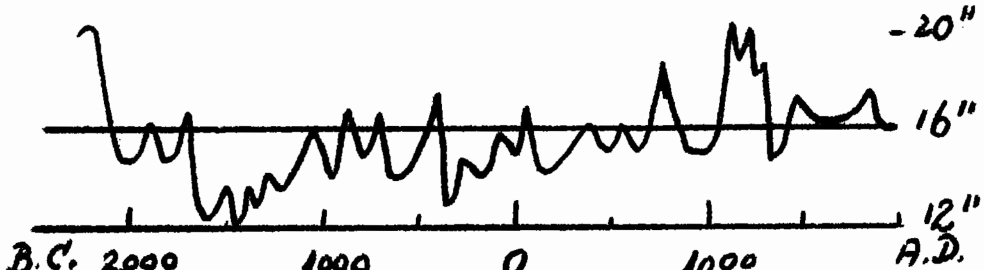


FIGURE I

ANNUAL MUD LAYERS OF LAKE SAKI, CRIMEA

AFTER W.B. SCHOSTAKOWITSCH (1935)

between 2200 and 2100 B.C. and the depopulation of the marginal lands beginning about 2100 B.C. lends considerable support to the applicability of both criteria. Further, this is sudden drop from a rainfall c.25% greater than that of the present, to one considerably lower than that of the present. This coincides remarkably with the persistance of the 140

82 Schostakowitsch, W.B. (1935) Met.Mag. pp.134-44

foot level of Lake Moeris into the late 3rd millenium, and the continued rainfall enjoyed by the more elevated parts of northern Egypt until a similar date. Lastly, the absolute minimum of the Crimean rainfall curve falls between about 1700 - 1100 B.C., lending further support to our tentative assumptions from the Jordan evidence. Conditions resembling those of the last half century appear to have replaced the Prehistoric Desert climate by about 900 B.C.

Although the empirical evidence from Egypt and Palestine pointed to a greater aridity, it could not express this quantitatively; Schostakowitsch's graph seems to fill this gap and supply the necessary confirmation of this period of maximum postglacial aridity.

The Anau Evidence. The Anau Kurgans in Turkmenistan have long been explored by archaeologists, who believe that the abandonment and reconstruction of several cities on this site has been due primarily to drought. C.E.P. Brooks [83] has based the first 3000 years of his rainfall curve for West and Central Asia solely on this evidence. Brooks adopts the date of 'prior to 8000 B.C.' which Pumpelly has suggested for the beginning of the first city, Anau I, on which date the subsequent chronology depends. Unfortunately this date has never been accepted by other archaeologists, and in contrast,

83 Brooks (1949) op. cit. p. 321

H. Schmidt would substitute 'prior to 2000 B.C.', and Peake and Fleure, 'approximately 3900 B.C.' for the same figure.[84] The wide discrepancy between these dates renders the Anau evidence unreliable and misleading. It would however be of great interest if these excavations were radiocarbon dated, as they could provide a large amount of vital information for this critical period.

Synthesis and Conclusions

Once again the available evidence unaminously supports an identical sequence. The more genial Prehistoric Moist Steppe climate was replaced by the Prehistoric Desert climate about 2200 B.C. The latter reached a maximum of aridity about 1700 - 1300 B.C. and lasted until about 900 B.C. Brooks'[85] reference to the drought which led to the evacuation of Susa and Tripolje 'about 2200 B.C.' further supports our findings.

However, a correlation of the Near Eastern and European evidence raises a number of apparent contradictions. In northern Europe, the most outstanding postglacial climatic feature was a thermal maximum between about 4000 - 2000 B.C., usually called the 'Climatic Optimum'. It has been generally stated without proof[86] that this period was one of maximum aridity in lower middle latitudes. However this has not been borne out by the Near Eastern data.

84 Peake,H. and Fleure,H (1927) Peasants and Potters, p110

85 Brooks,C.E.P. (1931) QJRMS p. 15

86 For example, the unfounded generalizations made by Willett, op. cit. pp. 47-8

Contemporary to the Near Eastern 'Prehistoric Moist Steppe' period was the European 'Atlantic' phase, generally associated with the 'Climatic Optimum'. The Atlantic period[87] was characterized by mild rainy winters, and hot, relatively humid summers. The average summer temperature was perhaps 3° F. warmer than the present, extending the growing season by about two weeks. The frequent summer droughts typical of this period certainly prove that this was a period of high index atmospheric circulation in Europe, but so far we cannot identify such a period in the Near East. The Prehistoric Moist Steppe phase was moister than the present, and judging by the indefinite marshy loam deposits in Palestine, perhaps a little warmer as well. Contrary to a high index circulation pattern, the westerly circulation of the Mediterranean appears to have been stronger than the present.

The maximum aridity postulated for the Near East was delayed by at least one millenium and occurred during the 'Prehistoric Desert' phase, which is chronologically equivalent to the 'Subboreal'. The latter period was characterized by fairly mild winters and hot summers in Europe, while the associated rainfall was doubtful, although probably fluctuating and less than during the Atlantic phase. The implication is that this was a period of pronounced high index circulation in both Europe and the Near East.

87 The European data here essentially follows the work of Brooks (1949) op. cit. pp.295-310 and Wagner, op. cit. pp. 112-134

In conclusion, beyond presenting a correlation table of the climatic phases of the Near East and Europe in recent geological times, there is no further point in speculation. Further climatic evidence is imperative for the Near East during this period, and further objective, substantiated work on the general atmospheric circulation principles involved is most desirable.

TABLE III

THE NEAR EASTERN CLIMATIC SUCCESSION (I)

Date B.C.	Egypt	The Levant	Persia
? - 8500	Moeris nearly dry	Arid	Loess? deposition
?8500 - 7500	Moeris 206' A.L.	Pluvial C?	Seal Mesolithic
?7500 - 4700	Faiyum Moist Phase I	ditto	Gazelle Mesolithic
4700 - 2200	ditto II	Warm & moist?	- -
2200 - 900	Desiccation	Desiccation	- -

Near Eastern Phase	Climate	European Phase	Climate
Mesolithic Desert	Very dry	Allerød	Subarctic
Mesolithic Savanna	Very moist	Lower Dryas	Arctic
Mesolithic Mediterranean	Moist	Preboreal, Boreal	Dry, cool
Prehistoric Moist Steppe	Less moist	Atlantic	Moist and warm
Prehistoric Desert	Very dry	Subboreal	Drier and cool

CHAPTER VI

THE CLIMATE OF HISTORICAL TIME

1. THE VALIDITY OF THE CLIMATIC CRITERIA

Before commencing the study of the climatic history of the Near East during historical times, it is imperative to investigate the validity of the climatic tools which shall be employed c0ntinuously throughout the succeeding chapter. The methods in question hinge upon the use of the Caspian Sea and other non-outlet lake levels, rainfall observations, the levels of the Nile River, and latterly, even movements of the Caucasus glaciers.

The Mechanism of the Individual Criteria

The Caspian Sea Levels. Bearing in mind that the Volga, which drains an immense basin in latitude 45 - 60° N. is by far the greatest, and almost the only important, tributary of the Caspian Sea, one is inclined to question the validity of using its levels as a climatic indicator for the Near East.

The Volga high-water level reaches Astrachan in June, and the Caspian reaches its annual maximum in August. Because the minor tributaries (such as the Kur, Terek, Kuma, Ural, Emba) have their highest levels in May or April, E. Brückner[88] believes the Caspian fluctuates in direct proportion to the Volga high-water levels. To amplify this, Brückner gave temperature statistics of Russian stations to show that temperatures in southern Russia have no reflection on the Caspian levels of the period 1850-1880.

Recent work on the matter does not confirm his point of view. L.S. Berg and Artur Wagner[89] point out that whereas rainfall in the Volga drainage basin increased after 1881, and especially after 1900, the Caspian has fallen steadily -- alone 3½ meters during 1900-1925. Evidently the evaporation over the Caspian or over the whole watershed increased considerably. Wagner believes that since only the winter rainfall of Russia had increased, the evaporation over the northern watershed remained the same. Consequently he concludes that the evaporation over the Caspian itself, in all probability, especially over the southern half of its great expanse, must have increased.

Whether this be the final word on the matter or not, it is most significant that the period of high index circulation pattern between 1901-1938 should lead to a pronounced drop in the Caspian levels, which in no way is affected by the increased rainfall in higher middle latitudes.

88 Brückner, E. (1890) Geog. Abhand. Heft 2,pp.33-87

89 Wagner, Artur (1940) Die Wissenschaft, pp. 76-81

<u>Rainfall at Jerusalem</u>. Overlooking some very dubious rainfall records from 1846-1859, reliable observations of rainfall in Jerusalem have been made since 1860. Corresponding to the high index circulation of the decades 1901-1938 one can show a mean rainfall of 66.0 cm for the years 1900-1915 in comparison to 73.6 cm for the period 1880-1900. The cold winters experienced in higher middle latitudes between 1917/18 and 1919/20 were carefully paralleled by three moist winters in the Near East, after which the rainfall decreased very sharply to a low of 24 cm in 1932/33. One may consequently rely upon the rainfall of Jerusalem to reflect world-wide trends with remarkable accuracy.

<u>The Levels of the Nile</u>. The highwater levels of the Nile reflect the intensity of the Southwest Monsoon in Ethiopia, whose precipitation is channelled through the Blue Nile and Atbara. On the other hand, the low-water level is largely controlled by the equatorial rainfall of Central Africa brought in through the White Nile.

The correspondence of the Nile levels to general atmospheric circulation patterns is also startling. Whereas the total Nile waterflow during the period 1870-1900 was 10% above average, that of 1900-1920 was 14½% below normal.[90]

Unfortunately, the earlier statistics on the Nile high and low-water levels are not very reliable, which fact

90 Data derived from figures quoted by Wagner, *op. cit.* p85

apparently accounts for the contradictions appearing at various times with the other criteria. For instance, the the average levels for the years 1651-1700 are based on 5 recordings of high-water levels, and only 1 of the low-water level.[91]

The Caucasus Glaciers. The movements of the Azau[92] glavier of Mount Elburs have been recorded for over a century. Until 1848 the glaciers were slowly retreating, when the Azau glacier began a spectacular expansion, knocking down a spruce forest in 1849 and reaching a maximum extension for one or two centuries. In 1873 it began to decline once again, and by 1881 it was 1 km back from the forest destroyed in 1849. During the intermittent retreat from 1883-1911, this glacier lost a further 350 meters, which were negligably affected by a readvance of 15 meters between 1911-1914. Since then a decline once more set in, so that the retreat had amounted to 1½ km by 1930.

Other than that the years 1847-1850 were apparently moist throughout Asia, there is little resemblance between rainfall statistics in Baku, Tiflis, or Jerusalem and the movements of the glacier. On the other hand, the overall retreat during the last 80 years resembles that of glaciers elsewhere in the northern hemisphere, and it appears that mean annual temperature is the dominant factor controlling

91 Brooks, C.E.P. (1930) RMSQJ p. 394

92 Wagner, op. cit. pp. 68-9

the rate of ablation, here as well as elsewhere.

A Correlation of the Independent Criteria

Having seen that each climatic indicator reflects circulation patterns in its own way, it remains to be seen how strong the individual correspondence is. For an accurate comparison, a composite graph of the following items has been drawn up.

(1) The Caspian Sea levels of 1850-1876 following the mean levels of E. Brückner.[93] The isolated annual mean of 1877/78 is omitted, as there is insufficient data to bridge the break of 1876/77 and the subsequent change in recording level. Fig.II

(2) The official annual rainfall data for Jerusalem, 1860-1886. Fig. III.

(3) The relative levels of a number of Near Eastern lakes following the data of R. Sieger.[94] This data is only qualitative and summarizes the relatively high or low levels, as well as the maximam and minima, as known in the 19th century. Table IV below is a synopsis of Sieger's valuable work.

The investigator has compiled a relative graph Fig.IV for the period 1847-1886 using this data, namely assigning one unit plus for a high level, 1½ units for a maximum, and identical negative values for low or minimum levels. The values are cumulative when dates are multiply confirmed, since there is

93 Brückner, loc. cit.

94 Sieger,R. (1888) Mitth. d. k.k. Geogr.Ges.,Wien 86pp.

no contradiction between the relative levels of two or more lakes.

TABLE IV

THE FLUCTUATIONS OF 10 NEAR EASTERN LAKES (AFTER SIEGER)

Lake Van		Lake Arin		Lake Urmia	
Rising after 1800		Rising	1838-50	Maximum	c.1810
Maxium	1820	Maximum	1850	Minimum	Early 30's
Minimum	1838	Sinking	1850-53	Rising	1834-50
Rising	1838-41	High	Late 50's	High	1850
High	1841-50	Disappeared	c.1870	Low	Early 50's & 60's
Sinking	1850-53			High	1880
Low	Early 70's	Lake Moeris		Lake Eljeg	
High in the 80's		High	1840	Maximum	Late 40's,50's
Lake Gölcük		Low	1871	Minimum	in the 60's
High	1847	High	1885	High	1886
Rising End of 70's		Lake Ala Kul		Lake Abistada	
The Hamun		Sinking	in 30's	Low	1839
High	1842	Minimum	c.1853	High	1878/79
Low	1872				
High	1886				

A comparison of Figures II, III and IV c.f. page 49 shows a startling parallelism, in which almost every detail is faithfully reflected year after year. Theccorrelation is about 0.8 and nowhere are there any important contradictions. This is all the more surprising when one considers thatgreat distances between the criteria under consideration, and the questionability of their relationships.

The similarity of these three phenomena, drawn from independent sources, is so great that one can safely conclude that the Caspian Sea levels, as well as those of other Near

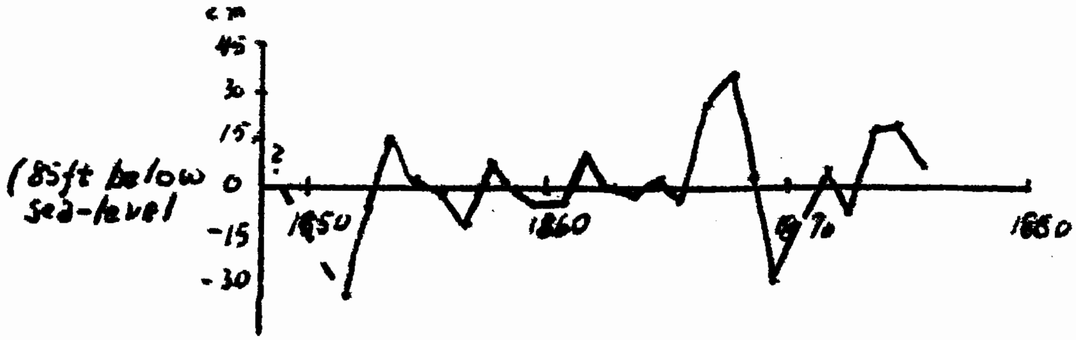


FIGURE II

CASPIAN SEA LEVELS 1851/52-1875/76 (AFTER BRUCKNER)

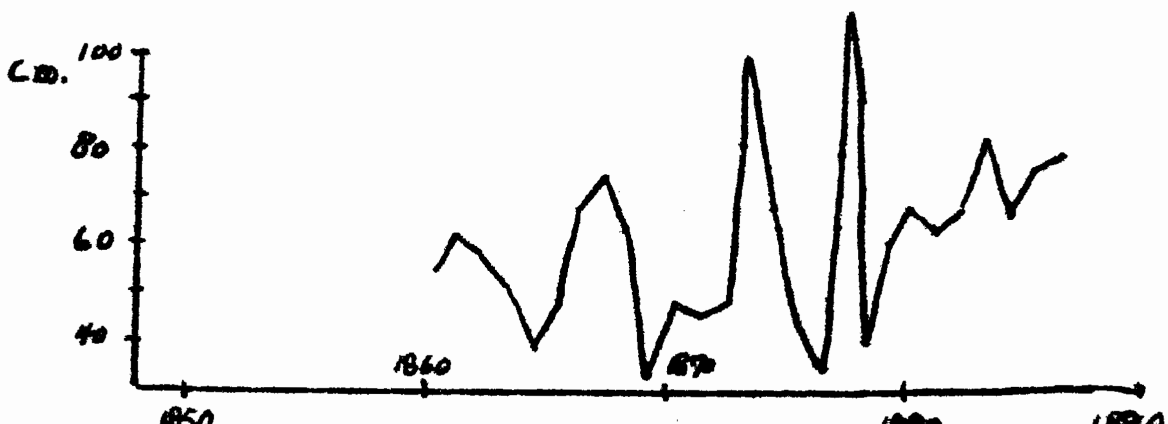


FIGURE III

RAINFALL AT JERUSALEM 1860/61-1886/87

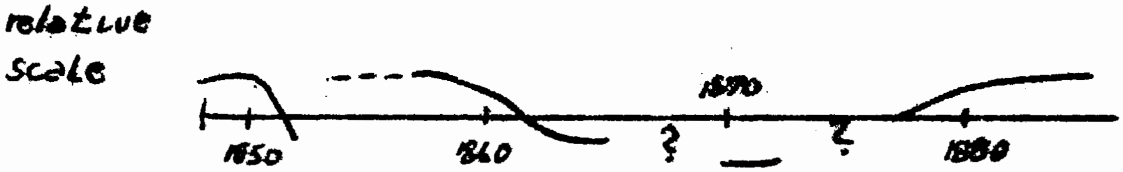


FIGURE IV

NEAR EASTERN LAKE LEVELS (BUTZER AFTER SIEGER)

Eastern non-outlet lakes, reflect rainfall trends throughout the Near East with sufficient accuracy. Having established this correspondence in detail for a 26 year period, we are at liberty to employ the principle of induction, and claim the validity of these climatic criteria as an indicator of precipitation in the Near East for the historical period.

2. THE CLASSICAL PERIOD 500 B.C. - A.D. 600

The climate of the last millenium B.C. is almost entirely unknown except by inference from the Crimean rainfall curve. Thereafter, a greater amount of information is at the disposal of the climatologist, but for the first time a number of contradictions become apparent. The only way that a deadlock can be avoided is by a clear realization that this period was subject to a rapidly fluctuating rainfall. A second difficulty is met in the form of accelerated soil erosion, which has given the erroneous impression of drastic climatic changes to a number of authors.[95] Soil erosion, deforestation and overgrazing are only one side of the picture, however, and they have been invoked all too freely to explain wholly unrelated phenomena. This is perhaps the result of a negative reaction led by a large number of futurists in the Near East, the self-styled 'Men against the Desert'.

95 Huntington, E.(1911) Palestine and its Transformation, pp. 249-404; and, Caetani, L.(1911) Studi di Storia orientale, t. I, pp. 55-288.

Egypt. A fair amount of material has been summarized by C.E.P. Brooks[96] for Egypt. The accounts given by Herodotus and Ammianus Marcellinus would suggest that the Nile floods were generally good during the 5th century B.C., and generally poor during the 4th. In the 1st century A.D. the Nile floods were rather good according to Pliny's commentaries, and extensive well boring lead to increased prosperity in the Kharga Oasis.

There is further substantiation of a moister period at this time in the weather record of Claudius Ptolemy (1st century) which has been investigated by Miss L.D. Sawyer.[97] Brooks[98] believes these observations were actually taken in Alexandria, but that they only record abnormal weather conditions. There are a number of interesting features in this chart. Brooks believes that the two entries of rain in July and four entries of thunder for June to August indicate occasional, rare depressions interrupting the steady, fine summer weather of the eastern Mediterranean Basin. Ptolemy records south winds on five occasions as well as three weather changes, during July and August, whereas to-day such conditions are unknown at this time. Great heat was concentrated in July and August, whereas to-day May and June are the hottest months. If Brooks' contention that these observations are authentic documents recording conditions in Alexandria is right, we may

96 Brooks (1931) op.cit. pp.19-21; (1949) op.cit.pp.329-41

97 Sawyer, L.D. (1931) RMSQJ pp. 26-7

98 Brooks (1931,1949) loc. cit.

infer a period of pronounced high index circulation during the 1st century A.D. Even if this weather record represents only one abnormal year, it nevertheless gives an illustration of the general trend of that century.

The Nile floods appear to have kept a high level during the early 2nd century, but by A.D. 200 they were once again poorer. The calendar of Antiochus, referring to Egypt at this time, records 19 weather changes falling between May and September, which period is to-day constantly dominated by the Etesian circulation. However, this calendar is of much more doubtful reliability than the weather records of Ptolemy.

The Nile floods were very low during the 4th century A.D. but had greatly improved by the close of the century. There is little or no data for the next two centuries and the 7th century showed nothing abnormal, although the Kharga Oasis suffered a great loss of prosperity. However, both floods and low-water levels were at a minimum between A.D. 750-800, and remained low till at least A.D. 1000.

The Levant. The luxurious pictures so often drawn of an abundant vegetation, prosperous agriculture, and wide extension of the cultivated lands into what is now desert, apply, if at all, to the first two centuries of the Christian Era only. Syria was uncommonly well-populated and this appears to have led to an agricultural expansion at the expense of the desert, made possible largely by the stable political conditions of the time.

An objective appraisal of the climate at this time is of course difficult. The Arab authors have long expounded a theory similar to that of Caetani and Huntington. Mas'udi[99] records many legends which describe the Syrian Desert as having running waters and numerous oases at this time, which had disappeared before the era of the Islamic expansion. The latter is well borne out by the archaeological evidence.[100] There are large Roman bridges and ruined piers in permanently dry wadi beds, and crudely-fashioned washing-boards along their banks. There are well-heads, well-houses, spring-houses and inscriptions referring to springs, where none exist to-day. The majority of these findings date from the first and second centuries of our era. Jerash, for example, enjoyed its greatest prosperity between A.D. 130-180.[101]

The ready explanation of soil erosion has been all too generously applied to areas where there has been little or almost no soil erosion. In particular, reference is made to the immense tracts of undulating steppe which are often called the 'Little Syrian Desert'. Irrigation has never been practised here,[102] and soil erosion is insignificant, in strong contrast to the limestone hills of Central Syria. Innumerable towns and

99 Mas'udi, Muruj al-Dhahal, (French translation, 1861) vol.1, pp.217-19

100 Butler, H.C. (1920) Geog. Rev. pp. 77-108
101 Gregory, J.W. (1930) Geog. Jour. p. 490
102 Issawi & Dabeziew (1945) Engineering pp. 345-6

and villages of the Roman period lie buried under this waste of dead soil, which is to-day the haunt of Badu tribes. Similarly, there has not been very much soil erosion east and south of the Hauran, areas which also depend on rainfall and not on irrigation. This region is strewn with the ruins of ancient towns and villages, whose buildings were constructed entirely of stone, discounting any deforestation theories. Admittedly, numerous cisterns have been discovered, cleared and brought back into use throughout the Levant, but the undeniable fact is that the water-table of the desert has fallen by two meters since the early Roman period,[103] and is still falling.

There is little doubt that other factors have played their part as well, but it appears that a slight increase in precipitation was one of the major factors involved in the expansion of sedentary cultivators into the marginal lands during the 1st and earlier part of the 2nd centuries A.D.

A period of decreasing rainfall appears to have set in by the end of the 2nd century, and in A.D. 333 the level of the Dead Sea was at least as low as, and probably a little lower than the present, according to the otherwise reliable testimony of the Bordeaux pilgrim.[104] Two centuries later it may have been just as low judging from the less reliable description of Gregory of Tours.[105]

103 Rees, L.W.B.(1929) Antiquity pp. 398-9

104 Huntington (1911) op.cit. p. 317

105 Ibid. p. 318

The catastrophic cessation of all building activity and sedentary occupation of immense areas after A.D. 610 cannot be solely interpreted by the devastating Persian invasion of 610-14. The greater part of the abandoned towns and homes do not appear to have been destroyed by man, and in the words of H.C. Butler, "no human hands were ever able to transform a fertile, populous and thriving country into a desert in so short a time."[106] That an intensification of the prevailing aridity played a considerable part in this final exodus from the marginal lands seems to be confirmed by many records of catastrophic droughts in northern Arabia, which apparently reached a climax in A.D. 640.[106a]

Persia. Many commentaries have been written about the march of Alexander of Macedon along the dreary coast of Baluchistan to Guadar and then to Bampur in 328 B.C. Many observers claim this feat proves that water was more abundant along this route at that time. Of the original 40,000 men, only 10,000 arrived in Bampur; but in comparison, Cyrus, the son of Cambyses, a century earlier, lost his entire army and escaped with only a handful of followers. Huntington[107] claims that the journey of Alexander's general Krateros from Seistan to Kerman with a large army, supplemented above all by elephants, would be impossible to-day. In his day, this 180-mile stretch was passable only by tiny caravans, and with great difficulty. However, other observers maintain that conditions here were no better in Alexander's day than now. No positive conclu-

106 Butler, loc. cit.
106a C.f. particularly pp. 110, 117, 118 below.
107 Huntington, E. (1919) The Pulse of Asia, pp. 300-03

sions can be safely drawn from such controversial evidence.

In the 5th century A.D. we first encounter one of the known levels of the Caspian Sea. At Aboksun the so-called 'Red Wall' was built by the Persians to keep out the Eastern or 'White' Huns (who ruled western Turkestan c. 375-567). The wall is attributed by Persian tradition to the Sassanid Shah Firuz (A.D. 459-484). This interval seems reasonable as the Sassanids counterattacked the White Huns effectively after A.D. 425 and by 455 had diverted their attention towards India. In the 1860's the remains of this wall were traced 18 miles out into the Caspian at a depth of 15 feet below the Brückner zero-level (85 feet below sea-level).[108] Consequently the present water-level is perhaps 3 feet higher than it was during the 5th century, indicating that the rainfall was relatively low at the time.

There is also evidence that a similar low level occurred in the succeeding centuries. The base of a wall, built near Derbent during the 2nd half of the 6th century against the Sevordik Magyars, is a little below Brückner's zero-level.

<u>Asia Minor</u>. In A.D. 401, the Black Sea was supposedly frozen over for 20 days.[109] From such severe cold we can infer at least a temporary glacial circulation pattern, and inductively, a moister phase between the low levels of the Dead and Caspian Seas, which fact is supplemented by the high

108 All Caspian Sea levels, unless otherwise stated, are derived from Brückner, loc. cit.

109 Wagner, op. cit. p. 87

Nile levels at the same time.

A 6th century Armenian monastary stands on an island in Lake Gölcük[110] which was once part of the mainland. Beside it a village lies submerged by 20 or 30 feet of water. A line of forts, dating from the 1st millenium A.D., crosses the lake bed about 4 miles from its western end.

Southern Arabia. A.S. Huzayyin[111] has provided some excellent information for southern Arabia. Essentially he believes there was an important deterioration of climate between the 3rd and 6th centuries A.D. from moister conditions which had persisted for perhaps a millenium. He gives a good deal of varied and substantial evidence to this effect.

Huzayyin divides the plateau of Yaman into three distinct steps ranging from east to west: (1) the Minaean Jauf, below 1000 meters, (2) the Sabaean Jauf between 1000 and 1500 meters, and (3) the plateau of Sana, above 1500 meters. The first area lies in the Rub al-Khali, but is cut by a number of dry wadis which used to feed a number of ancient oases, among which was the capital of the important and prosperous kingdom of the Minaeans (c.900-600 B.C.). Subsequently, Ma'rib in the Sabaean Jauf was the political and economic centre of Yaman under the Sabaeans and Himyarites. In the 6th century AD. the centre of gravity had shifted so much, that the capital

110 Huntington (1919) op. cit. p. 322

111 Huzayyin, A.S.(1935) Bull. Fac. Arts Cairo pp.19-23

was moved to Sana in the highlands, where it has remained since. This century also saw the complete cessation of agricultural occupance in the entire Jauf region below 1500 meters.

On the other hand, the upper part of the Hadramaut valley had been the nucleus of the ancient kingdom, and the capital, Shabwa, was situated several miles from the river. To-day, the principal cities and the capital are all situated on the river and in the lower half of the river, which was probably unoccupied in ancient times, judging by archaeological findings. To explain this, Huzayyin quotes numerous classical sources which invariably refer to Hadramaut as an unhealthy, fever-ridden 'Valley of Death'. To-day it is one of the health-iest regions of southern Arabia. Huzayyin believes that a slight increase in rainfall would lead to the formation of (malarial) swamps in the lower river valley, whose mouth is chronically choked by sand bars. Instead of the now unimpor-tant incense-trees for which Hadramaut was once famous, the date-palm, doura and irrigation have been introduced.

In other words, a decrease in rainfall made the eastern foothills of Yaman untenable to agriculturalists, while it eliminated the marshes of the lower Hadramaut valley and forced the people to move downstream, to live along the river-banks, and take up irrigation.

Huzayyin believes this deterioration had begun in the 3rd century A.D. when the Tanukh and Quda'ah tribes migrated across the line of oases of the southern Nadjd and Hasa into the Fertile Crescent, instead of following the shorter, caravan route through the Hidjaz. Evidently they found this route too difficult for travel en masse, probably because of a lack of sufficient water.

Summary and Synthesis. Interpolating from the general trend of the Crimean rainfall curve, the climate of the last five centuries B.C. can be tentatively suggested. Whereas the 5th century was relatively moist, the next three centuries were somewhat drier, with an improvement towards the beginning of the 1st century B.C.

The evidence of almost all the regions concerned points unaminously to a period of bountiful rainfall, very probably somewhat greater than that of the present, in the 1st and early 2nd century A.D. Thereafter the precipitation of the Near East diminished and remained a little lower than that of the present until the close of the 4th century A.D. About A.D. 400, there was a brief reversal to moister conditions, which lasted a generation or so, and were replaced by similar arid conditions that persisted until the close of the classical period. There is also reason to believe that there was an intensification of this drought at the end of the 6th and beginning of the 7th century A.D., reaching a maximum about A.D. 640.

3. THE CLIMATE OF THE ISLAMIC ERA

The last period of climatic history under discussion is the Islamic Era, from the 7th century A.D. to the present. The climate of these centuries is better known than for any other period of the past, an with an appreciable amount of detail. There have been numerous rapid fluctuations, some of which have been quite pronounced, but none of which were sufficiently prolonged to affect the landscape of the Near East permanently.

In both 673 and 800/01, the Black Sea was covered by ice several feet thick. The Dardanelles were filled with ice during the winter of 763, and the Adriatic Sea, frozen over only twice in historical times, was ice-covered in 859/60.[112]

When the Arab geographer Istakhri visited Derbent in A.D. 915/21, six towers of the wall at Derbent were under water. Brückner estimates this level at 28.9 feet above the zero-level, which seems rather incredible. The accuracy of this figure depends on to what extent these six towers were 'submerged'. At any rate, the Caspian level was quite high in the early 10th century; if it fell shortly afterwards, one cannot tell.

In the Hamun-i-Helmend of Seistan, the town of Kuh-i-Khoja was at one time connected with the shore;[113] whereas it

112 Wagner, op. cit. p. 87

113 Hedin, op. cit. p. 206

is on an island to-day. Huntington believes that the Hamun was somewhat expanded about A.D. 900, basing himself on a local legend and the restriction of contemporary ruins to more elevated regions.[114]

The high Caspian level of A.D. 915/21, the Crimean rainfall curve maximum of about A.D. 800, and the possible high level of the Hamun appear very logical when we consider that the reoccurrence of such phenomenally cold winters as in 672/3, 762/3, 800/01 and 859/60 reflect a strong glacial or low index circulation pattern. It is fairly well established that the period c. 670-925 was relatively moist, a fact that is borne out by archaeology in the Levant, where hunting-boxes and baths were built in the desert by the Umaiyads, where no water or game exists to-day.

There are numerous houses and even towns, of unknown date, submerged in the Caspian Sea, particularly in the Bay of Rescht. However, a partially submerged caravanserai at Baku is dated as '12th century' by Brückner on architectural grounds. Its base is 15 feet below the zero-level and indicates a dry phase at the time of construction, approximately equivalent to that of the 5th century. If this caravanserai was actually built a century earlier, which is just as well possible, the sequence of Caspian levels would coincide almost perfectly with the Crimean rainfall curve, which

114 Huntington (1919) op. cit. p. 324

records a minimum in the 10th and 11th centuries followed by a fairly pronounced moist phase. From the unsubstantiated testimony of the Russian pilgrim Daniel, the Dead Sea may have been a little higher in A.D. 1106.[115]

Judging from the cold winters experienced in the Mediterranean Basin in A.D. 1216 and 1234,[116] the 13th century was probably quite moist in the Near East. The Venetian traveller Marino Sanuto notes that the Caspian Sea rose rapidly at the end of the 13th century at the rate of 32 inches per year. Before it once again began to sink in A.D. 1306/07 it reached a certain well-known holy grave, at 36.7 feet above the zero-level, according to Sefi Ed-Din. Berg discounts this precise level on empirical grounds,[117] but the existence of a very high level at the time remains fairly certain. Tentatively, the moist phase suggested by the previous evidence can be assigned to the period c. 1100-1310.

According to Bakui, the Caspian inundated part of Baku during a rapid rise in the early 1400's, reaching the level of a certain mosque at 16 feet above the zero-level. By inference, the general Caspian level of the 14th century was quite low, and the period of drought and low Nile levels in Egypt between 1398-1421 confirm that this period was very dry in the Near East. The rise of the Caspian recorded by

115 Huntington, (1911) op. cit. p. 319

116 Wagner, loc. cit.

117 Cited by Wagner, op. cit. p. 79

Bakui very likely corresponds to the short phase of low index circulation verified in Europe for the years 1428-1460. After this the level probably sank again, but Jenkinson in 1559 describes the level as being relatively high.

The available evidence of the last three centuries or so is adequately summarized in the following table of E. Brückner.

TABLE V

CASPIAN SEA LEVELS (AFTER BRUCKNER)

Year	Level relative to zero-level (85'below S.L.)	
1638	+16.1 feet	+4.9 meters
1715/20	1.0 "	0.3 "
1742/3	H I G H	
1756/6	L O W	
1815	8.0 feet	2.4 "
1830	1.5 "	0.4 "
1843/6	-2.3 "	-0.59 "
1847	+0.9 "	+0.22 "
1851-76	-1.3 to +1.4 feet	-0.33 to +0.35 meters

The high Caspian level of 1638 appears to be confirmed by the cold winters of 1608 and 1621 when the Bosporous was ice-bound.[118] This corresponds to the 'Little Ice Age' experienced in Europe between 1540-1680, which was beyond question a period of low index circulation. In the second half of the 17th century, the Caspian sank to approximately the zero-level, and only after 1715 began a slow rise which was paralleled in

118 Wagner, op. cit. p. 87

Lake Van.[119] A reversal to a low index circulation pattern could be suggested from the intensely cold winter which affected the Mediterranean Basin in 1708/09. [120] Towards the end of the century both Lake Van and the Caspian were quite high.

Several short term fluctuations may be mentioned in the course of the 19th century. A succession of wet years in 1846-1850 was reflected by a rise of almost a foot in the Caspian Sea, and a similar rise is known in a number of other lakes. This phase appears to have been decidedly cool in the Caucasus, judging by the remarkable advance of the Azau glacier. Subsequently, there were a number of very arid years between 1850-1853.

An exceptionally arid year in 1869/70 was followed by a number of further dry years. The Caspian dropped by a foot, and the Dead Sea stood at least 8 feet below the 1910 level. At the same time, Lake Arin (near Lake Van) dried out entirely.

The long term trend between 1810-1875 was one of decreasing rainfall. Thereafter a quarter century of very moist conditions followed, during which the Dead Sea rose rapidly (10 feet between 1890-1898).[121] The Caspian regained a slightly higher level, and the other non-outlet lakes of Western Asia reached minor maximum levels. Simultaneously the Nile flow was considerably above average.

119 Brückner, op. cit. p. 107-09

120 Wagner, loc. cit.

121 H. Koppe, cited by Wagner, op. cit. p. 82

After 1900 a turn for the worse set in, broken only by a few wet years, as for example 1917-1919. Between 1920 and 1933 there was an accelerated deterioration in precipitation which resulted in a series of crop failures in the unirrigated lands of the Near East. This well-known period of high index circulation since 1901 is responsible for the 11 foot drop in the Caspian Sea between 1900-1925,[122] and is involved in the accelerated drop of the water table during the last few decades.[123] The Nile flow has diminished noticeably and, all in all, moisture conditions in the Near East are worse at present than at any time since the 14th century A.D.

4. A SYNTHESIS OF THE CLIMATE OF HISTORICAL TIME

Since 900 B.C. the climate of the Near East has not shown any particular long-term trend, and one is justified in assigning the label 'Historic Dry Steppe' to this climatic phase, which in general enjoyed moisture conditions about midway between those of the Prehistoric Moist Steppe and Prehistoric Desert climates. The European parallel is obviously to be sought in the Subatlantic phase, which began between about 800 and 500 B.C.

The climate of the Christian Era is relatively well-known, and an attempt at a general classification of the

122 Wagner, op. cit. p. 79

123 The water-table of the Egyptian oases has dropped by about 15 feet in the last 50 years, c.f. Murray, loc.cit.

short-term trends would not be premature. Table VI below attempts such a classification in broad lines. The dates are at best approximate, and the labels of moist, dry, etc. are intended to be merely general qualitative expressions.

TABLE VI

THE NEAR EASTERN CLIMATIC SUCCESSION II

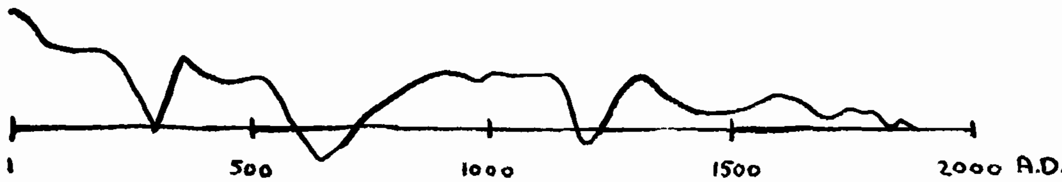
(SHORT-TERM RAINFALL TRENDS OF THE CHRISTIAN ERA.)

1 - 180?	Very moist	1428 - 1460	Very moist
?180 - 390	Dry	1460 - 1540	Dry
390 - 415	Moist	1540-- 1680	Very moist
415 - 670	Very dry	1680 - 1708	Dry
670 - 925	Very moist	1708 - 1838	Moist
925 - 1100	Very dry	1838 - 1875	Dry
1100 - 1310	Very moist	1875 - 1900	Moist
1310 - 1428	Very dry	1901 -	Very dry

The data summarized by Table VI can be summarized even more accurately and in greater detail by a graph, Figure Vb., where it is contrasted to a similar graph of Ellsworth Huntington[124], Figure Va. The former graph exclusively follows the data as presented in detail during the preceding chapter of this thesis, with the exception of the small trough in the mid 12th century A.D. (in broken lines) which is derived from the Crimean rainfall curve, and was probably paralleled in the Near East. The occasional resemblance between Huntington's

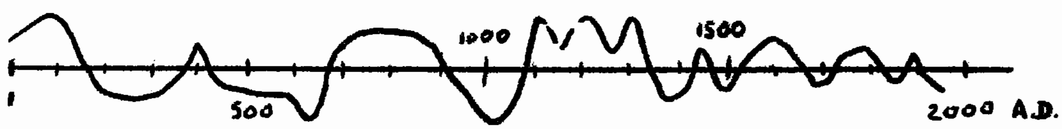
124 Huntington (1911) <u>op</u>. <u>cit</u>. p. 375

FIGURE V



a. AFTER HUNTINTON (1911)

RAINFALL TRENDS OF THE CHRISTIAN ERA



b. AFTER BUTZER (1955)

curve and the Figure Vb. is chiefly due to the Caspian Sea levels which Huntington already employed in the latter part of his graph.

Lastly, as a résumé of the complete 'postglacial' climatic succession after 10,000 B.C. as established above, Figure VIc. has been presented below, preceded by the rainfall curve of Huntington[125] from 3000 B.C. to the present (Figure VIa.) and that of Brooks[126] from 5500 B.C. to the present (Figure VIb.). Huntington's graph is essentially that of a progressive desiccation, interrupted by frequent

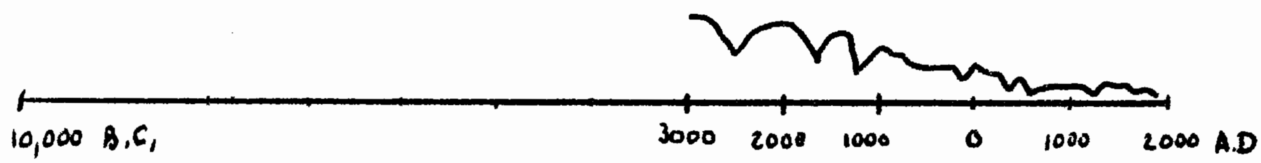
125 Huntington loc. cit.

126 Brooks (1949) op. cit. p. 321

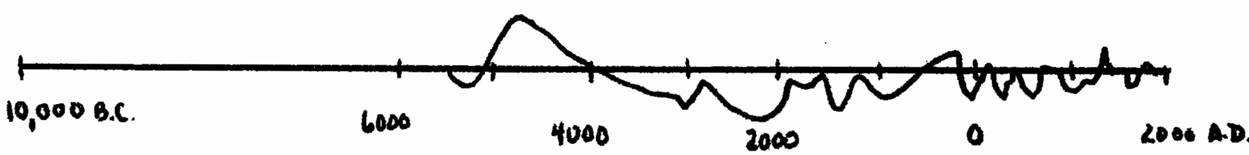
FIGURE VI

LONG-TERM RAINFALL TRENDS IN THE NEAR EAST

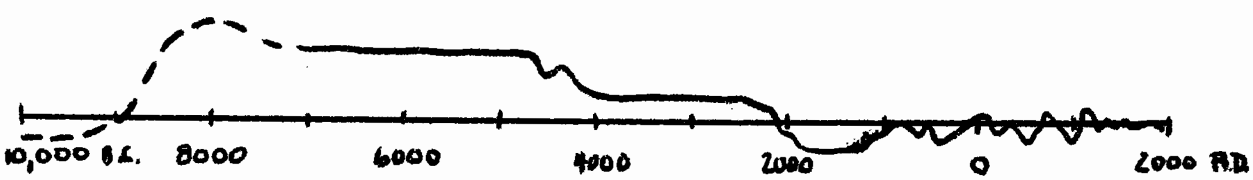
a. AFTER HUNTINGTON (1911)



b. AFTER BROOKS (1949)



c. AFTER BUTZER (1955)



'pulsations', while Brook's curve is hinged upon a theoretical 'Climatic Optimum' between 4000-2000 B.C. Although the last curve, i.e. Figure VIc., represents an exhaustive and objective study of the geological and other literature dealing with the climate of this period, it stands to reason that it will have to be modified as further evidence becomes available, and in this respect can only be considered tentative.

PART II. SOME HUMAN ASPECTS OF CLIMATIC VARIATION

CHAPTER VII

THE ALLEGED CULTURAL STIMULUS OF DESICCATION

The problem of the origin and diffusion of the Neolithic culture is of particular interest in a climatic history of the Near East because, rightly or wrongly, this origin and diffusion has been connected with a number of climatic hypotheses. The word 'Neolithic' signifies: (1) the fabrication and use of polished stone implements, such as axes, adzes, chisels, hoes and gouges, (2) the conquest of the procreative forces of nature through agriculture and animal husbandry.[126] Although these two cultural stages are often identical, the latter meaning has been generally adopted in this chapter.

I. THE CLIMATIC THEORY OF NEOLITHIC ORIGINS

Neolithic Origins in Space and Time

Before embarking on a discussion of the climatic hypotheses associated with the origins of agriculture and animal husbandry, it is essential to scetch the background of these cultural origins briefly.

Modern opinion[127] is gradually converging to the

126 Coon (1939) op. cit. p. 76

127 This discussion is chiefly drawn from O. Ames (1939) Economic Annuals, pp. 119-143; C.S. Coon, (1954) op. cit. pp. 126-134; and, C.O. Sauer (1952) Agricultural Origins and Dispersals, pp. 62-94.

acceptance of a general area embracing Persia, parts of Afghanistan and the adjoining oases of Turkestan, as one of the principal foci of agricultural domestication. So far at least three world centres of agricultural origins are recognized. The type of agriculture about which our own civilization has evolved, is peculiarly adapted to a winter-rainfall regime, necessitating a processing and preservation of foods. This stands in contrast to the tropical vegetative planting technique, in which most foods have to be eaten when ready. Whether the Neolithic economy represents the merging of two independent food-producing techniques, or an integral whole, is open to question.

There remains considerable doubt among botanists as to the ancestors of the cultivated species, but it is possible to list the major economic annuals generally believed to have been domesticated in Western Asia: bread, emmer and einkorn wheat; barley; rye; oats; millet; grass, and garden pea; flax; sesame; melon; lentil; broadbean; chick pea; poppy; spinach; and many more. The list is quite impressive, and to it one may add the characteristic Mediterranean species and their probable areas of origin: grapes (Transcaucasia); olives and figs (the Levant); dates (the Persian Gulf coast); pears and apples (Western Zagros); and lastly, walnuts, almonds, peaches, plums, apricots (Southern Turkestan).

The next major point in dispute is the type of terrain where first cultivation was most likely. Ames[128] has convincingly refuted Sauer's theory of forest origins, and points out the extreme unlikelihood of a mountain origin as postulated by Vavilov. Peake and Fleure[129] ably demonstrated that the inadequacy of early Neolithic implements preclude a riverine or potamic origin. This leaves the grassy foothills, where geographical terrain as well as diverse cultural contacts are optimum, as a very likely focus of early cultivation.

Southwest Asia is also considered as the hearth of domestication of herd animals. The goat, sheep and horse offer few problems, but the original centres of domestication of the cow and pig are controversial.

The location of the origins of the Neolithic economy in time has been a third major point of controversy. Botanists have claimed that the lack of wild ancestors to many of our cultivated plants points to a mid or early Pleistocene origin of cultivation. However the recent discovery of mounds like Jarmo (Iraq) and the Caspian Sea caves have shown a continuous sequence of cultural levels from the more recent period, through the Neolithic into the early early Mesolithic and beyond. As these sites come from the geographical focus of earliest cultivation, the dates assigned to them should come close to the truth.

The Belt Cave in Persia shows indirect evidence of

128 Ames, <u>op</u>. <u>cit</u>. pp. 132-3

129 Peake and Fleure, <u>op</u>. <u>cit</u>. pp. 21-28

agriculture and animal husbandry in a level dated 5835 B.C. (± 330) by radiocarbon.[130] This is by far the oldest of all the sites in question. Since this particular cave was very probably not the first such site, it seems safe to assume that the origins of agriculture and animal domestication may be dated in the 7th millenium B.C. and certainly not earlier than the 9th millenium.

The Climatic Theory of Neolithic Origins

A half century ago, R. Pumpelly, the leader of the American expedition to the kurgans at Anau, conceived a theory which has intrigued and stimulated a large number of leading archaeologists, anthropologists and prehistorians, and is still widely accepted to-day. To the present time there persists a very widespread opinion that the period between roughly 10,000 and 5000 B.C. consisted of an uninterrupted transition from a long, even uniform, glacial-pluvial to a static postglacial climate in the Near East, and that at the latter date, or a little later, conditions closely resembling those pf the present set in. This has led a number of eminent authors to make extensive use of the seemingly established progressive postglacial desiccation of the marginal lands of the Near East in their sociological theories.

Archaeological evidence has of course shown that large

130 Ralph, loc. cit.

areas of what are now poor steppe or desert were relatively densely inhabited during Pleistocene times. In fact, the Sahara desert, East Africa and Arabia are to-day considered as the life centre of human development, and during alternating pluvial and interpluvial epochs it is believed that the deserts attracted and expelled hordes of hunters.[131]

Pumpelly[132] conceives of the origins of agriculture as a response to such an expulsion from the desert due to the postglacial 'desiccation' in the following excerpt,

> With the gradual shrinking in dimensions of habitable areas and the disappearance of herds of wild animals, Man, concentrating on the oases and forced to conquer new means of support, began to utilize the native plants; and from among these he learned to use seeds of different grasses growing on the dry land and in marshes at the mouths of larger streams on the desert. With the increase of population and its necessities, he learned to plant the seeds, thus making, by conscious or unconscious selection, the first step in the evolution of the whole series of cereals.

More recently, the work of Peake and Fleure[133] should be cited,

> The northward shifting of the zones of ocean storms and westerly winds . . .[led to the desiccation of Arabia and the Sahara], . . . and, though for a while the old hunting life remained possible, game became scarcer and considerable sections of the population were forced to emigrate to the north or south, while some moved eastward from the Sahara into the Nile Valley. . . men naturally turned their attention back to the old habit of collecting food as their hunting became less successful. In certain regions however, men were led towards a new idea; it occurred to them to produce food by the cultivation of edible plants.

131 Coon, <u>op</u>. <u>cit</u>. p. 41

132 Pumpelly, R (1904) <u>Explorations in Turkestan</u> pp.65-6

133 Peake and Fleure, <u>op</u>. <u>cit</u>. p. 14

As a last example, V. G. Childe has put the problem skillfully,

> Faced with the gradual desiccation, three alternatives were open to the hunting populations. They might move north or south with their prey, following the climatic belt to which they were accustomed; they might remain, eking out a miserable existence on such game as could withstand the drought, or they might remain, and emanicipate themselves from dependence on the whims of their environment by domesticating animals and taking up agriculture.[134]

> . . . the diversion of the Atlantic rain-storms from the Southern Mediterranean zone to their present course . . . would certainly tax the ingenuity of their inhabitants to the utmost. Enforced concentration in oases or by the banks of ever more precarious springs and streams would require an intensified search for means of nourishment. Animals and man would be herded together round pools and wadis that were growing increasingly isolated by desert tracts and such enforced juxtaposition might almost of itself promote that sort of symbiosis between man and beast signified in the word domestication.[135]

It should be pointed out that we are not concerned here with the sociological sequence from a hunting to a pastoral, a food-gathering to a food-producing, or a hunting to a food-producing, economy. Our sole concern is the physical basis of these hypotheses, i.e. the climate of the period between 8500 and 6000 B.C. into which we assigned the beginnings of agriculture. It has been demonstrated above that these millenia were very moist, in sharp contrast to the preceding period, falling into the Mesolithic Savanna and Mesolithic Mediterranean phases. As noted above, there was little, if any, deterioration between these two periods,

134 Childe, V.G. (1929) The Most Ancient East, p. 46

135 Ibid. p. 42

and the rock paintings and drawings found throughout wide expanses of the Sahara date from both of these periods, as mentioned above as well. The transition between the Mesolithic Savanna and Mesolithic Mediterranean cannot be regarded as a period of desiccation if semidesert regions were similarly inhabited in both periods, as well as in the succeeding period.[136]

IT seems reasonably certain that the physical basis of these theories has no foundation in fact. The great spasms of drought recurring so frequently in previous millenia failed to evoke any visible response. Why for instance, did not the pronouncedly arid period of about 10,000 B.C. stimulate man to free himself from the whims of the environment? The sad response can be readily seen in the scarcity of human implements in the loess-like layer of the Belt Cave.[137] Another more recent contradiction of such a 'stimulus' is found in the Faiyum Oasis, where the arrival of the Neolithic people coincided with a decidedly moist period. When a phase of desiccation set in c. 4700 B.C. their culture rapidly degenerated and eventually disappeared completely.[138] In the light of the above evidence, the words of C.O. Sauer appear quite appropriate, "needy and miserable societies are not inventive, for they lack the leisure for reflection, experimentation,

136 For example, the Neolithic peoples living on the barren Kharga Plateau, c.f. above p.34

137 C.f. above p. 32

138 Caton-Thompson and Gardner (1929) op.cit. pp. 54-5

and discussion."[139]

The riddle of the origins of agriculture has another answer, and it must be found elsewhere. Perhaps A. S. Huzayyin has come much closer to the truth when he says,

> it may be argued with more force that it was the relaxing of the climatic crisis rather than its intensification that led to the fostering of new cultures and the facilitating of contacts between widely separated groups in otherwise arid regions.[140]

2. THE PROBLEM OF DESICCATION AS A PHYSICAL CHALLENGE

In his well-known "A Study of History", A. J. Toynbee has employed certain concepts of the postglacial climatic succession to account for the genesis of some of the civilizations he identifies. Within the Near East, he has invoked the 'physical challenge of incipient [postglacial] desiccation' to promote the genesis of the Egyptiac, Sumeric, [Indic] and Nomadic Societies.

> After the close of 'the Ice Age', our Afrasian area began to experience a profound physical challenge in the direction of desiccation; and simultaneously two or more civilizations arose in an area which had previously been occupied by primitive societies of the Palaeolithic order. Our archaeologists encourage us to look upon the desiccation of Afrasia as a challenge to which these civilizations responded.[141]

> . . . there were communities that responded to the challenge of desiccation by changing their habitat and way of life alike, and this rare double reaction was the dynamic act which created the Egyptiac and Sumeric civilizations out of the primitive societies of the vanishing Afrasian grasslands.[142]

139 Sauer, op. cit. p. 20
140 Huzayyin, (1941) op. cit. p. 319
141 Toynbee, A.J. (1935, 1955) A Study of History, Vol. I, p. 304
142 Ibid. p. 305

> When the grasslands overlooking the lower valley of the Nile turned into the Libyan Desert and the grasslands overlooking the lower valley of the Tigris and Euphrates into the Rub 'al-Khali and the Dasht-i-Lut, these heroic pioneers -- inspired by audacity or desperation -- plunged into the jungle-swamps of the valley-bottoms, never before penetrated by Man, which their dynamic was to turn into the Land of Egypt and the Land of Shinar.[143]

This physical challenge seems to consist of two stages. Firstly, the changeover from glacial-pluvial conditions to those of the present led to the migration of some groups into the primeval riverine swamps, where they were stimulated to change their way of life and adopt a food-producing economy. The inapplicability of the last clause has already been demonstrated, but another fundamental consideration deserves to be studied:

> The forefathers of [the modern Dinka and Shilluk] . . . were living, in what is now the Libyan Desert, cheek by jowl with the fathers of the Egyptiac civilization, at the time when these responded to the challenge of desiccation by making their momentous choice . . . some five or six thousand years ago.[144]

From the above survey of Pleistocene climate, it is obvious that there can have been no continuous belt of habitation between Lower Egypt and the Sudan, provided that the Nile Valley was uninhabited, as Toynbee suggests. This persistance of a permanent tract of desert precludes any special cultural identity between the forefathers of the Dinka and Shilluk and those progenitors of the Egyptiac civilization, who were supposedly forced out of the Libyan Desert. As a consequence, the hypothetical comparisons often made between these two peoples can be of little value.

143 Ibid.

144 Ibid. pp. 312, 314

The first-known agriculturalists in the Valley had settled at Merimde and Tasa about a millenium before the date suggested by Toynbee, and it has been seen that these people were by no means the first agriculturalists, and that their physical and cultural relatives in the Faiyum responded very wretchedly to the 'stimulus of desiccation'.[145] The Faiyum illustration also shows that a people can be induced by moist conditions to settle around a permanent water-body; in fact, the Merimdians and Tasianssettled in the Nile Valley during the moist phase before 4700 B.C. Neither Egyptian agriculture nor the first settlements in the Nile Valley were a response to the 'searching challenge of desiccation.'

The second essential stage in the genesis of the potamic civilizations appears to have been the taming and drainage of the sudd-fields and jungle-swamps which Toynbee assigns to the lower river valleys. However the physiography of the Lower Nile was quite different from that of the Bahr-al-Jabal and its endless stretches of sudd marshes. The Upper Palaeolithic was marked by a process of degradation in the bed of the Nile in Lower Egypt, and as the waters of the drying river were no longer able to inundate its sides, they became more and more confined to a limited bed which they cut down. Consequently the flood-plain and the Delta were no

145 C.f. above pp. 73, 76

longer reached by inundations and the lateral and deltaic marshes were gradually drained into the river.[146] In the words of A.S. Huzayyin, "the bottom of the Valley and its Delta must have been rendered fairly suitable for hunting, fishing and permanent or semi-permanent settlement." [147]

Neither did the genesis of the Sumeric civilization occur in the tidal lagoons of Iraq. The lower delta was still an extension of the Persian Gulf 6000 years ago, and was only subsequently filled with alluvium and reclaimed. The earliest colonists came from the eastern foothills where

> . . . [farming] villages occupy the sites of earlier settlements disclosing a culture probably prior in time, if not ancestral, to the oldest culture of Sumer.[148]

From here, the origins of the Sumeric civilization can be traced back, not to progressive desiccation, but to the introduction of agriculture from somewhere to the northeast.

Lastly, the same controversial challenge of desiccation has been evoked for the origin of nomadism. In effect,

> The first spasm of desiccation had found Eurasian man a hunter and nothing else; the second spasm found him a sedentary cultivator and stock-breeder . . . The challenge of desiccation, when it was now redelivered with greater insistance than before, evoked two new and diverse human reactions.[149]
>
> [Some Eurasians] flung themselves upon the Steppe . . . to make themselves at home upon it _en permanence_ and to wrest a livelihood from it under physical conditions which were more inimical to life than any which had yet prevailed on the Steppe since Man had first set foot upon it.[150]

146 Huzayyin, _loc. cit._ pp. 320-1
147 _Ibid._
148 Childe, V.G. (1952) _New Light on the Most Ancient East_, p. 103
149 Toynbee, _op. cit._ vol. III, p. 10 150 _Ibid._ p.12

The first step in the sequence appears to have been taken between the 7th and 9th millenia B.C. as was seen above, at a time of relatively genial conditions of moisture. The domestication of the nomad's future herd animals was certainly not far removed in time from the general introduction of the Neolithic economy, and did not apparently coincide with a first or a second spasm of desiccation.

When man first embarked permanently upon the Steppe we do not know. That he acquired his full panoply of animals only gradually can be deduced from the striking fact that those two vital elements in the nomad's life, the horse and the dromendary, were effectively domesticated only long after he had first taken up his characteristic way of life. The inference is that nomadism is an economy which developed very gradually, and not as any dramatic defiance of the desert.

When man first began the development of a pastoral way of life there is little likelihood that climatic conditions were poor, and certainly no possibility that physical conditions were worse than any which had yet prevailed on the Steppe since the appearance of man. Man has inhabited the Steppe during pluvial phases throughout the Pleistocene Epoch, and each major interpluvial period brought moisture conditions far less favourable than those experienced at any time during the Holocene.

3. CONCLUSIONS

In summary of the above chapter, a detailed enquiry into the supposed stimulus of desiccation in evoking the genesis of agriculture, animal domestication, nomadism, and the birth of a number of Near Eastern civilizations has returned a negative verdict. Whereas the historical and sociological principles involved in these hypotheses have often been under fire, the pseudo-scientific background has received little or no criticism. It was found that it was the fundamental climatic and physical basis of these hypotheses that was false, and there remains little necessity of criticizing the sociological superstructure.

If there is to be any acceptable climatic hypothesis of Neolithic origins at all, it will be along the lines suggested by Huzayyin. The return to genial conditions of moisture in Mesolithic times made possible a cultural intercourse between widely scattered groups over what are now desolate and barren lands, thereby fostering the birth and the dispersal of a new way of life into the entire Near East. It was this new sedentary way of life which made possible the rapid perfection of civilization in lands blessed with a fertile, yielding soil, and bountiful conditions of warmth and moisture.

CHAPTER VIII

THE GREAT MEDITERRANEAN RACIAL DISPERSAL

Another interesting problem, intimately connected with the climatic succession of the Near East, is presented by the dispersal of the dolichocephalic, gracile members of the Mediterranean race into Europe and North Africa during Neolithic, or rather, during both Late Mesolithic and Neolithic times. Once again, the postglacial desiccation of the Near East is generally invoked as the lever which loosed the flood of Mediterranean humanity into Europe. Such broad generalizations are obviously dangerous, and in the subsequent chapter, the successive waves of migration will be briefly examined to ascertain the climatic factors, if any, involved.

1. A SURVEY OF THE RACIAL MOVEMENTS

During Mesolithic times it appears that North Africa, Egypt and Palestine were occupied by a brachycephalic people, probably derived in part from Homo Neanderthalensis, and sometimes called under the broad term 'Afalou'.[151] This would place the primeval home of the Mediterranean race somewhere in southwestern Asia, northeastern Africa, or both. The modification of the Afalou people in Morocco at the time of introduction of the advanced microlithic technique in Tardenoisian times has suggested the penetration of elements from the

151 Coon (1939) op. cit. pp. 60-1, 92-3

eastern Mediterranean region. Simultaneously the Afalou-like Natufians of Palestine were superseded by small Mediterraneans from somewhere to the south or east in Late Natufian times. Lastly, the Portuguese midden-dwellers appear to have been racially very similar to the Late Natufians of Palestine.[152] Coon[153] has suggested a northward thrust of the Mediterranean race caused by climatic shifts incident upon the final glacial retreat.

The most important appearance of the Mediterranean race is of course in connection with the polished stone implements and food-producing economy of the Neolithic culture. The Mediterranean race and the Neolithic culture seem inseparably linked upon their appearance in Europe.

The first such Neolithic movement of which there is any definite information is the appearance of the Neolithic paoples in the Faiyum at the close of the 6th millenium. Elsewhere in Egypt, the Merimdians appeared in the Delta on their westward movement along the coast of North Africa. The latter disappeared in the Delta region after 4000 B.C. and a people very similar to them appeared in Morocco and Spain about 3000 B.C.[154] Meanwhile, Crete was occupied about 4000 B.C., and Asia Minor and Greece had been occupied about 500 years later. Southern Italy was lastly occupied by sea about 3000 B.C.[155] During the second half of the 3rd millenium B.C., similar Mediterranean culturebearers settled throughout the Danube Valley, following

152 *Ibid*. pp. 60-5 153 *Ibid*.

154 *Ibid*. p. 93

155 Menghin, O. (1934) Weltgeschichte der Steinzeit, pp. 294 - 302

a route which is still not agreed upon. They may have come from Anatolia or Southern Russia, or both.

The last of the Neolithic dispersals from the Near East into Europe was that of the tall, more robust Mediterraneans originally associated with the construction of the megaliths or dolmens.[156] The Megalithic People came by sea from somewhere in the Eastern Mediterranean Basin and settled along the Mediterranean and Atlantic shores as farafield as Britain and Scandinavia. These migrations are dated in the late 3rd millenium B.C., and this time-interval has been substantiated by radiocarbon dating at Stonehenge, England, which gives 1847 B.C. (±275) for the early phase of the monument.[157] The Megalithic People were implanted upon the smaller Mediterraneans who had preceded them, and they were followed (about 2000 B.C.) by similar peoples in the company of dinaric-like brachycephals who probably originated in the hill country of Asia Minor and the Levant.[158] These westward migrations during Late Neolithic and Early Bronze Age time were real colonizations adding substantial new racial elements, and at their close, the central and western Mediterranean Basin had assumed the racial features they still, in general, possess.[159]

2. THE APPLICABILITY OF A CLIMATIC IMPETUS

The racial movements outlined above constitute the first of the two classes of human movements considered in this

156 Coon, op. cit. pp. 79-80, 146
157 Menghin, loc. cit. ; Libby, op. cit. (1951) p. 292
158 Coon, op. cit. p. 146
159 Ibid. p. 152

thesis and they stand diametrically opposite to nomadic migrations. The latter are generally the movement of barbaric nomads into the lands of civilized, sedentary cultivators, while the Mediterranean racial dispersal, responsible for the diffusion of the Neolithic culture, was that of a sedentary, civilized folk into the lands of culturally inferior peoples, oftime hunters.

It may be profitable to outline the possible climatic mechanism involved in these racial movements. The early cultivators obviously lived in the better lands, rather than in the arid or even marginal areas, and as such, the dependence of Neolithic man upon the vagaries of rainfall could only be indirect. Crop failures seldom lead to large-scale migrations, and at best one can postulate the restriction of agriculture to better areas in the neighbourhood of waters, at the risk of overpopulation and subsequent emigration. Another even more dubious reaction would be the expulsion of sedentary cultivators from their homes by hunters or pastoral nomads directly affected by a spasm of desiccation.

The invention and adoption of new tools, a new food technique, and a new way of life inevitably led to a strong increase in population, made possible by the plentitude of available food. When a locality reached its carrying-capacity, the rate of increase had to level off, either by emigration or by a higher death rate. Surrounded by inviting lands but thinly populated by backward, primitive and unprogressive peoples, they chose the former course and sent out colonies which supplanted or absorbed the local inhabitants. Such is a second mechanism of a different variety, which may also have been involved in these racial movements. Only by correlating and comparing the climatic data with the racial dispersal can it be ascertained whether the first or the second hypothesis is valid, or whether the true picture is presented by an interplay of both elements.

The limited racial movements of the Late Mesolithic took place before the end of the 6th millenium, during the Mesolithic Mediterranean phase, which was pleasantly moist in the Near East. The subsequent Neolithic invasions were however more important and more definite than the Mesolithic movements, and came much closer to a wholesale migration.

The appearance of the Faiyum and Merimde people in Egypt cannot be convincingly attached to any climatic stimulus. They may well have been emigrants from the Fertile Crescent bearing the agricultural technique which had originated further east, and as such would qualify strongly for the second hypothesis above. It is unlikely that the climatic deterioration of c. 4700-4200 B.C. should have directly affected a site like Merimde on the west bank of the Nile Delta. Similarly an expulsion by desert peoples seems improbable because the Merimdians emigrated <u>westwards</u> into what should have been the 'encroaching desert'. Their journey along the southern Mediterranean coast took many centuries, and the movement of such a large body of people will have required more water than was available, to people of a similar cultural level, along this route in a later period. This likewise points to the second hypothesis above.

The migrations after the 4th millenium tend to emphasize the first hypothesis. No longer is the southern Mediterranean route used as a route of migration. When a land route is employed it is the northern route, through Anatolia into Southeastern Europe. The only Mediterranean route still employed is a maritime one -- like that of the Megalithic invaders who moved westwards by sea. In other words, the Danubian people following the northern land route, and the Megalithic invaders following the southern sea route -- both in the last half of the 3rd millenium B.C. -- suggest a climatic factor. This is borne out well, both by the climatic succession, which saw a deterioration after 2500 B.C. leading to the Prehistoric Desert phase, and by other evidence from the Syrian Desert. In the last century of the 3rd millenium, the Amorite nomads occupied Syria from the east, very possibly expelling large numbers of the local inhabitants who took refuge on the sea, the Atlanto-Mediterranean and Dinaric types met in the last Megalithic wave of invasion.

In conclusion, it may be observed that whereas the earlier migrations cannot be justifiably connected with any climatic hypothesis, the later migrations, particularly those of the Danubian and Megalithic folk, bear unmistakable signs of a climatic impetus. What remains even more certain, however, is that the dynamic rôle of climate has been overemphasized in the dispersal of the Mediterranean race.

CHAPTER IX

CLIMATE AND NOMADIC ERUPTIONS IN THE NEAR EAST

The second great class of population movements to be considered are the nomadic eruptions out of the Steppe into the Sown. Before attempting to consider the relation of climatic fluctuations to nomadic migrations, it is vital to describe the special problems involved in such migrations per se.

1. SOME RELEVANT ASPECTS OF NOMADISM

Vegetation, Water and Pasture

The expanse of Arabia, and its northward extension, the Syrian Desert, consists predominantly of arid steppe and semi-desert, and patches of true erg are comparatively rare in the northern and central parts. In the springtime, tall feathery steppe grasses of great variety and abundance flower everywhere. For the most part however, this evanescent plant life withers under the summer sun, leaving only such hardier bushes as camel thorn, tamarisk, acacia, and various aromatic sclerophylls. The unreliable early spring rains are critical, and a week-long extension of the 'latter rains' may carry the spring pasture season through the period of isolated, but important, May showers. Whereas late spring rains permit a sizeable increase of herds, an early dry season implies considerable hardship until the following year. The revival of the perennial plants, parched during the summer drought, is critically dependent upon the 'former rains' of the early autumn.

To illustrate the unreliability of the steppe rainfall quantitatively, Table VII below provides the monthly precipitation of a Wadi Hauran station for the climatically unspectacular years 1935-1938.

TABLE VII

PRECIPITATION IN INCHES FOR RUTBA (32°55' N, 39°45' W)[160]

J	F	M	A	M	J	J	A	S	O	N	D
.22	.16	.18	.68	.00	-	-	-	-	.59	2.40	.18
.42	.29	.05	.13	.11	-	-	-	-	-	-	.68
1.56	.21	-	1.09	.48	-	.01	-	-	.51	1.90	-
1.50	.81	.59	.13	.23	-	-	-	-	-	-	.90

Annual Total	1935	4.3 inches
	1936	1.8 inches
	1937	5.8 inches
	1938	4.4 inches
4-Year Mean		4.1 inches

Besides the glaring monthly inconsistencies, it may be noticed that while 1937 had a rainfall 41% higher, 1936 had a rainfall 56% lower than the 4-year mean. The implications of such drastic year-to-year variability are all too obvious.

Surface water is available from springs ('*ain*), wells (*bir*), and less reliably, in rain-water pools (*khabari*). The

160 Boesch, *loc. cit.*

khabari may be found in the wide shallow hollows of the hammada during the rainy season, but they are of short duration, and depend on the vagaries of the rainfall from year to year.

The nomad takes a well measured advantage of these seasonal variations of vegetation and water, and within his own traditional circuit (dira), he only enters the erg or rocky hammada for a few weeks during exceptionally moist winters. When the seasonal pastures of his southerly range give out, he moves northward during the late spring. Tribes living on the margins of the better lands naturally do not have to wander so far for means of subsistence.

With such a delicate ecological balance, it is evident that every small climatic fluctuation will have a disproportionately large effect on the nomad. During a season of drought, the customary raids (ghazwa) on the flocks of hostile tribes or on neighbouring sedentary communities take on a more serious character. A few years of deficient rainfall will force a tribe to seek water or pasturage outside of its own tribal orbit, and spontaneous intertribal warfare results. The culmination of such movements and friction may very logically be the infiltration, or even invasion, of the bordering agricultural states. Very possibly, a longer sequence of particularly hard years may lead to a wholesale, spontaneous emigration from the steppes into the domain of the settled nations.

By excluding migrations as evidence for our climatic chronology, we are now in a position to consider the known migrations with reference to the climatic data. The hypothesis postulated above has too often been taken for granted, but has never been investigated objectively. In the subsequent chapters of this thesis, an attempt will be made to establish certain conclusions and qualifications to this hypothesis.

Some Preliminary Problems

The desett and steppes of the Old World can be subdivided into two groups: the Northern, or Eurasian, Steppe, extending from the Hungarian Allföld through the Ukraine, north of the Causcasus, Elburz and Hindu Kush mountains into Mongolia; and the Southern, or Afrasian, Steppe, covering the broad expanse of the Sahara, the Arabian Desert, Iran south of the Elburz, and extending into India to include the Thar Desert. In the succeeding chapters, only those migrations known to have originated within the Near Eastern segment of the Southern Steppe will be considered. The southward movements of nomad and transhuming pastoralists from Anatolia and the Caucasus are generally the peripheral activity of the Northern Steppe, and will be mentioned only briefly when relevant, or not at all.

As a second fact it may be pointed out, that except for the infiltration of a few brachycephalic dinaric-types (so-called 'Armenoids') before 2000 B.C., none of the historic invasions of Mesopotamia have changed the racial composition of that country in any noticeable way.[161] This points to the general racial continuity of Arabia, Mesopotamia and Persia. Consequently in the following discussion of nomadic invasions, one is dealing with ethnic movements, often of interrelated people, and not racial displacements.

The leading Semitists of this century are in general agreement that the Arabian Peninsula is the primeval home of the Semites. This appears logical when all known Semitic movements have without doubt originated here. The problem is rather, in what part of Arabia is this home to be found? From the standpoint of climatology, it makes a great amount of difference whether the steppes of the Nadjd or the highlands of the Yaman qualify for this position. Philby[162] believes the source area is to be found in Yaman, and that migrations took a general eastwards course across the peninsula, along the Persian Gulf coast into Mesopotamia, and from there across Syria to the Mediterranean or Egypt. Although his arguments are interesting, the problem has by no means been solved, as Huzayyin has concluded that the same area cannot well qualify as a centre of cultural diffusion, judging by the extreme scarcity of Lower Palaeolithic implements found there by the Egyptian Expedition.[163]

A fourth important consideration has been pointed out

161 Coon, op. cit. p. 89

162 Philby (1947) The Background of Islam, pp. 7-10

163 Huzayyin (1937) op. cit. p. 514

by W.F. Albright.[164] Nomadism in the Near East, since its origin after the domestication of herd animals, evolved in two distinct stages, which consisted of ass-herding and camel-herding. At first glance, this may appear as a trivial distinction, but its importance is fundamental in that the camel provides a greater mobility and wider range to the movements and migrations of the nomad, enabling him to make long journeys and in case of need, to retire and take refuge in the innermost desert. It has been well said that a large part of Arabia would have remained unexploited and uninhabited by man, but for the domestication and utilization of the camel.[165] The effective domestication of the camel was only accomplished in the 12th century B.C., although partial and sporadic domestication may go back several centuries earlier.[166] Even then it did not come into universal usage until the 9th century B.C. The nomads dependent upon ass-herding were forced to live either in oases or on the outskirts of the farming areas, whose crops they periodically pillaged. They could not make unexpected raids or long forced journeys, but had to travel and attack on foot. As a result, the distinction between the Ahlu'l-Badu and Ahlu'l-Hadar, the nomadic and the sedentary folk, will have been much less than it is to-day. The universal introduction of the horse from the Eurasian steppes after the 17th century B.C. will have gone some way

164 Albright, op. cit. pp. 120-22

165 Inayatullah, Sh. (1941) Geographical Factors in Arabian Life and History, p. 59

166 Albright, loc. cit.

in providing that irresistable mobility which characterizes the camel-riding badawin of to-day. But owing to the lack of abundant water and good pasture, the horse has always been rare in Arabia, and it could not exist there without the care of man.[167]

A number of Orientalists, such as Hugo Winckler, believe that Arabia inevitably becomes overpopulated every 1000 years or so, and the ensuing transplantations take the form of 'waves' of migrations. The first such 'wave' was the vague and little known movement, at the close of the 4th millenium, through which a Semitic stock was implanted in Egypt, Akkad, Babylon and Assyria. Whether this was a peaceful penetration and colonization, or an armed invasion is not known. Recent evidence shows there was no serious ethnic hostility in Mesopotamia between the Semites and indigenous Sumerians at the time. The second and third of these 'waves' were quite spectacular and widespread movements. The Amorite invasions (about 2100-1700 B.C) were followed by the Aramaean invasions (about 1400-800 B.C.) which included the Hebrews, Chaldaeans and Libyans. However there were no correspondingly great 'fourth' and 'sixth' waves if we consider the Islamic Dispersal as the fifth. The Nabataeans in the 6th century B.C. and the Shammar and 'Anaza in the 17th century A.D. cannot well qualify for such positions. At best one can detect only three 'wave' movements, and they

167 Inayatullah, op. cit. p. 64

are by no means rhythmic. Consequently, throughout our discussions all supposed periodicities in migratory movements as well as in climatic variations shall be treated with scepticism.

Lastly, our knowledge of nomadic invasions is seriously limited in its source material. The historical information about them is derived, not from the nomads themselves, but from observers among the sedentary societies affected, limiting our knowledge to the period posterior to their arrival from the Steppe in the Sown.

2. NOMADIC MIGRATIONS OF THE PRE-CHRISTIAN ERA

Within the light of history, the first migration of any extent from the the Southern Steppe, is recorded towards the close of the 3rd millenium. Between c. 2250-2000 B.C. Egypt fell into a state of chaos, usually described as the 'Dark Ages'. The cause of the anarchy and tumult was internal: the breakdown of central authority in the face of the growing power of a feudal nobility. The nomads of Palestine and the Libyan Desert took advantage of these internal disorders to occupy parts of the Nile Delta, while the Nubians, in company with Sudan negroes, invaded the Valley from the south.

In general, this period coincided with decreasing rainfall incident upon the onset of the Prehistoric Desert phase, and in the latter half of this period a catastrophic decrease occurred. It seems reasonable that both the social vacuum in Egypt and the contemporary deterioration in climate were involved in the origin of these migrations.

Chronologically, these movements coincided with the invasion of the pastoral Gutian nomads from the hill-country of Kurdistan which eventually overwhelmed Mesopotamia, where a Gutian dynasty reigned from 2150-2060 B.C.

The Amorite Migrations. The far more universal and consequential migrations of the semitic Amurru or Amorites began in the early 21st century B.C., precisely in the century that witnessed the drastic diminution of rainfall observed in the Near East. The consequence of such a decrease in precipitation would be the destruction of large areas of pasture-land. The remaining steppe-country would be severely overpopulated as the carrying-capacity of the land dropped sharply.[168]

In the early 20th century B.C. these Amorite nomads occupied the Jazira, where they established a powerful state at Mari which was only absorbed after 1728 B.C. by the Amorite empire of Hammurabi. A century earlier, they had begun to penetrate and colonize the hills and plains of Syria and Lebanon. In 1960 B.C. the concerted action of Amorites and Elamites removed the 3rd Dynasty from the throne of Ur. Playing the part of both invader and mercenary, their relentless

168 In Australia it has been estimated that 20 inches of rainfall per year can maintain 600 sheep per square mile, while 13 and 10 inches can only maintain 100 and 10 sheep respectively. C.f. Curry, J.C. (1928) Antiquity, p. 292

advances brought the ancient empires of Akkad and Sumer to their collapse. Babylon fell about 1830, and Assur a few generations later. The Amorites had by this time penetrated, colonized and dominated most of the Fertile Crescent, although they were numerically dominant only in the Jazira.

That this migration was not always peaceful is attested by the destruction of such towns as Ai during the 20th century B.C. Considering that the Amorites were ass-nomads and had no great military superiority in terms of mobility or numbers, their centuries-long peaceful infiltration into, and armed aggression against, the prosperous and well-established kingdoms suggests a climatic impetus.

The Indo-European Invaders. The 18th century B.C. is marked by the widespread activities of the highland folk of Asia Minor and Caucasia, probably instigated and spearheaded by the newly-arrived Indo-European horse-nomads.

One such conglomerate group is represented by the Hyksos who invaded the Fertile Crescent with their terrifying horse-drawn chariots about 1750 B.C. They continued into Egypt where they ruled the Delta from 1675-1567 B.C. The high proportion of Hyksos chieftains with Semitic names leaves little doubt that an appreciable segment of the invaders consisted of nomads drawn from Syria and Arabia, and precludes the absence of nomadic activity in the period following the Amorite expansion.

Meanwhile, another movement of pastoral mountaineers, the Kassites of the Zagros Range, turned itself upon the plains of the Tigris and Euphrates. Between 1677 and 1674 they conquered the eastern sections of Mesopotamia, and ruled in Babylon from 1595-1171 B.C. Thus the Indo-European night settled down over the Near East, till 1550 B.C. in Egypt, and a century later in Mesopotamia.

The Aramaean Migrations. During the 14th century B.C., nomadic unrest in the Syrian Desert was renewed on a large scale with the raids, local conquests and settlements of the Aramaeans. One example is given by the Confederacy of Israel which entered Canaan about 1375 B.C.[168] Again, the largely Semitic roving bands of Habiru ravaged Syria and Palestine for two generations before their defeat at the hands of Seti I (1318-1299B.C.), Pharaoh of Egypt.

This first phase of the Aramaean invasion, in contrast to the later phases, consisted of bold, frontal attacks on relatively strong kingdoms. This phase also coincided with the latter part of the absolute rainfall minimum connected with the last part of the Prehistoric Desert phase. The important rôle played by the climate is further borne out by an Egyptian inscription of this period: "A few of the Asiatics, who knew not how they should live, have come begging a home in the domain of Pharaoh . . ."[169]

168 Sandford, E.M. (1951) The Mediterranean World, p.97

169 Ibid.

Between 1223 and 1194 B.C. all authority in the Near East ceased to exist due to the maritime invasions of the 'Peoples of the Sea' and the upheaval in Asia Minor which sent whole nations roaming through Syria in search of new homes. Only Assyria managed to divert the invaders, some of whom settled in Palestine as the Philistines.

The amelioration of climate during the 12th and 11th century did not deter the Aramaeans from taking full advantage of this bout of anarchy. They migrated en masse into the defenseless lands of the sedentary peoples, and within two centuries fully restored the Semitic character of the Fertile Crescent. The nomads of the Libyan Desert raided and settled in the Nile Delta at will. One major invasion took place c. 1221 B.C. and another about a generation later. Only Assyria, still intact, repulsed the invaders. For obvious reasons, this second phase of the Aramaean migrations proceeded without recourse to a climatic impetus, and was simply the consequence of a social vacuum.

There is also evidence of a social and economic revolution among the nomads at this time, namely the effective domestication of the camel. About 1100 B.C. the camel-riding Midianites occupied parts of Canaan till their well-known expulsion at the hands of Gideon.

The 10th century B.C. was marked by a continuation and reintensification of the nomadic movements in the Near

East, for which we may assign some blame on the reversal of the upward trend of precipitation at the time. It may be mentioned that continued absolute rainfall minima may be only a little more effective in producing nomadic unrest than moderate decreases over shorter periods. This follows when, after herds and population have become numerically adjusted to the carrying-capacity of the range, a deterioration of pasture follows the decrease in rainfall.

During the 10th century, the Aramaean attacks from the Jazira against Assyria reached their highest pitch, after which they declined. Similarly, the more peaceful penetration of the Chaldaeans into Sumer and Akkad reached its maximum intensity in the 10th and 9th centuries. In Egypt the Libyans established themselves as permanent rulers, and their dynasty reigned from 945-712 B.C. in the Delta. Considering that this last phase of the Aramaean migrations persisted into the 9th century, which was decidedly moist, it is very likely that the increased use of the camel was a factor continually gaining in importance.

In conclusion therefore, unlike in the case of the Amorite invasions, one can only attach a possible climatic implication to the first phase of the Aramaean migrations, namely those before c. 1200 B.C. Increased aridity may have played a part in the last phase, but the evidence is by no means conclusive.

<u>The Later Migrations</u>. After the Aramaeans had settled down and established flourishing commercial cities in Syria, the desert took on the human aspects which characterized it until recently. Mobile, predatory camel-nomads held full sway outside of the margins of the Sown, and no sedentary power could subjugate them effectively.

Early in the 9th century B.C. the Saba, a tribe of northern Arabia swept southwards into southwestern Arabia where they had fully subjugated the older Minaean kingdom in Yaman by c. 600 B.C.[170] There is no apparent climatic correlation, and the evidence of internal strife in Yaman, and the possible invitation of the Sabaeans by a local king involved in the struggle[171] suggest that climate played no part whatever in the movement. It is possible that the 'Arabians that were near the Ethiopians' who raided Judah during the reign of Jehoram (848-844 B.C.)[172] were identical with these Sabaeans.

The relentless Assyrian considered the Badu as a thorn in his side. During his reign, Tiglath-Pileser III (745-727B.C.) established his suzerainity over large areas of Arabia. But Sargon II (722-704 B.C.) and his successors were obliged to carry out nine different campaigns to chastise the unredoubtable Arabs who continually interfered with the caravan routes and harassed Syria. This renewed bout of nomadic activity at

170 Philby (1947) <u>op</u>. <u>cit</u>. pp. 35-7 171 <u>Ibid</u>. p. 39

172 The Chronicler II Chap. 21: 16,17

the close of the 8th century B.C. occurred simultaneously with a drop discernible on the Crimean rainfall curve. It is possible that a short sequence of bad years are to blame for the sudden reversal from a passive servility under Tiglath-Pileser III to the indomnitable hostility shown Sargon II and Sennacherib. Nevertheless, it is poor speculation.

The next of the nomadic movements within this period took place after 586 B.C. when the Nabataean Arabs began to occupy the lands of the Edomites in Jordan, the Negeb and Sinai. In this same century, the Habashat of Yaman emigrated across the Strait of Bab al-Mandab into Ethiopia.[173] It is likely that the other migrations of the Ausan and Ma'afir to the coast of East Africa took place somewhere in these years.[174] In the Crimea the 6th century saw a sharp reversal to arid conditions, and it is likely that the Near East reflected a similar high index circulation pattern at the time.

The last of the migrations contained in this time-span are those of the Arab Badu into the disintegrating possessions of the Seleucid Empire in the Levant. The Jazira was overrun by a badawin horde in 127 B.C., and till the end of the dynasty in 64 B.C. the nomads raided Syria at will. Any mention of climate under such circumstances would be superfluous.

173 Rossini, C. (1928) Storia d'Etiopia, p. 102

174 v. Wissmann, op. cit. p. 428

CHAPTER X

THE GREAT ARABIAN MIGRATION. A CLIMATIC IMPETUS?

The intricate mass of political, social, religious and historical factors interwoven in the framework of the Muslim Arab migration and conquests cannot be readily summarized and assigned climatological implications. However, this nomadic eruption is most important in any consideration of related phenomena, in that it is the only major nomadic outbreak which falls well within the light of history, and is sufficiently documented. Furthermore, it serves as a most vital test-case on which the climatic hypothesis of migrations stands or falls.

It is consequently well within the scope of this thesis to give the Islamic Dispersal a brief, but sufficiently detailed, scrutinization in its origins and development, from the viewpoint of the climatological hypothesis.

1. THE POLITICAL, ECONOMIC AND SOCIAL DECLINE OF SOUTH ARABIA

The powerful, cultured and prosperous kingdom of Saba was established in Southwest Arabia in the 8th and 7th centuries B.C. on the ruins of the Minaean kingdom. One of the greatest feats of the Sabaeans was the construction of the famous dam of Ma'rib. This great barrage, with its sluices and distributaries, was built across the mouth of one of the channels of the Wadi Kharid, where it emerges from the hills, between about

650-630 B.C.[175] In this way perennial irrigation opened large areas of the eastern foothills of Yaman to a prosperous agriculture.

Similarly, powerful, rich and civilized states dedicated to commerce, stock-breeding and agriculture flourished over wide areas, such as Taima, al-Higr, al-'Ula, Qataban and the Hadramaut. Agriculture employed a much greater segment of the population than it does to-day, and the nomadic pastoralists were confined to the bleak steppe of the interior. There was a lively cultural and commercial intercourse with the hellenized nations of the north, but even more vital was the favourable commercial position of Southwest Arabia between India and the Mediterranean. Arabian caravans and Arabian sailors monopolized this trade and the commercial wealth of Saba and Himyar was noted.

The decline of Arabia's civilized kingdoms was in the earliest instance economic. In 31 B.C. an Egypto-Roman fleet secured the mastery of the Red Sea route to India, and in 25 B.C. an abortive attempt was made to conquer Yaman itself. Thereafter the caravan route from Dofar and Qana to Petra and Gaza began to decline seriously, with resultant distress in South Arabia.

During the 3rd century A.D. a second and much more decisive catastrophe occurred in the partial destruction of the great dam of Ma'rib by an earthquake or volcanic action. Large numbers of tribesmen were forced to abandon agriculture and emigrate northwards into the territories of Rome and Persia.

175 Philby, op. cit. p. 38-9

But this catastrophe was apparently not the only factor at work behind this emigration, for the Taghlib began their migrations into Iraq somewhat earlier, taking advantage of the chaos in Persia after the disestablishment of the Parthians (A.D.226). They were followed by the Tanukh, the Quda'ah, the Bakr, the Ghassan, and the Yazids, and the last disturbances associated with this wave of migrations appears to have been the severe defeat of the Yazids at the hands of Sapur II in A.D. 309. One may assignean approximate date of A.D. 225-310 for these migrations, which Huzayyin would attribute, in part, to decreasing rainfall in southern Arabia. By the end of the 5th century, the Ghassan had formed a principality subordinate to Byzantium, in the Hauran and al-Balqa region. Similarly, other Yamanite tribes formed a client kingdom of Persia at Hira near the Euphrates, under the Lakhmid dynasty. The Ghassanids and Lakhmids served as buffers between the desert nomads and the great empires, and the imprudent dissolution of these states, in A.D. 580 and 602 respectively, left the Fertile Crescent wide open to the desert marauders, and made possible the Muslim conquest.

In the 5th century, internal chaos set in as civil and religious wars were supplemented by badawin aggression from the steppes. The political decline was completed by the Abyssinian occupations of about A.D. 330-375 and 525-575. There was damage to the Mar'ib dam in successive years due to floods, and in A.D. 449-50 major repairs were made. It is not necessarily a coincidence that the decline in precipitation suggested by Huzayyin[176] should occur simultaneously with this period of internal chaos. The damage of flood waters to the dam can be attributed to two possible factors. Either neglect of the public water works resulted from the decline in political power, or, the recurrence of wet years after intermittent phases of greater aridity gave rise to sheet-floods and the removal of excessive quantities of weathered rock by the overloaded watercourses. Such overloaded spates contribute to a rapid silting-up of the canals, as well as to the destruction of the sluice gates themselves. It appears that both negligence, and a decreasing and more unreliable and variable rainfall played their rôle in these successive breaks.

The course of events can be clearly followed when the rebellion of a number of nomad tribes (a curious occurrence in what once belonged to the Ahlu'l-Hadar, or settled lands) inflicted such serious damage to the dam that 11 months and 14,000 camels were required for repairs, A.D. 542-3. The agricultural communities were gradually disappearing in the face of nomadic encroachments. The continuous decrease in rainfall apparently forced many of the agriculturalists to take up a nomad pastoral economy as well, and the last settled populations of the lowlands were displaced when the dam and the irrigation schemes were finally destroyed completely at sometime between A.D. 543 and 570.

176 C.f. above pp. 57-8

2. THE PRE-ISLAMIC INFILTRATION

After a lull of about one and a half centuries, broken only by a few local raids in Palestine before A.D. 384 and again before A.D. 420, a renewed and vigorous wave of migration was ushered in over all Arabia after about A.D. 475.

About A.D. 480 the powerful Rabiah tribe left Yaman, and after long years of infiltration, formed the dominant population of the Jazira,[177] taking advantage of the almost uninterrupted anarchy brought about by the Byzanto-Persian wars. Also about A.D. 480, a short-lived coalition of newly immigrated Yamanite tribes formed in the Nadjd, which from its inception to its dissolution raided and devastated Roman and Sassanid territories. This kingdom of Kinda collapsed with the annihilation of its royal family in 529.

In the 6th century more Yamanite tribes moved north, strikingly coincident with the uprising of 542-3. The numerous clans of the Tayy and Qais settled in Syria about A.D. 600 after protracted wanderings through the Hidjaz. After menacing Persia, parts of the Iyad tribe from the Yamanite Tihama were dispersed by Anuswirwan (A.D. 531-578) and subsequently settled in Mesopotamia and Syria. The strong Iyad immigration into Syria reached its greatest intensity in the first quarter of the 7th century.[178] So great was the influx of desert tribes, that large sections even of northern Syria were populated solely

177 Caetani, L. (1907) _Annali dell'Islam_, vol. 2, p. 853

178 _Ibid_.

by settled badu at the time of the Muslim conquest.

This great wave of colonization after A.D. 475, of which a few outstanding examples have been given here, was apparently connected with a deterioration of rainfall throughout Arabia, as postulated in Chapter VI. The tribal legends of the nomads bear considerable historical weight, and in this connection a legend of the Sherarat (of the northern Hidjaz) is most enlightening. There was apparently a great drought in 'the days of Muhammad', during which no rain fell for seven years. The scarcity of water and pasture forced the entire tribe, with a few exceptions, to migrate through Egypt into Africa.[179]

Further climatic symptons can be deduced from the fratricidal 'Days of the Arabians' (ayyam al-Arab), the inter-tribal warfare which brought anarchy into the political realm. The 40 year feud of the Bakr and Taghlib, the 'Day of Basus' ended about A.D. 525 with the exhaustion of both sides. The 'Day of Dahis and al-Ghabra' which broke out in the second half of the 6th century, between the Abs and Dhubian of the Nadjd, persisted at intervals for several decades into Islamic times.[180] Lastly the bitter feud of the Aws and Khazraj tribes of Madina in the days before the Hijra is well known. Even the fanatic struggles of the Ghassanids and Lakhmids throughout the 6th century fit well into the picture of chaotic, internal strife of brother turned against brother, generally agreed to be a

179 D. Carruthers cited by Huntington (1911) op.cit.p.331

180 Hitti, P.K. (1937) A History of the Arabs, p. 89

sign of drought and hard times upon the Desert.

In summary, there was a remarkable but little known immigration into the Fertile Crescent, predominantly of South Arabian tribes, beginning universally after about 475, at a time when the climate of Western Asia was definitely worse than the present, and when the internal decline of Yaman had reached its climax. It was this same undramatic infiltration that was miraculously transformed into one of the world's most spectacular political expansions under the banner of Islam.

3. THE RECEPTION OF ISLAM

An important distinction must be drawn between the two separate social groups which played a decisive part in the early history of Islam. The first such group consisted of the urban merchant of Makka and Ta'if, and the agriculturalists of the oasis of Madina, among whom the religious and intellectual revolution fermented. The other group was that of the nomad badu who carried the political supremacy of Madina and Arabia to the Pyrenees and the Amu.

The majority of the earliest Muslims came from the class of clients or protected persons (mawali) and the slaves of Makka.[181] The cadre of the new society however, came from those companions of Muhammad who fled with him in the Hijrah, and from among his hosts in Madina. These citizens of Madina adopted

181 Caetani, op. cit. vol. 1, p. 240

the new faith as a remedy for the chaos into which Arabia had sunk, to subjugate the passions of men to the discipline of a superhuman code of law.

The badu on the other hand, were only loosely affiliated to Muhammad. The earliest allies were bound by pacts of mutual aid, and Muhammad contented himself with exacting a payment of 'poor tax' (zaka) and a verbal profession of faith.[182] This same tax served to fill the state treasury, which was in turn used to win over interested shaikhs to the cause. For a tribe to become Muslim simply meant that its chief so became.[183] Furthermore, the promise of booty attracted many an ambitious chieftain, and the properties and perequisites obtained through their association with Islam ensured their continued support in times of crisis.

The year 630-31 was the 'Year of Delegations' (sanat al-wufud) when numerous tribes sent delegations to the Prophet to offer their allegiance. That the number of tribes who joined out of convenience, if not of conviction, was large is contained in the words attributed to 'Umar, "The Badu are the raw material of Islam"[184] And so it was when these nomads, bound by a new kinship of religion and a determination arising from want and avarice, went into action under the command of their city brethren. Islam made full use of the tribal system for its military purposes, and divided the army into units based on

182 Hitti, op. cit. p. 119

183 Ibid. p. 141 184 Ibid. p. 119

tribal lines.[185]

The badu were the military arm of the religious movement, and were themselves little interested in matters of religion. Even to the present day, the badawin never pays much more than lip homage to the Prophet.[186] It has been said that the Wahabi movement of the 18th century represented not so much a movement of 'reform', but the genuiune conversion of the badu to Islam.[187] On the other hand, the legislation of the Qu'ran is fashioned according to the customs of city life, for only in a city can all the requirements of the faith be fulfilled in detail.[188] It was the urban and sedentary population that provided the nucleus of the Muslim faith, not the animistic nomad of the Desert.

Consequently, we are attempting to deal only with a migratory movement -- the dispersal of the Arabians, and not of Islam. Islam provided the watchword, and the essential unity which characterized the nomads' eruption, but <u>not the motive</u>. There was no zealous impulse to proselytism, and one can find few traces of any Arabian hordes incited by religious enthusiasm.[189] Only two or three centuries later did the bulk of the conquered provinces profess the faith of the Prophet.[190] Neither was the expansion premeditated in Madina, but until the decisive victories of the Yarmuk and Qadisiya it was carried out with the reluctant consent of the Caliph. It is

185 Ibid. p. 25 186 Ibid.
187 C.S. Hurgronje cited by Wissmann, op. cit. p. 477
188 Grünebaum, V.(1946) Medieval Islam, pp. 173-4
189 Becker, C.H. (1913) in The Cambridge Medieval History, vol. 2, pp. 332, 345
190 Hitti, op. cit. p. 145

only by divorcing the nomadic invasions from the religious upheaval of the sedentary Arabs, that the Muslim Arab dispersal can be envisaged as another great Semitic migration, on a scale similar to that of the Amorites and Aramaeans. The great Arabian migration, as it should be called, also extended over a period of several centuries, namely from about A.D. 475-661 or later. Islam only changed the character of a large-scale migration already well in progress.

4. THE RIDDA WARS

After the death of Muhammad in A.D. 632, a bloody civil war broke out in Arabia which the Muslim authors attribute to the secession and apostasy of numerous tribes from Islam.

However, in the short time involved, and with the complete absence of any organized missionary activity and the lack of communications, not more than a third of the Arabian Peninsula could have professed the new faith or recognized the rule of Madina by this date.[191] Although many tribes will have felt disinclined to continue paying the zaka after the death of Muhammad, the majority of the 'secessionists' had not previously been adherents of the religion, and many had not even been attached to the political state of Islam.[192] In the latter category belonged the Christian tribes of the

191 *Ibid*. p. 141

192 Becker, *op. cit*. p. 334

north, as well as Yaman, Hadramaut, Mahra, 'Uman and Hasa.

The war centred about the political supremacy of Arabia, and the sword of the military genius Khalid settled the score in favour of Madina. The effect of the Ridda Wars of 632-33 was to transform Arabia into an armed camp, and to excite the warlike inclinations of the powerful Central Arabian tribes, so that a northward surge of the victorious troops became inevitable. On the other hand, the South Arabian tribes were temporarily eclipsed, and played no part in the first expansion of the mew Islamic state.

5. THE ISLAMIC DISPERSAL

The first phase of the Arabian migration was a series of unplanned military expeditions, incited by the prospects of booty, and made possible by contemporary political conditions in the Fertile Crescent. The internecine wars of A.D. 572-591 and 603-628 between Byzantium and Persia had fearfully devastated the countryside, emptied the treasuries and squandered the manpower. Added to this were the bitter ethnic and religious antipathies between the indigenous Semites and the ruling Greeks and Persians. Had not a short-sighted policy permitted the ruin of Ghassan and Hira, the Ghassanids and Lakhmids would have presented an almost insuperable obstacle to the Armies of Khalid and S'ad.[193]

193 Becker, *op. cit.* p. 332

The secular aspect of this phase of military expeditions is strikingly illustrated in the part played by the Christian Arabs of the northern frontiers. The first victory on the Iraq frontier in 635 was the work of the local Christian tribe of the banu-Shaiban. Their chief, al-Muthanna, was definitely no Muslim at the time and owed no allegiance to Madina, a testimony of the voluntary cooperation between Arabs of any faith for a common purpose -- the ghazwa. Similarly the assistance of the Christian Arabs in Syria made the Muslim success a reality. When the byzantines withdrew their subsidies from the Christian Arabs of southern Jordan and the Negeb in A.D. 633, most of the tribes, such as the Judham and Quda'a joined the invaders to recoup themselves by plundering raids.[194]

Only after the military expeditions had finally overrun Syria (636) and Iraq (637) did the full-scale Arabian migration begin. The incessant flow of South Arabian tribes once more resumed its course towards the cultivated lands which lay open to them. "These new arrivals did not come in the form of organized troops, but advanced in tribes, bringing their wives and children with them and hoping to find in the new land fertile residential areas."[195] Before this time, the Muslims considered themselves as being on a large-scale ghazwa, but now, the movement took the form of systematic conquests in which, as a rule, entire tribes participated.[196] Thus the systematic occupation of Egypt (after 639) was carried out for the most part, by

194 Ibid. p. 341 195 Ibid. p. 342

196 Ibid. p. 348

impoverished tribes from Yaman. Interestingly, the conquest of the Nile Valley was followed by the large-scale, regular importation of Egyptian wheat by Madina.[197] Chronologically, this period corresponds to the rainfall minimum established above, which is illustrated by the catastrophic and universal drought suffered in Arabia A.D. 640. The heat and drought of this 'Year of Destruction' burnt the soil of Arabia to 'ashes', as the Arab authors put it.[198]

In conclusion, we have some further material which also coincides remarkably well with the climatic chronology. The migration into the Fertile Crescent and Egypt continued for a few years and then appears to have stopped. It is very significant that no Arab nomads settled in Northwest Africa during the occupation of the Magrib (A.D. 670-699); the Arabs settled in the towns but did not occupy the open country.[199] This can point to only one thing -- that the wholesale migration of the badu had ceased before 670, and that the conquest of the Magrib was solely military and political. In fact, the end of the nomad migration could be assigned with some justice to the year 661 when the capital of Islam was transferred from Madina to Damascus, from desert frugality to urban luxury.

6. CONCLUSIONS

We have been able to identify an Arabian migration which

197 Ibid. p. 349

198 Moritz, B. (1923) Arabien, pp. 51-2

199 Ibn Khaldun, cited by Toynbee, op.cit. vol.3, p.324

was already in process 150 years before the Hijra, and which attained a maximum during the lifetime of Muhammad. As an explanation of part of this movement, contemporary conditions in Yaman were briefly described, and the decline of South Arabia was seen to be closely connected with a deterioration in rainfall. In the northern half of Arabia, it was noted previously that the rainfall of the second half of the 5th, and the whole of the 6th century was fairly scant. In the early 7th century, the precipitation of the Near East diminished further, reaching a new minimum about A.D. 640, after which it increased fairly rapidly to conditions somewhat moister than the present.

Islam entered the scene only when the great Arabian migration was in full swing -- and when the rainfall had reached a very low ebb -- as the Sherarat legend and the 'Year of Destruction' lucidly illustrate. Similarly the banu-Asad of the Nadjd suffered from a severe famine in the year 630.[200] Islam changed the character of the migration from an undramatic infiltration and colonization, to a violent and politically-organized military invasion, but it did not alter the motive involved. In this regard one can quote the words of the Persian general Rustam to a Muslim envoy in 637, "I have learned that you were forced to what you are doing by nothing but the narrow means of livelihood and by poverty"[201]

200 _The Encyclopaedia of Islam_, _sub voce_ Asad.

201 Al-Baladhuri cited by Hitti, _op_. _cit_. p. 144

Similarly, a verse of abu-Taiman summarizes the Islamic expansion very strikingly,

> No, not for Paradise didst thou the nomad life forsake,
> Rather, I believe, it was thy yearning after bread and dates.[202]

A glance at the situation in the Eurasian Steppe will give further illumination of this point. In A.D. 552 a demoniac surge of nomad hordes began in the heart of Asia, which hurtled whole nations headlong into the settled lands of Europe and Asia.[203] The Khitan and Turks overran North China; Turks crushed the nation of the White Huns in Western Turkestan in 563-8; Avars, Khazars, Magyars and Huns burst through the Russian steppes between 553 and 568. The overall similarity of Near Eastern and Central Asiatic climatic trends, and the absence of any religious upheaval in the latter area, points emphatically towards a climatic impetus in both cases. Even more intersting is the cessation of the migrations in the second half of the 7th century when the rainfall of the Near East had returned to normal.

By singling out the Arabian migration from the Islamic conquests, and illuminating its development and course before A.D. 622, the essential nature of the movement becomes apparent. The great Arabian migration was a wholesale movement of the Semites, in the same class as the Amorite and Aramaean invasions. In the latter two cases we could, for want of evidence, merely point to chronological correlations between periods of decreased rainfall and migrations. In the former case, which is superficially

202 _Ibid_.

203 Passarge, _op_. _cit_. p. 506

the least apparent of all, it was possible to employ a vast mass of differing material to relegate an economic motive, intimately connected with a diminished precipitation, to first position. In the second phase of the great Arabian migration political, and only lastly, religious, motives and factors came into the foreground, still however subordinate to the economic. The words of T.W. Arnold put the case very tersely,

> These stupendous conquests which laid the foundations of the Arab empire, were certainly not the outcome of a holy war, waged for the propagation of Islam, but they were followed by such a vast defection ~~defection~~ from the Christian faith that this result has often been supposed to have been their aim. Thus the sword came to be looked upon by Christian historians as the instrument of Muslim propaganda, and in the light of the success attributed to it, the evidences of the genuine missionary activity of Islam were obscured. But the spirit which animated the invading hosts of Arabs who poured over the confines of the Byzantine and Persian empires, was no proselytising zeal for the conversion of souls. On the contrary, religious interests appear to have entered but little into the consciousness of the protagonists of the Arab armies. This expansion of the Arab race is more rightly envisaged as the migration of a vigorous and energetic people driven by hunger and thirst, to leave their inhospitable deserts and overrun the richer lands of their more fortunate neighbours. Still the unifying principle of the movement was the theocracy established in Medina, and the organization of the new state proceeded from the devoted companions of Muhammad, the faithful depositaries of his teaching, whose moral weight and enthusiasm kept Islam alive as the official religion, despite the indifference of those Arabs who gave it a mere nominal adherence.[204]

204 Arnold, T.W. (1913) <u>The Preaching of Islam</u>, pp. 46-7

CHAPTER XI

CLIMATE AND NOMADIC ERUPTIONS IN THE NEAR EAST (CONT'D)

1. MIGRATIONS OF THE LATER ISLAMIC ERA

Early in the 9th century A.D. a new wave of nomadic migration began in the Near East, with the movements of the banu-Hamdan. The Hamdan originally came from northern Yaman and took up their new homes in the Jazira by méans of a peaceful infiltration.

In A.D. 890 a new militant religious movement began under the name of the Carmathians, which affected the majority of the migrations of the subsequent century. In 899 a Carmathian missionary converted a badu tribe of the 'Abd-al-Qais in the Hasa. A period of devastation and bloodshed followed in the Near East. In 903 the Carmathians subjugated Yaman and invaded 'Uman; in 914 they invaded Iraq, and in 923 they ravaged the borderlands of Syria. Even Makka was sacked in A.D. 930, and the sacred Ka'aba stone carried off. Making use of the weakness of the Caliphate, the Carmathians were able to continue their reign of terror for another generation or two thereafter.

Elsewhere in Arabia, the movements of the notorious banu-Hilal of the Nadjd-Yaman border began in the early 9th century. Together with the local banu-Sulaim, they sacked the city of Madina in A.D. 844-5, and in the 10th century they joined the marauding Carmathians. Between 975-996 the Fatimid Caliphs forced them to move over to Upper Egypt, after the Carmathian tribes had been pacified. In 1052 the Fatimids, anxious to get rid of these unstable and obnoxious elements, unleashed them upon the unhappy lads of Northwest Africa. As the first Arab badu in the Magrib, they completed the Arabization of Northwest Africa, and left a legacy of anarchy and destruction behind them. Even as late as the early 15th century these barbarians were still terrorizing the Magrib.

In the Syrian Desert, the banu-Asad under their Mazyadi warlords invaded Iraq in 1012; similarly the banu-Kilab, under the Mirdasids, invaded Syria in 1011. Both these tribes originally came from the Nadjd.

This first bout of nomadic activity between approximately A.D. 800-1100 is complicated by the action of several extraneous forces: the impact of the Iraqi military-religious movement of the Carmathians, the disintegration of the Abbasid Caliphate of Bagdad after 861, and the action of the Shi'ite Fatimid Caliphate of Egypt (A.D. 969-1171). Yet a few conjectures can be made with respect to a climatic factor. The epic cycle of the banu-Hilal attributes both their original movement from Bilad al-Sarw into the Nadjd, and their migration into the Magrib to a severe famine.[205] In the climatic chronology it was noted that the rainfall of the Near East probably reached a maximum about A.D. 800 and declined therafter, with the onset of the 'very dry' phase

205 The Encyclopaedia of Islam, sub voce Hilal.

assigned to the period c. 925-1100. If climate played an appreciably part in the early half of this period, it was in the form of chronic famine due to overpopulation resulting from the considerable increase in pasture, flocks and population made possible by the preceding moist phase. This motive, which is suggested by the legend of the Hilal, may have initiated the movement in the early period before any outside factors came into play. The second phase, namely after about A.D. 900 should in all likelihood, be attributed to politico-religious motives than to a climatic factor, although the latter cannot be entirely discounted.

No subsequent migrations in the Southern Steppe took on such a universal character. One can point to two phases of limited effervescence between A.D. 1319 and about 1425, and c. 1650-1700, prior to the politico-religious movements initiated in the 18th century.

The first movement was limited to the Saharan belt. About 1319 an intensified movement of the Juhaina Arabs into the Sudan, through Egypt, set in. The years 1398-1405 and 1412-21 were periods of sore distress in Lower Egypt with badu raids, famine and drought due to the low water of the Nile, and recurring plagues. Lastly the activity of the Tawariq (Tuareg) of the Western Sahara culminated in the conquest of Timbuktu in 1434. It is known from the climatic chronology that the years c. 1310-1428 were 'very dry' in the Near East, coinciding well with this period of effervescence, but it would be inadvisable to assign any conclusive value to this fact.

About A.D. 1650 the Shammar, the last clans to move out of South Arabia, began their trek into the Jazira, followed about 20 years later by the Anaza tribes of the Nadjd. Meeting head to head in the Jazira, these two tribes began a prolonged conflict which lasted several centuries. Eventually the northern Shammar tribes were ousted by the Anaza and forced into Iraq. Thanks to the military prostration of Turkey, the Anaza kept the fringes of Syria in perpetual chaos, even looting the city of Halab before energetic measures were enforced in 1862. It was noted above that the Caspian level of the second half of the 17th century was at least 15 feet lower than that of 1638, and only in the early 18th century did a gradual rise set in once again. Consequently, the sharp decline in rainfall midway in the 17th century shows some correlation with the initial movements of the Shammar and Anaza. The continued unrest of the 18th and 19th centuries, on the other hand, can only be a consequence of the chronic political chaos in the outlying domain of the Osmanlis.

Lastly, the movements associated with the militant religious sects of the Wahabis, Sanussi, and Mahdists deserve attention. Each of these movements waxed and waned according to political conditions in the derelict Ottoman Empire. The violent Wahabi expansion of 1800-1810 into South Arabia and the Fertile Crescent shows absolutely no correlation with any adverse climatic features. Possibly their renewed expansion of 1922-34 may have been influenced by the crop failures incident upon the sharp decline in rainfall between 1920-1934. The Sanussi expansion into Cyrenaica and Wadai during the 1850's might also be associated with the slight deterioration in precipitation at the time, but the upheaval of the Baggara nomads in the Mahdist rebellion of 1883-1899 occurred at a time of bountiful rainfall.

Thus, in effect, the nomadic migrations of four millenia have been outlined, analyzed and contrasted with the climatic data as presented above. If climate appears to have been over-emphasized in connection with these migrations, it has been done so only to present some detailed information from which the climatic hypothesis of migrations can be judged. At the same time however, the possible evidence in favour of alternate explanations has been impartially represented.

2. SYNTHESIS AND CONCLUSIONS

The immediate impression left by such a cursory study of migrations in the Near East is twofold. Firstly it is obvious that there is no simple pattern behind nomadic eruptions. The nomads have erupted during periods of decreasing as well as increasing rainfall, they have invaded derelict as well as militarily powerful states, and they have invaded spontaneously as well as in politically organized bodies. Secondly it is even more obvious that climate never plays an exclusive rôle, but is only one of a number of factors variously involved in each different migration. At times, climate played no visible rôle whatsoever, and even where a climatic impetus appears to be the dominant factor, it is never the sole factor.

In order to present a comprehensive survey of these last chapters, Table VII below has been drawn up. The various migrations have been listed with their very approximate dates and the general rainfall trends of the the time. Added to this are three corresponding columns listing the relative importance of the contemporary climatic trend, the known degree of political organization of the invaders, and lastly, the military condition of the sëdentary nations affected. The three major invasions, i.e. the Amorites, Aramaeans and Arabs, have been capitalized throughout for the the sake of emphasis.

In view of this synthesis, a few conclusions will be attempted.

There is no perfect correlation between nomadic eruptions and any external forces, which stands as a refutation of deterministic concepts. Through this long sequence of migrations it is clear that, despite his dependence upon the whims of nature, the nomad has always displayed a definite initiative of his own. Probably at the instigation of well-

TABLE VII

FOUR MILLENNIA OF MIGRATIONS IN THE NEAR EAST

Date	Tribes	Rainfall Trend
B.C.		
2100-1800	AMORITES	SEVERE DETERIORATION
1750-1600	'Hyksos'	Still deteriorating
1400-1200	ARAMAEANS 1)	ABSOLUTE MINIMUM
1200-800	ARAMAEANS 2)	IMPROVING
725-700	Arabs	? decrease
586-500	Nabataeans	? decrease
127-64	Arabs	? increase
A.D.		
225-310	Yemanites	Decreasing and low
475-660	A R A B S	DECREASING AND LOW
800-1100	Carmathians,etc	Decreasing, then low
1650-1700	Shammar,Anaza	Decreasing and low
1800-1810	Wahabis 1)	Very moist
1883-1899	Mahdists	Improving
1922-1934	Wahabis 2)	Deteriorating

Role of Climate	Political Organization of the Nomads	Military Strength of Sedentary Nations
B.C.		
VERY IMPORTANT	NONE KNOWN	RELATIVELY STRONG
Very important	Organized by Hyksos	Weak
VERY IMPORTANT	HEBREWS ORGANIZED	RELATIVELY STRONG
NEGLIGABLE	PARTIALLY ORGANIZED	POWERLESS
?	Partially organized	Strong
?	Partially organized	Weak
?	Partially organized	Weak
A.D.		
Important	None known	Relatively strong
VERY IMPORTANT	Well organized after 628	INCREASINGLY WEAK
Less important	Well organized	Increasingly weak
Important	None known	Weak
Negligable	Well organized	(Turkey)weak
Negligable	Well organized	Relatively strong
Important	Partially organized	Relatively strong

informed leaders, the nomads have generally taken full advantage of the weaknesses of their sedentary neighbours. Again, the

Semites have usually shown a clear judgement of hopeless military situations by resorting to quiet infiltration, rather than to armed invasion, of powerful nations. Many individual raids or even smaller migrations undoubtedly reflect the military genius and ambitions of one talented leader. In the case of the Muslim Arab eruption, a politico-religious kinship was able to change the character of a large-scale Semitic migration from that of a more or less peaceful penetration to a well-organized and politically-motivated military adventure, which however succeeded only through the military decadence of the Byzantine and Sassanid Empires. Thus, no Arab valour or fanaticism could break the ranks of the Frankish infantry of Karl Martell, or scale the walls of a youthful Constantinople.

It is further clear that there is no hard and fast rule between migrations and external forces, nor is there any visible periodicity in these waves of migration. This stands in direct contradiction to the conclusions of A.J. Toynbee, who believes categorically that the eruptions of the nomads are the mechanical resolutions of inanimate physical forces, displaying a sharp periodicity in 300 year phases of alternating quiescence and effervescence.[205] It takes all the skill and talent of Prof. Toynbee to arrive at such a startling result, at the price of a ruthless and often unjustified elimination of the many details which do not conform to the desired pattern.

205 Toynbee, op. cit. vol. 3, pp. 395-453.

The only correlation which has any justification atall is that of climate and migrations, despite its obvious deficiencies. Of the three major migrations (waves) identified, two, and the initial phase of the third, suggest that climatic variation was the dominant factor involved. And, despite all the exceptions and variations resulting from human capacities, the impetus of increased and prolonged aridity remains undeniable in the dramatic sequence of historical migrations. In this respect, the climatic hypothesis of nomadic eruptions is borne out, and it could be termed the 'ideal case' -- so typical, and so rare. We may conclude that, while <u>climate is generally the dominant factor involved in a nomadic migration</u>, it is nevertheless subject to the innumerable exceptions, qualifications and deviations so common to any general rule, and above all, it is never the <u>only</u> factor responsible.

And lastly, as an afterword to Part II of this thesis, it should be said that whereas the determinists have been too rash and dogmatic in their utterances, they have at least been positive and original. Climate has not played the dominant rôle in the course of Near Eastern history, and it has not played a very decisive rôle, but contrary to the tepid phrases of the possibilists and their kin, <u>it has played a rôle</u>.

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