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Paleo-Beduin and Transmigrant Urbanism

> 'Walking in the torrent bed at Ma'an my eyes lighted upon, and I took up, moved and astonished, one after another, seven flints, chipped to an edge; we must suppose them of rational, that is an human labour. But what was that old human kindred which inhabited the land so long before the Semitic race?'
>
> DOUGHTY, 1888

The answers came almost a century after Doughty's question: from Beidha nearby (Kirkbride, 1966) and Jericho (Kenyon, 1979), and more recently from Ras en-Naqb (Henry, 1979); and also from the semi-arid lands to the east. No desert has always been empty of mankind, or without relevance to the lands about it. This paper deals with such a region and its neighbours, and with a recognizable pattern as old as those seven flints of Ma'an.

I Paleo-beduin (FIGS 1–7)

During the post-Glacial period man probably lived in the Black Desert of Jordan, Syria and Saudi Arabia—the Basalt Barrier (Baly and Tushingham, 1971)—as early as 10,000 BC, if not before: some flint bladelets were found near caves in wadi Rajil near Jawa and Natufian material was discovered near Der'a in southern Syria (Cauvin, 1973). However, the bulk of physical evidence comes later, though precisely when has remained a mystery until now. The abundance of man-made structures in this 'desert' always implied a once intensive occupation, as noted by Rees in 1929: '. . . it is possible that it (the Black Desert) supported a large permanent population in some past period or periods.' He, among many others, referred to stone hut circles and the 'desert kites' and the only clues available then came from the beduin who said that these things in general belonged to 'olden times . . . the fathers of the fathers of our fathers already found them' (Aharoni, 1946); or, of 'kites', that 'these walls are not of the Arabs, but the Romans . . .' (Poidebard, 1934). Perhaps the best tale comes from Maitland (1927) who first published accounts of the 'kites'. His beduin friends referred to them as the 'Works of the Old Men in Arabia', possibly the pre-Islamic Arabs and folk before even them; in other words, the Paleo-beduin of Arabia.

In function the two structural enigmas, hut circles and 'kites'—the latter star-shaped enclosures with radiating stone walls kilometres long—are complementary, reflecting desert ecology: shelter and food production. It is possible therefore that more intensive study will demonstrate a direct link between them, evincing a highly organized and cohesive subsistence economy. The evidence most recently collected is fragmentary—hence evaluation most preliminary—but already evocative of a kind of prehistory in Jordan's Black Desert hitherto unsuspected (Betts; Helms, 1977a, 1980).

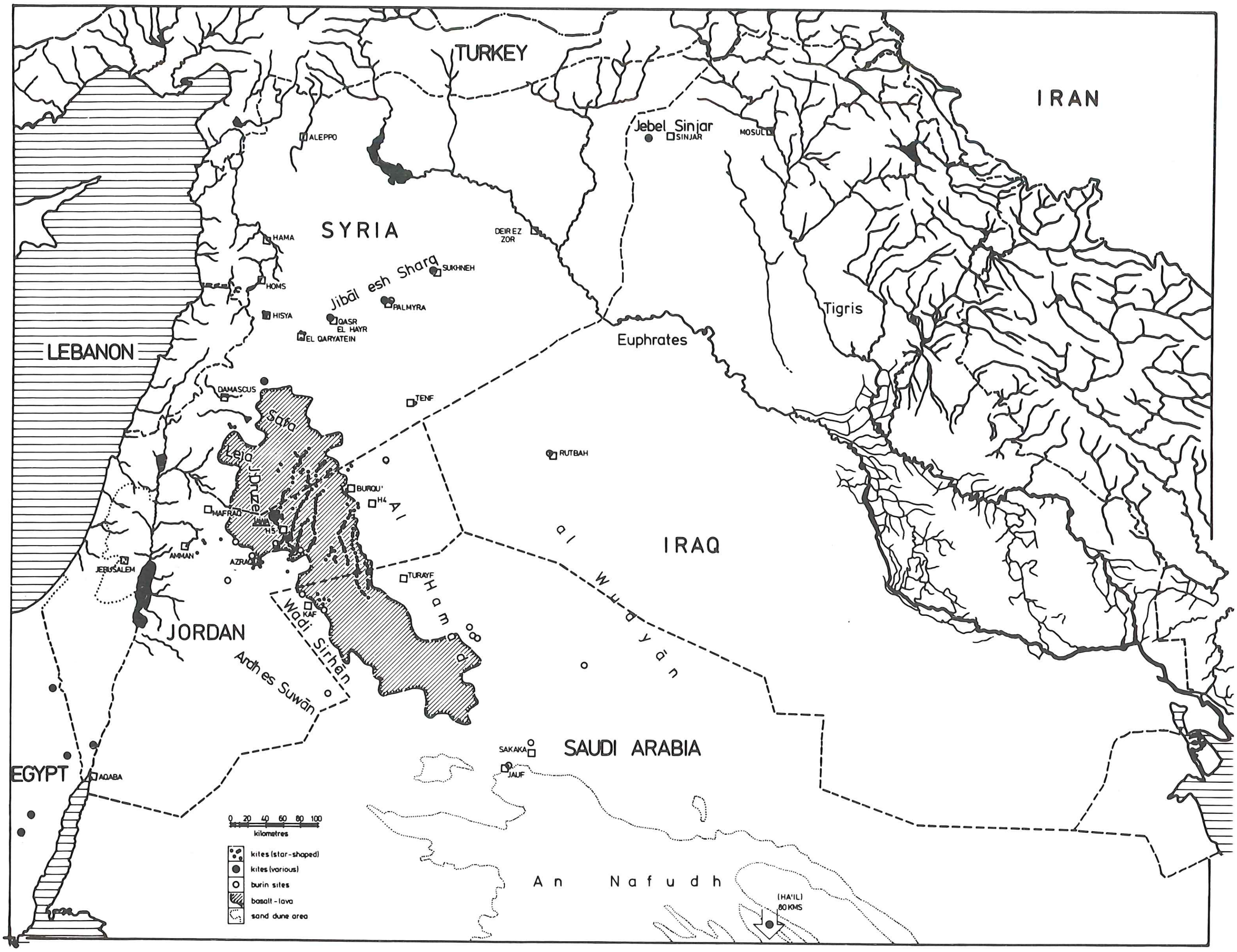
Beduin sites (B) (FIG. 3)
These represent most recent nomadic activity and might be considered as spanning the last thousand years. They divide into three types: camp sites with hearths and lines of stones to hold down the flaps of tents; hut circles and corrals (some very recent, others re-using older structures); and graves with cairns.

Safaitic beduin sites (S) (FIG. 3)
Often over-built by modern beduin sites (B), these are characterized less through artifacts (Roman/Byzantine ribbed wares) than through the profusion of Safaitic inscriptions and drawings about them. In building style they resemble the modern sites.

Hut circles and corrals without flint (C2) (FIG. 3)
Irregular clusters of sub-circular structures, they vary in size and complexity and also location, some lying on the basalt/mudpan margin, some on sheltered slopes and others on the tops of promontories. Their resemblance to site types S and B places them next in this tentative sequence.

'Jellyfish' (C1) (FIGS 3 & 4)
There are now several groups of these strangely formalized sites known in Jordan. They are regularly shaped, 20 to 50 metres across, usually made up of two concentric circles of low stone walling divided into segments by radiating walls.

1. Map: Middle East.

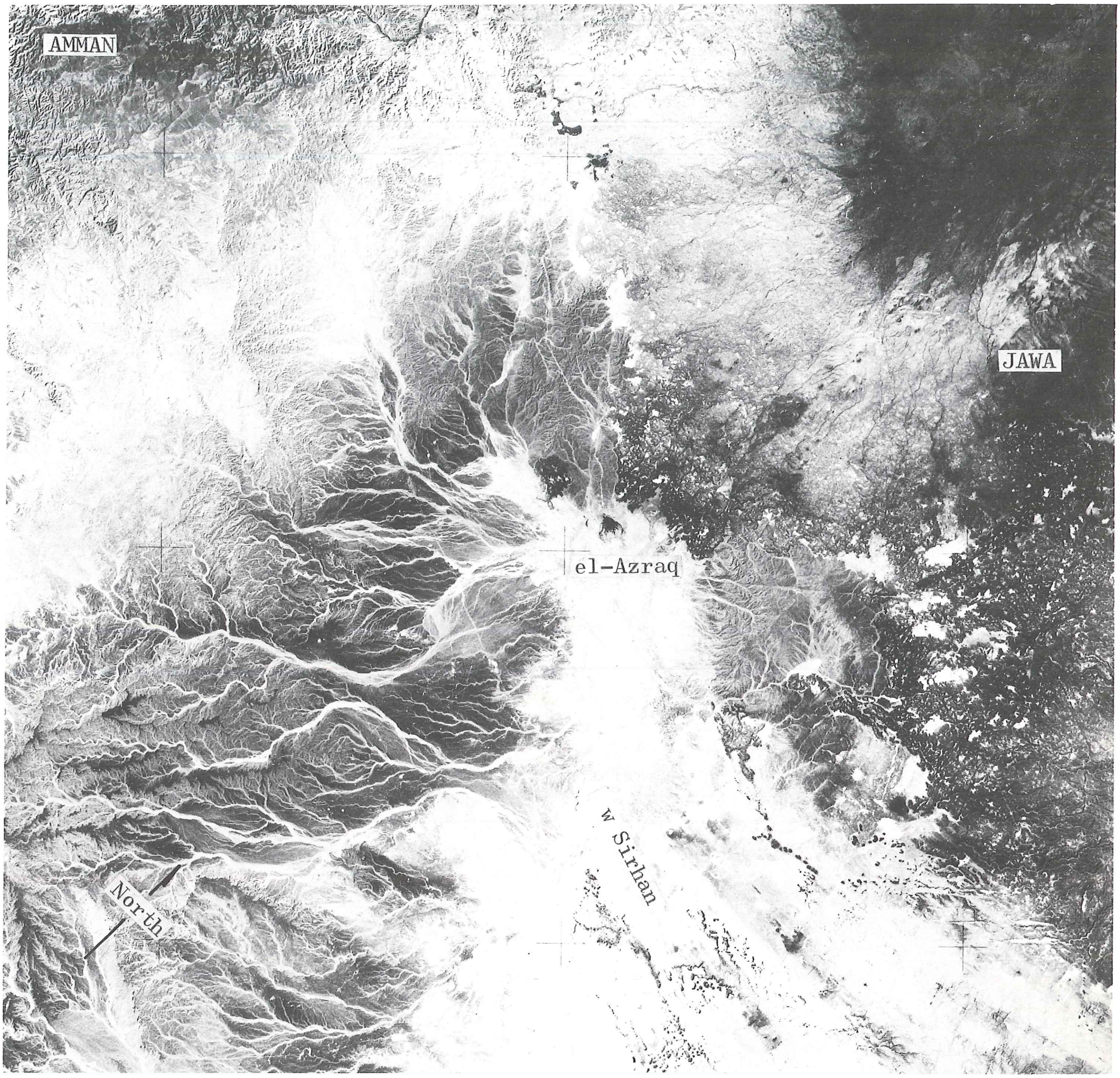


Some have hut circles attached to their outer ring and several have complicated entrances. There is no actual dating evidence available yet, but a very early date is suggested since the walls are low and eroded compared to the sites discussed so far, two examples incorporate 'kite' walls, one site (QMJ 14J) has burins (see below) inside it which would mean that it pre-dates the adjacent burin sites and finally, the 'architecture' resembles that of Munhata 3 (FIG. 4) dated in the Pre-Pottery Neolithic (B) period (PPNB) (Perrot, 1964).

Hut circles with flint (C2) (FIG. 3)
Their shape, layout and distribution is the same as the undated C2 sites noted earlier, but for the first time dating evidence was found. The C2 sites at Qa'a Mejalla (Betts) contain concave truncation burins (FIG. 5: 5–8) together with various types of awls, borers and scrapers of the PPNB period. At wadi Dhobai (Waechter and Seton-Williams, 1938) identical burins are associated with naviform cores (also PPNB) and projectile points which are basically PPNB in form but with a rather more elaborate retouch (similar to the 'kite' points) which is normally attributed to the Late Neolithic period. In addition, these C2 sites also contain tabular scrapers, including one type said to occur only in the Late Neolithic (Moore, 1973). There are some tentative and rather dubious parallels with some of the Jawa flint assemblage (see below, FIG. 10).

Knapping sites (C3)
These occur mostly on hilltops and include scatters of waste, blanks, roughouts and cores. There is no associated architecture. Diagnostic artifacts consist of naviform cores and tanged points of the PPNB period. The cores are the same

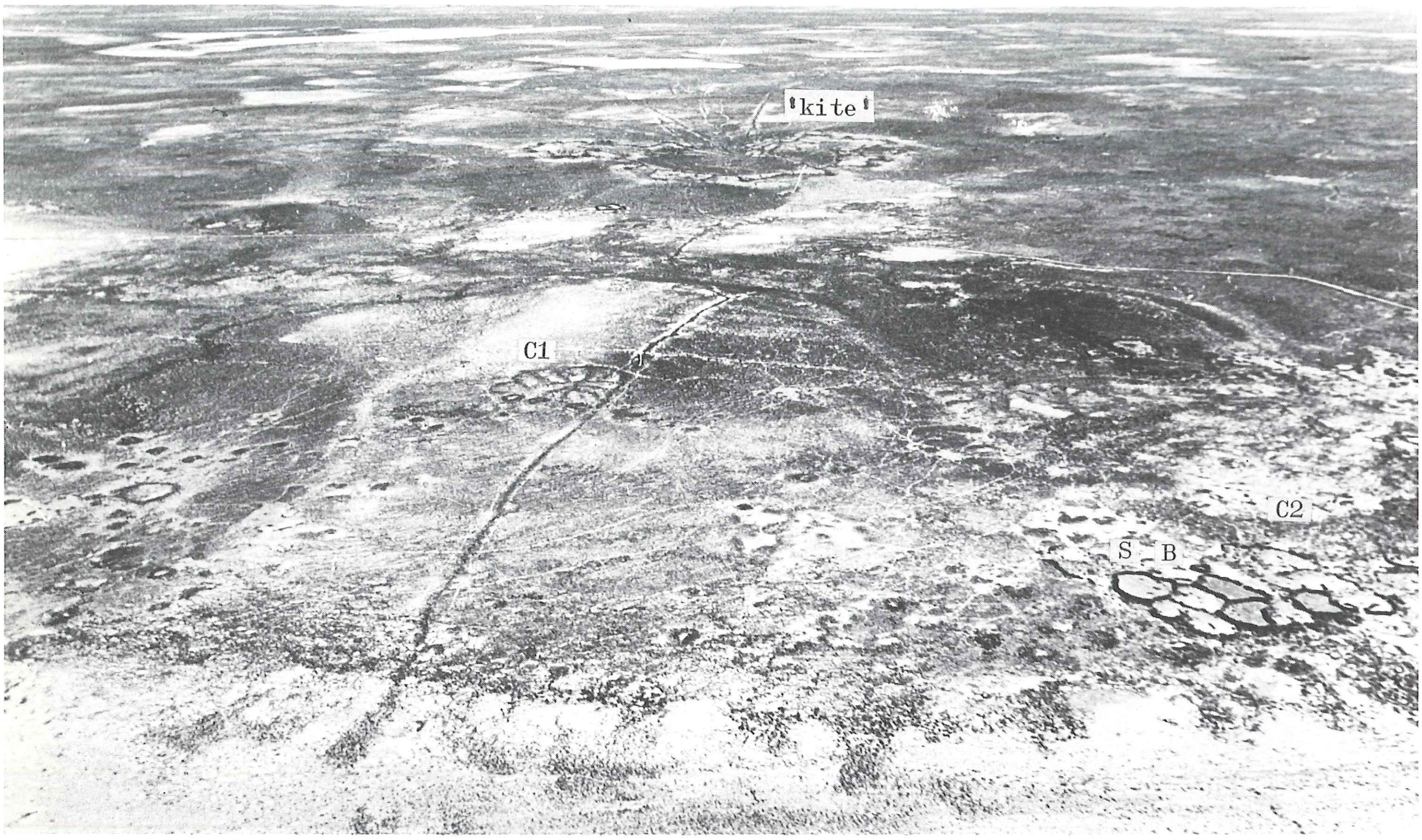
2. Skylab 1: 2, 820, 434 Jordan, Syria, Saudi Arabia.



as those found in wadi Dhobai, but the points—although the same basic type—are shorter in the tang and less carefully worked. They are therefore probably earlier in date.

Desert kites (K) (FIGS 4, 5 & 6)
Whereas the function of the sites noted so far is clear—the Neolithic ones certainly are the shelters and working areas of a semi-nomadic folk—that of the 'kites' has remained obscure throughout the long discourses that followed their discovery after World War I. Two views prevailed: the 'kites' were fortified corrals for domesticated animals (Rees, 1929; Kirkbride, 1946; Harding, 1953, Yadin, 1955, Eissfeldt, 1966; Ward, 1969); or they were gazelle traps of uncertain date (Crawford, 1929; Dussaud, 1929; Field, 1960; Meshel, 1974). Crawford quoted an appropriate ethnographic parallel from Burkhardt's *Notes on the Beduins and Wahabys* (1831) describing the gazelle hunt in the Syrian Desert which entailed leading animals along walls and forcing them to leap through

3. Sites B, S, C2 and C1.



gaps into a ditch. Many similar parallels have since been quoted, all pertaining to the hunt and all of them demonstrating, in general, the true function of the 'kites'. However, detailed application of much later ethnographic parallels can be misleading without field confirmation and in this lay a source of confusion.

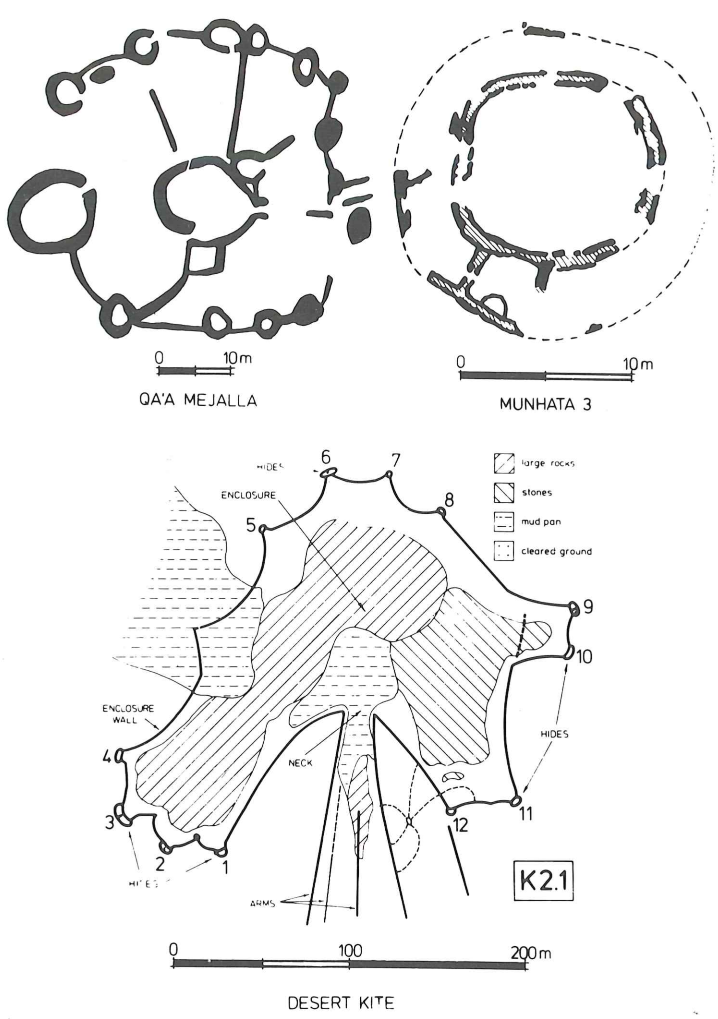
The 'desert kites' divide into two groups, in a very general way: small single-chambered traps, apparently the only type to be found in the Sinai peninsula (Meshel, 1974), but also encountered in Jordan at Jawa (Helms, 1975a) and elsewhere in the Black Desert (air photographs: NRA) thus negating the idea that two separate sub-species of gazelle were exclusive to each region (Meshel, 1974: *gazella dorcas* in Sinai and the Negeb Desert and *gazella subguttorosa* in Jordan); and second, large star-shaped enclosures c. 150 metres across with rounded protrusions and radiating arms often c. 2.5 kilometres long (average). The protrusions of the second group are not 'defensive embrasures' as argued by some, nor are they traps as Meshel has suggested, but simply—and logically—hides for the hunters. This is obvious even now: the hide walls facing the enclosures are higher than any others in these 'kites'. Gazelles would thus never be tempted to jump over them, no matter how intense their fear and panic.

The distribution of 'kites' remains a somewhat open study as does, to some extent, their use throughout time and only the second, larger types can be discussed further now (FIG. 1). There are a number of sub-types—this much is clear from air photographs, even the very early ones (Poidebard, 1934)—but one distinctive type, the star-shaped one, appears in chains according to our surveys. The radiating arms are linked to obstruct the westward migration of gazelles, to allow spotters (on knapping sites?) to predict their course and direct hunters to the relevant enclosures and hides. These chains of 'kites', very roughly, number between 8 and 10 and represent well over 1,000 individual 'kites'—or, roughly, about 4,000 kilometres of stone walls: c. 7 million tons of basalt which is about the weight of Kufu's pyramid at Giza. They span the central area of the Black Desert. Individual 'kites' of this type (at present not associated in chains or dated) reach as far as the Nafudh Desert of Saudi Arabia (Adams and Parr *et al.*, 1977) and as far north and east as Jebel Sinjar via Sukhneh in the Jibal esh-Sharq of Syria (Poidebard, 1934).

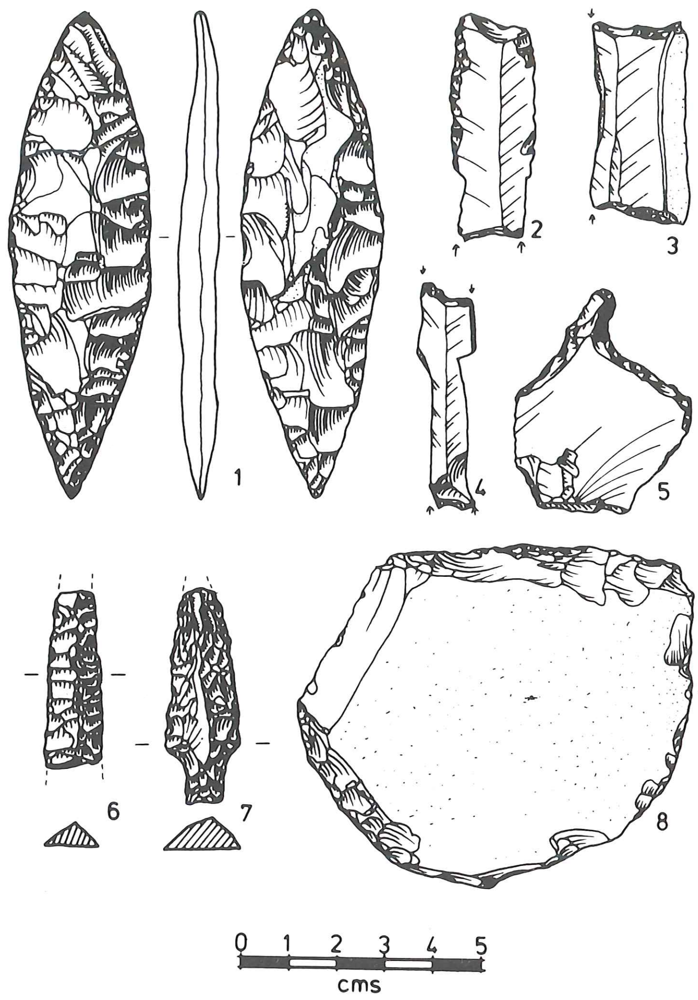
We have now dated some of these chained star-shaped 'kites' and at least qualified the Safaitic date proposed by Harding (1953) and the unsatisfactory interpretation of Yadin (1955) already properly countered by Ward (1969), and introduce a quite new idea of desert life.

A cache of spearheads was found in a 'kite' trap at Qa'a Mejalla (Betts) (FIG. 5: 1). These points are paralleled in the

4. Plans: Site Types C1, Munhata 3 and 'kite' K2.1.



5. Flint: Lance Point, Arrow Heads, Burins, Borer.



late 6th millennium Amuq A period (Braidwood and Braidwood, 1960) but due to the rather crude nature of working they could possibly be late PPNB. Farther north similar chained 'kites' near wadi Rajil produced projectile points from the enclosures where after all one would expect to find them (FIG. 5: 2–4). These show fluted retouch, again usually related to the Late Neolithic period, that is to the early 6th to late 5th millennium. However, they are also identical to points from wadi Dhobai, supposedly there stratified with PPNB burins. A general time span for the floruit of this broadly distributed 'kite' system then must be from the 7th to the 5th millennium.

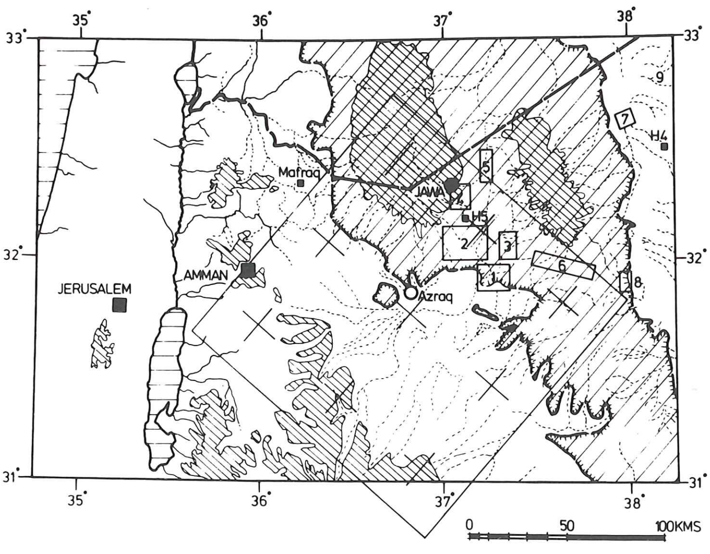
We have therefore begun to reveal a highly organized system of hunting technology as well as—though as yet not strictly related—relatively dense semi-permanent settlements: a subsistence architecture in this semi-arid region of Jordan which implies a large cohesive paleo-beduin population between the 7th and the 5th millennia. At this time, during the Neolithic period, more permanent settlements based more exclusively on agriculture and perhaps also trade appeared in the verdant hilly flanks of the Taurus and Zagros mountains and at several oases beyond the Black Desert—in the hitherto much more fully documented Fertile Crescent. The almost timeless scene to be was set and remained essentially unchanged up to and well beyond Gertrude Bell's description of the 'Desert and the Sown' in 1907—and the relationship between the two regions is represented by the next chapter of prehistory in the Black Desert.

II **Transmigrant urbanism** (FIGS 8–14)

The hypothesis advanced here so far visualizes a large successful beduin population in the Black Desert up to the 5th millennium—that is up to the Late Neolithic period. We have absolutely no artifactual, datable evidence for human occupation from then on until the late 4th millennium. But just as we must accept a human 'continuum' from Safaitic times (AD: 3rd/4th century) to the recent beduin presence here without much tangible evidence, so must we regard the millennium between the floruit of the 'kites' and the advent of Late Chalcolithic/EB I Jawa (Helms, 1975a, 1976b, 1977a, 1980). Hypothetically however, we must also postulate a decline in population and explain this dominantly through the relatively

6. 'Kite'.

7. Map: Transjordan Survey Areas 1974–79.



unstable demographic equilibrium across the Desert/Sown interface: in this case an ever intensifying trend towards urbanism in the verdant regions east, north and west of the Black Desert. Thus by the late 4th millennium, while the first recognizable economic-urban systems had appeared in Mesopotamia/Syria, while a chalcolithic agrarian village culture still flourished in Palestine, the basaltic desert areas were inhabited by the heirs of the 'kite' builders. The paleo-beduin of that time were still living in much the same way: semi-nomadic, hunting, gathering, herding (perhaps), possibly practising ephemeral agriculture when the rains were good and trading across the Desert/Sown border as a minor part of their desert economy. They may even have taken their flocks into the more verdant areas.

The date of Jawa[1] is given by ceramic and lithic assemblages, the former having affinities with Late Chalcolithic Ghassul (IV), the so-called Proto Urban A and B or EB I tradition of Palestine, early Amuq G and Hama K of Syria (full analysis in preparation). The flint tools of Jawa bear no resemblance to the lithic material presented so far in this paper. They belong to the later stages of Ghassul in general and already include Canaanean blades typical of the Early Bronze Age (Duckworth, 1976)[2]. We are, therefore, dealing with a large and heavily fortified settlement of the late 4th millennium.

According to the essentially ceramic-based interpretation of later prehistory, this period was one of extensive migrations in the Near and Middle East; the first recognizable of many that have been part of the grand demographic pattern of these regions ever since. The causes are varied, but often of two fundamental kinds: natural disasters and man-generated violence based in greed. The former is essentially neutral though often explained mystically as divine retribution; the latter the fruit of developed economies, measurable in refugees (new ceramic typologies, for example)—a negative symbol of an aggressive urban imperialism. Thus the earliest accounts regarding the natural or supernatural causes and those man-made ones have described the pattern in folk tales which millennia later could be invoked successfully as prescriptive justification of yet another turn in the demographic cycle, to create the most recent migrations in the Near East.

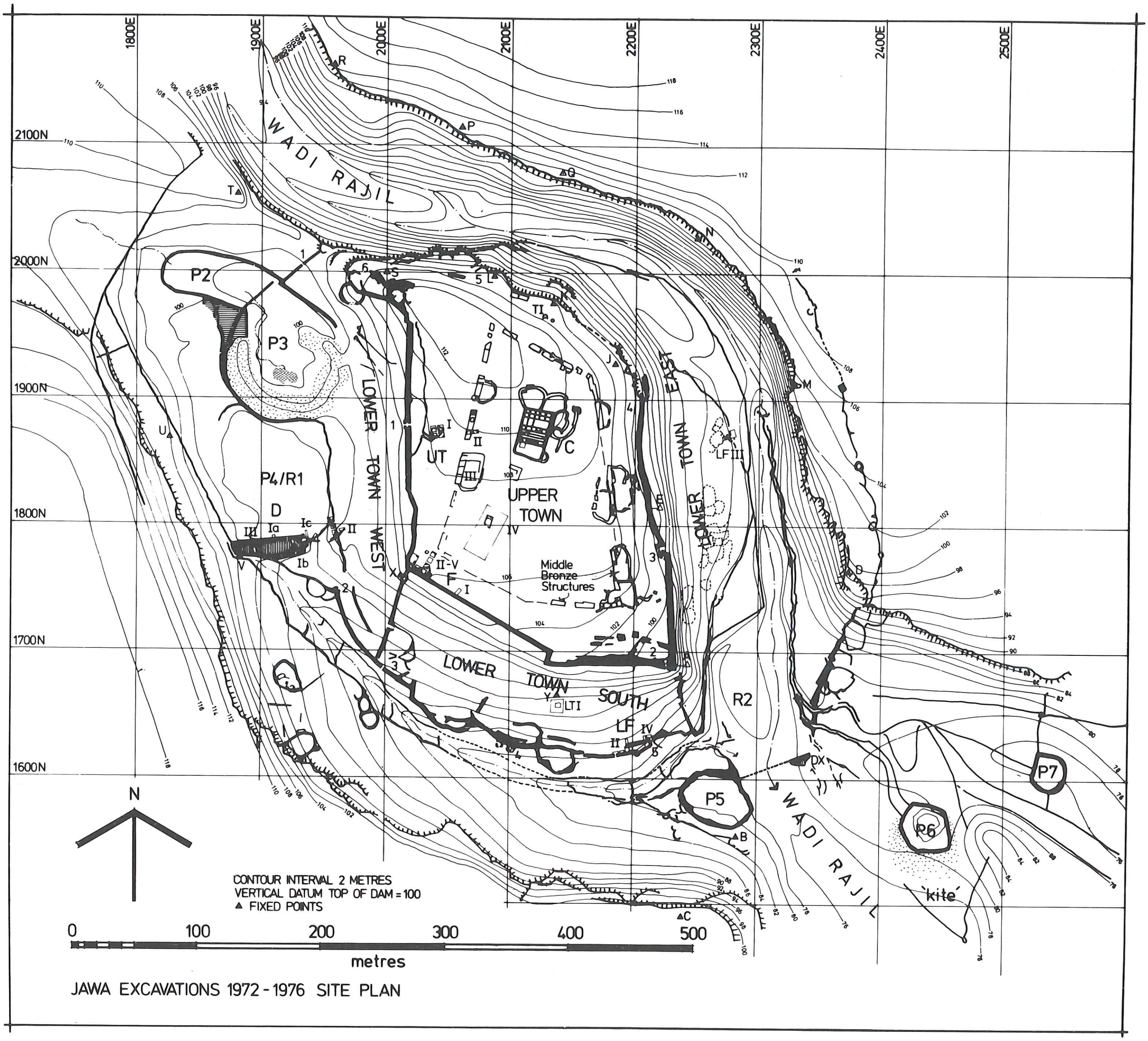
It is in this bleak but realistic light that we should look at Jawa in relation to the Black Desert: as the product of some prehistoric exodus that forced a developed, even civilized people to wander and settle, almost by accident, in a hostile alien land; to impose an urbanism, transplanting a way of life and grafting it onto the basalt region where nothing like it had ever been before and where later on in history all such grafts were the intrusive products of external cultures. Due to the accidental, even paradoxical nature of this large and apparently unique settlement of Jawa, because the people who built the town were themselves migrants of a kind (perhaps refugees) and because they stayed but a few years, we may call this stage of the story transmigrant urbanism.

That Jawa represented something quite new to the remnants of the 'Old Men' in Arabia is clear when we note the scale, scope and design of the heavy stone fortifications (FIGS

[1] The final study of pottery is being prepared and will appear in a second volume, *Excavations at Jawa: Technical Studies* (S. W. Helms, editor). Preliminary work indicates that close parallels exist with north Syrian assemblages such as that from Habuba Kabira (cf. Sürenhagen, D. *Keramikproduktion in Habuba Kabira*, Berlin 1978).

[2] The final analysis of flint tools from Jawa will appear in *Excavations at Jawa: Technical Studies*.

8. Jawa: General Site Plan.

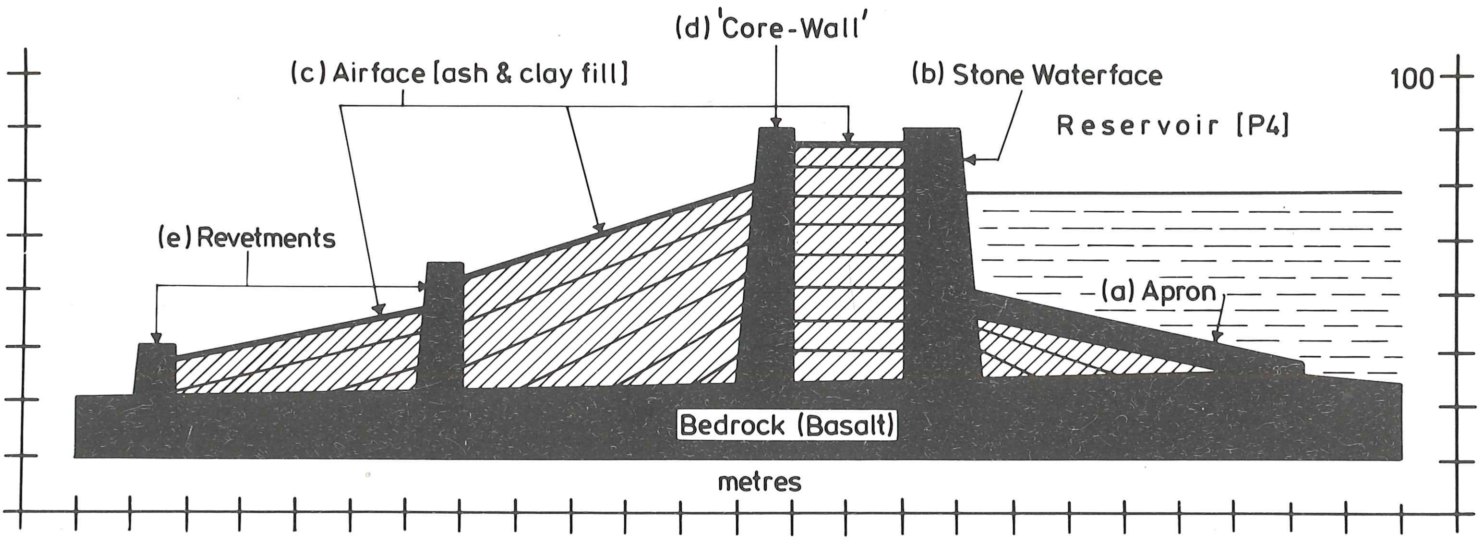


9 & 13). The walls of the upper town—the controlling centre of the founders (Jawaites, for lack of a proper name)—are an average of 4.5 metres wide and once stood at least 6 metres above the ground. Those of the lower three quarters were smaller, but of similar design, enclosing a total area—including the upper town—of about 100,000 square metres which, by Early Bronze Age urban standards of Palestine a few years later, ranks Jawa among the biggest urban establishments known (compare FIGS 17–19). There are, furthermore, over a dozen well designed gates, some of which represent a type of chambered gate not generally used in military architecture until the Middle Bronze Age over a millennium later. But the most fantastic aspect of this early town in Jordan's Black Desert is its water supply which must, according to the hydrological reality of the land, derive from short and fickle winter rains and be stored throughout the long hot summer.

Two catchments were combined at Jawa (FIG. 10) and it is a measure of that town's technological brilliance that both were essential despite the one being vastly larger than the other. Wadi Rajil—the macrocatchment (MC)—originates in

9. Jawa.

10. Jawa: Dam D1 (Schematic Section).



Jebel Druze, covers about 300 square kilometres and today receives an annual precipitation of c. 245 millimetres which amounts to c. 70 million cubic metres of water entering the catchment in an average year. It has been estimated (NRA) that about 2 million cubic metres of water are discharged annually at Jawa. The microcatchments (mc) consist of several deliberately linked areas next to the town site (System I) and two separate areas (Systems II & III) whose dimensions and yields may be summarized as follows for an average annual precipitation of 150 millimetres.

Syst.	(mc)	area (ha)	slope (%)	runoff (m³/ha)	yields (m³/yr)	sub-total
	C1	38	2.5	200	7,600	
I	C2	98	2.3	150	14,700	39,550
	C3	115	2.6	150	17,250	
II	C4	16	6.7	220	3,520	
III	C5	143	6.0	160	22,880	
Total					65,950	

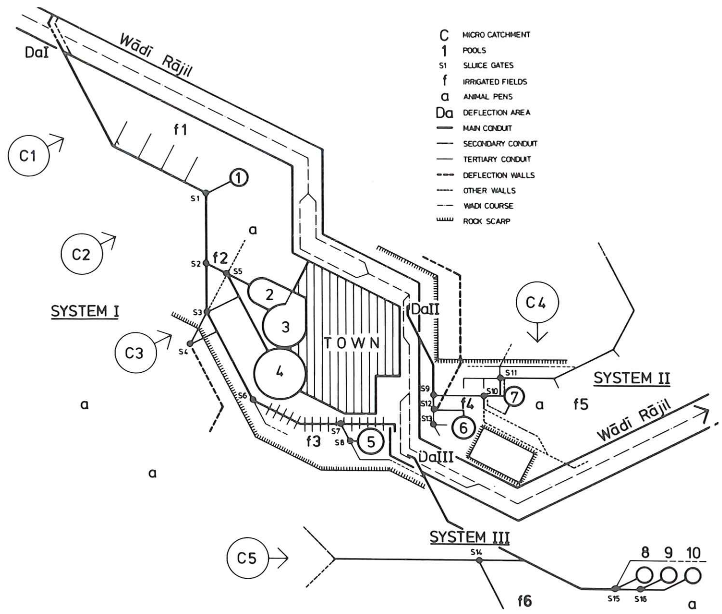
The general principle of the water system of Jawa is shown in FIG. 7. Water from the macrocatchment is deflected by dams from wadi Rajil into three separate systems of gravity canals leading to storage areas. These canals also form the baseline of the various microcatchments, all of which are supplemented by deflection walls along watersheds and cliffs in order to redirect surface runoff. In system I, the largest because it supplies the municipal water storage area (P2, 3, 4), the canal is capable of discharging water into fields as well as into animal watering points: for example, a subsidiary canal leads from sluice gate S1 to an underground cistern formed in a lava-flow cave; a by-pass or spillway leads water past storage area P4 to a second animal watering point at P5. Similarly the canals of system II run via sluice gate S9 to either animal watering point P6 or P7. System III is devoted to irrigating fields below the canal and supplying animal watering points P8, 9, 10.

Jawa not only represents an advanced knowledge of hydrology and hydro-dynamics but also an understanding of water conservation and probably also an appreciation of sanitary science by the careful segregation of human and animal watering points. This is something that stands in some contrast to the later Early Bronze Age Systems, as we shall see.

Stone pens and corrals (a) are sited next to the animal watering points and just below the cistern P1 stands a large rock upon which is carved a herd of cattle. We may (cautiously) relate these illustrations to late fourth millennium Jawa since the faunal remains of the site include a percentage of *bos taurus* (8.5 per cent) which, in terms of dietary importance (relative weight of meat per animal), exceeds even the ubiquitous sheep/goat (Köhler).

The task of storing water through the dry season—up to seven months or more—is a challenge, even in modern times. Obviously the Jawa system functioned, if only for a short

11. Jawa: Schema of Water Systems.



time, and so we must add another feather to the Jawaites' prehistoric technological cap by stating that the dams of the site were amazingly successful and even modern in structure. They consisted of a stone water face above an apron, a stone corewall and earth/ash fill (low terminal infiltration rate) and a stone revetted earth/ash airface (FIG. 10). Storage capacities have been estimated as follows, where V is the absolute capacity, VA the corrected one for animals, VH the corrected one for human beings. Volumes are in cubic metres.

total	pool	area (m.²)	V	VA	VA total	sub-VH	VH total	sub-system total
	01	—	500	500		—		
	02	2,300	5,994	—		4,000		
I	03	5,000	21,749	—	4,300	15,500	42,000	46,300
	04	8,400	30,821	—		22,500		
	05	1,660	4,989	3,800		—		
II	06	1,250	3,771	2,800	3,800	—		3,800
	07	530	1,325	1,000		—		
	08	380	950	700		—		
III	09	280	707	500	2,000	—		2,000
	10	430	1,075	800		—		
Totals					10,100		42,000	52,100

So much measurable evidence is available that we may attempt further calculations. We may, for example, estimate a relatively sound population range for the fully developed town based on average dwelling unit area. This gives a figure between 3,000 and 5,000 people. From this, based on analogous data (Evenari *et al.*, 1971), an average monthly consumption rate can be derived (taking the higher population) which is about 1,200 cubic metres. Animal consumption, weighted according to the percentage of species present, would boost this to a total monthly requirement of 1,800 cubic metres.

Given the data regarding average annual water yield (mc + MC), the storage capacities and consumption rates, could all of this really have worked? It obviously did, for the ruins are there to prove it. But may we reasonably apply modern climatic data (NRA) to a time over five thousand years ago in order to test the systems as we have discovered and partly reconstructed them?

We assume that the Black Desert was then as it is now: that during the last five thousand years fluctuations in climate may have occurred, but no major changes. Certainly the formation of this volcanic land partly supports this (Bender, 1968). If we then do this and test the evidence, the results are as follows, demonstrating one of the first and earliest yet analyses of man's hydro-technology by reconstructing the water balance of ancient Jawa.

The basic water balance equation is: Inflow = Outflow ± Δ Storage which, adapted to Jawa's life support systems becomes:

$$mc_s + mc_i + MC_s + MC_i = E + C + I \pm \Delta St$$

where $-_s$ represents water meant for storage, $-_i$ water for irrigation, mc and MC the micro- and macrocatchments respectively, E losses (mainly evaporation) weighted according to probable monthly totals, C the animal/human consumption rate (1,800 m.[3]), I the total irrigation requirements and St the end-of-month storage in the various pools and reservoirs.

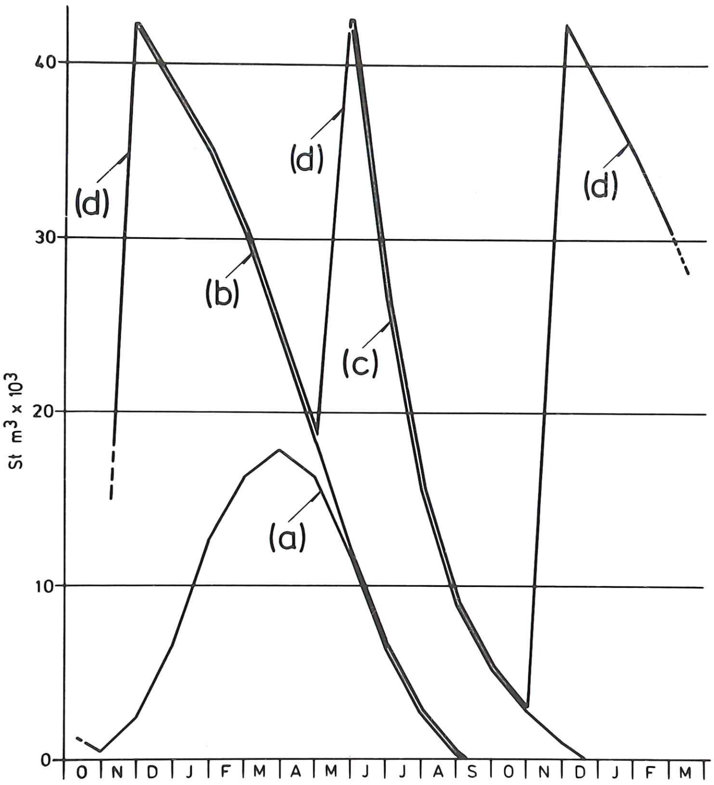
To show the interdependence of the two separate catchments as well as the probable behaviour of discharge at Jawa, four hypothetical situations may be cited:

a) $mc - (E + C)$: water yield from microcatchments alone;
b) $MC^{no} - (E + C)$: water yield from macrocatchment alone, November flood;
c) $MC^{my} - (E + C)$: macrocatchment alone, May flood;
d) $MC^{no} + MC^{my} - (E + C)$: macrocatchment alone, November and May floods.

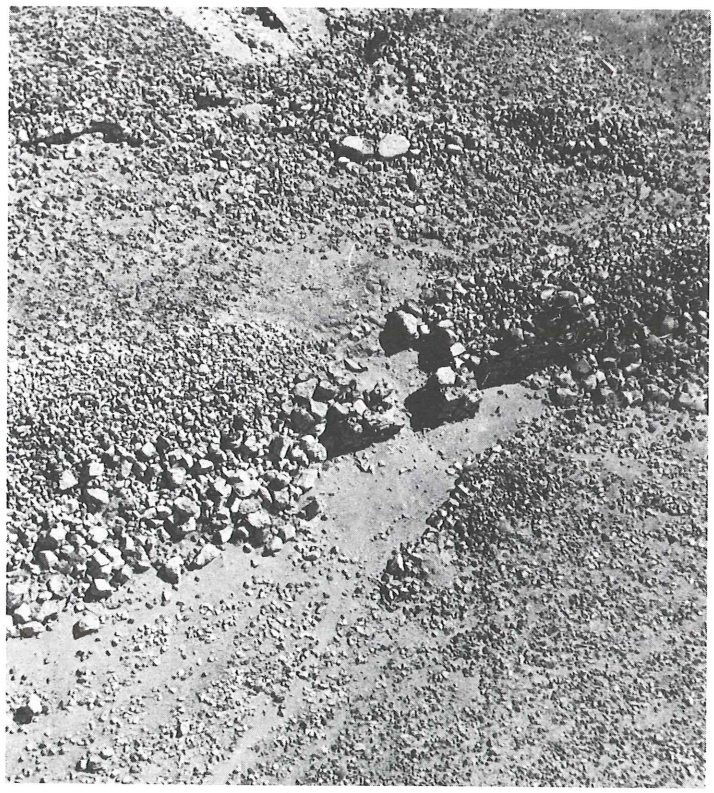
We note that only situation (d) avoids failure (FIG. 12) and that only because of an unnaturally biased distribution of peak floods in wadi Rajil. But when the two catchments are combined and their input as well as losses are weighted according to probable quarterly totals, the following estimate (see table) of Jawa's optimum water balance is achieved regarding system I, the most vital to the ancient town.

The archaeological/structural evidence at Jawa implies that this high and successful level of technology was achieved in a very short time—perhaps no more than two or three years—and that it soon disappeared. Among several proofs of this are two dominant facts. The upper town of Jawa was attacked: walls were breached in the west and south sectors and this was followed by a short period of re-occupation without any marked changes in material culture (FIG. 13). Second, the water systems were 'renovated' to accommodate a larger

12. Jawa: Situations (a) to (d).



13. Jawa Fortifications.



quarter	month	mc totals	INPUT						OUTPUT					±ΔSTORAGE	
			mc_s		mc_i	MC_s		MC_i	E		C		I	St	
			H	A		H	A		H	A	H	A		H	A
I	N D J	18.24	05.81	01.39	11.04	—	—	—	00.85	00.29	03.48	00.75	11.04	03.00	01.15
II	F M A	17.56	09.04	01.80	06.72	44.43	03.82	12.24	19.54	02.20	03.48	00.75	18.96	33.44	03.83
III	M J J	01.42	00.72	00.70	—	—	—	—	22.25	02.86	03.48	00.75	—	08.44	00.91
IV	A S O	02.33	01.06	01.27	—	—	—	—	04.50	00.63	03.48	00.75	—	01.52	00.80
		(39.55)	16.63	05.16	17.76	44.43	03.82	12.24	47.14	05.98	13.92	03.00	30.00		
					100.04						100.04				

(amounts in $m.^3 \times 10^3$)

population but this new scheme failed principally because it departed from what had gone before. Therefore we conclude that a human tragedy occurred at Jawa near the end of the fourth millennium and that quite possibly a second stage of migration ensued for the technocrats of Jawa, leaving their advanced life support systems in the hands of the latter day 'Old Men' in Arabia.

In a very short time indeed—especially for prehistory—part of the great demographic cycle repeated itself on an albeit small scale and, it seems, a 'civilized' people twice dispossessed once more set out to wander in the wilderness, taking their idea of a city with them.

III **The desert** (FIG. 14)

Jawa had no apparent effect on the life style of whatever nomadic folk continued to live in the Black Desert. The life support systems of the site failed and whoever had inherited or conquered Jawa, lost interest and returned to the more normal way of the desert. Thus again the cycle: the Jawaites continuing in search of their lost city; the semi-settled beduin returning to the nomadic life they had known before the transmigrant intrusion.

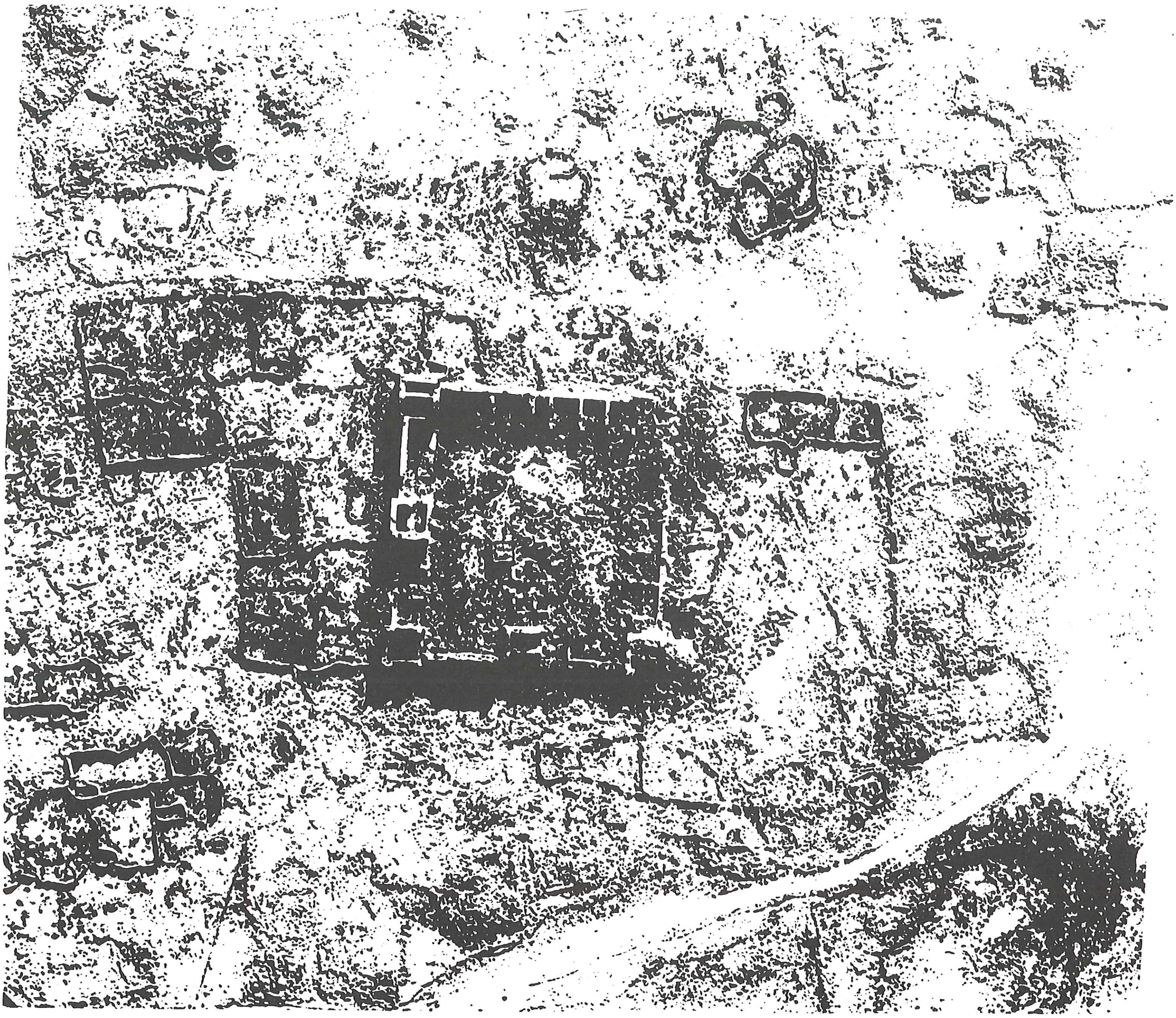
We suggested earlier that the archaeological evidence to hand implied a decrease in human activity during the millennium preceding Jawa. Now, after Jawa and into the third millennium, there is again virtually no recognizable human presence in the Black Desert and yet—as always—we must accept that no semi-arid lands are ever entirely empty. This negative evidence then could be understood as a further population decrease and one very obvious causative factor in this would be the increasing urbanism in the verdant areas of the Near and Middle East. In other words, the equilibrium between the Desert and the Sown was tipped more strongly (and irreversibly?) towards the static, nucleated, agrarian, mercantile style: accommodating and, of its own, generating more people.

In the desert, after Jawa's brief transmigrant urban interlude, the pattern of urban-based intrusions can be seen to continue, Jawa merely being the first of many. Albeit they are few in the early periods and long between, but they also demonstrate a part of the grand scheme.

At Jawa itself we have the ruins of a Middle Bronze Age complex (FIG. 8) made up of a centrally placed two-storeyed 'citadel' with roofed corridors and cells, surrounded by broad-roomed houses with forecourts describing a rough pentagon. This complex was never a town, though urban in origin: it was rather a caravanserai, presumably one of many on the internal desert route from the southern Levant to northern Syria (Dubertret and Dunand, 1954/5). Middle Bronze Age Jawa demonstrates the first known example (in Jordan) of a new kind of urban-based desert activity. Whereas Late Chalcolithic Jawa was an accident of time, water and space, the 'citadel' complex was a planned, deliberate, civilized, almost proto-imperial creation whose subsequent development in the Black Desert led to the Roman/Byzantine limes, Umayyad castles and finally, during the thirties of this century to the creation of Jordan's Arab Legion whose forts, so like the older castra, are still welcome landmarks in the land today.

These limes were defending borders as well as communication routes as much against the independent beduin tribes as against whoever the current international (urban) enemy may have been. The ancestry of the beduin—at least in life style—can now be traced back to the Neolithic 'Old Men' in Arabia as early as the 7th millennium. At that time the nomadic population may still have been greater—in both

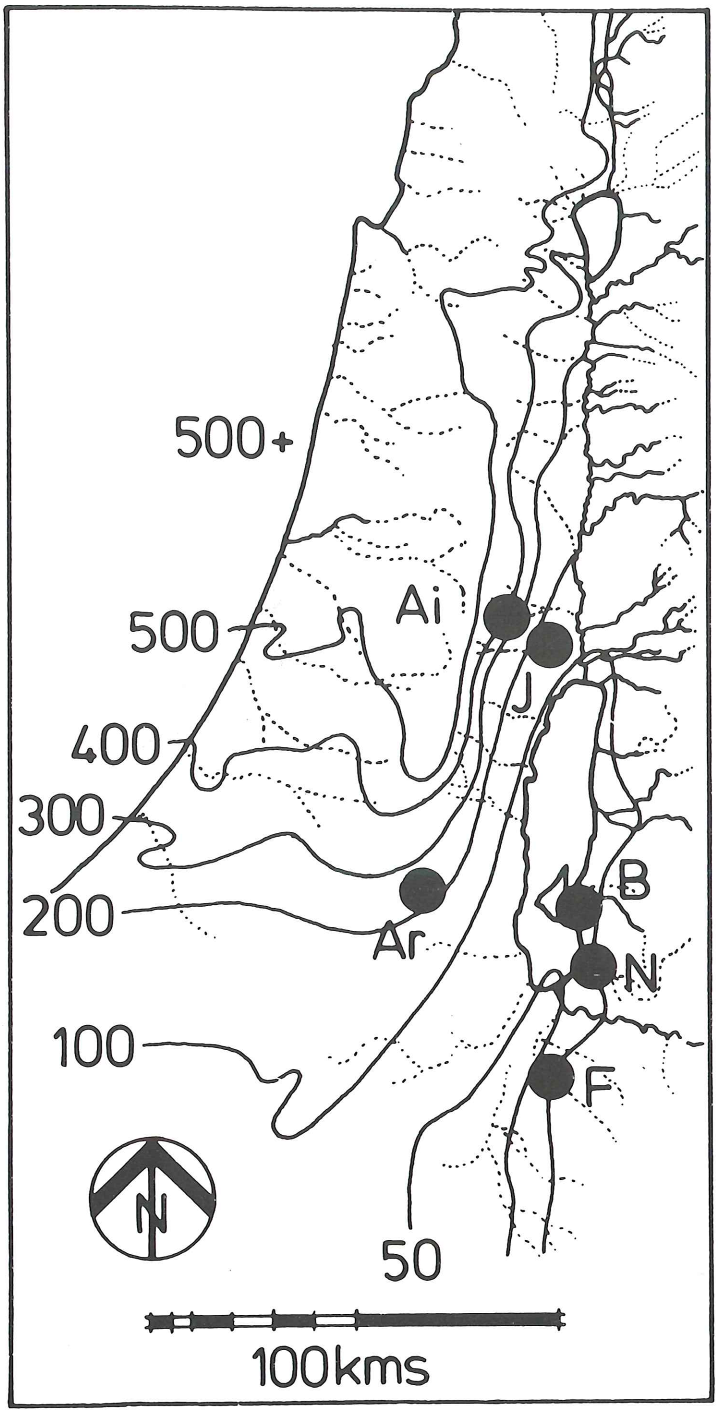
14. Deir el-Kahf (after Poidebard).



semi-arid and verdant regions—than that of the recently established permanent settlements. The continuing presence of beduin after Jawa is not evidenced until the Nabatean/Roman period when the semi-literate Safaitic tribes began to leave their messages on the black basalt boulders (Macdonald). Many of these inscriptions refer to the 'rumi', a generic term beginning as Roman qua Roman but later meaning any of the intrusive urban folk and their soldiers from towns like Bosra, Salkhad and Umm el-Jimal. Such towns, some perhaps going back in date as far as the Iron Age, were the first since Jawa. After over 2,000 years urbanism (not transmigrant but transilient) was encroaching upon the northern, better watered regions of the Black Desert. Over 2,000 years later most of these lands were still in the control of the beduin. Poidebard's photograph of Deir el-Kahf in 1931/2 (FIG. 14) shows hut circles encroaching on the ruined castrum: since then this place has slowly become the nucleus of a village—the modern equivalent of the castrum a few hundred metres away. Deir el-Kahf, like so many similar sites, thus symbolizes the apparent end of the cycle that began as an unstable equilibrium between the mobile and the static forms of life over 10,000 years before.

As a measure of technological progression within this sub-region, let us note briefly modern use of water resources

15. Early Bronze Age Towns and Isohyets.



near Deir el-Kahf (FIGS 2 & 7) and compare this to Jawa, less than fifteen kilometres away in space and over 5,000 years in time. Jawa diverted water from wadi Rajil for storage in reservoirs: beside the source. The wadi Rajil catchment ultimately contributes to the lake in the Azraq basin whence water is now pumped back to Deir el-Kahf, to be stored in water towers for distribution among the recently settled beduin.

IV **The sown** (FIGS 15–19)
Closer again to prehistory, we might finally examine what can be called the technological legacy of Jawa; whether it was a directly transmitted one via that place or not. Jawa represents historical technical precedent in relation to the first general urban stage of Palestine during the Early Bronze Age. The hypothesis here is that the builders of Jawa were but a small group among many that archaeologists suspect entered the Jordan Valley region about the turn of the millennium, and that they represent generally—not specifically—the diffusion of a developed technology already current in Syria/Mesopotamia and presumably Egypt, without prejudice toward any indigenous technical innovations that are the natural products of continued settled life.

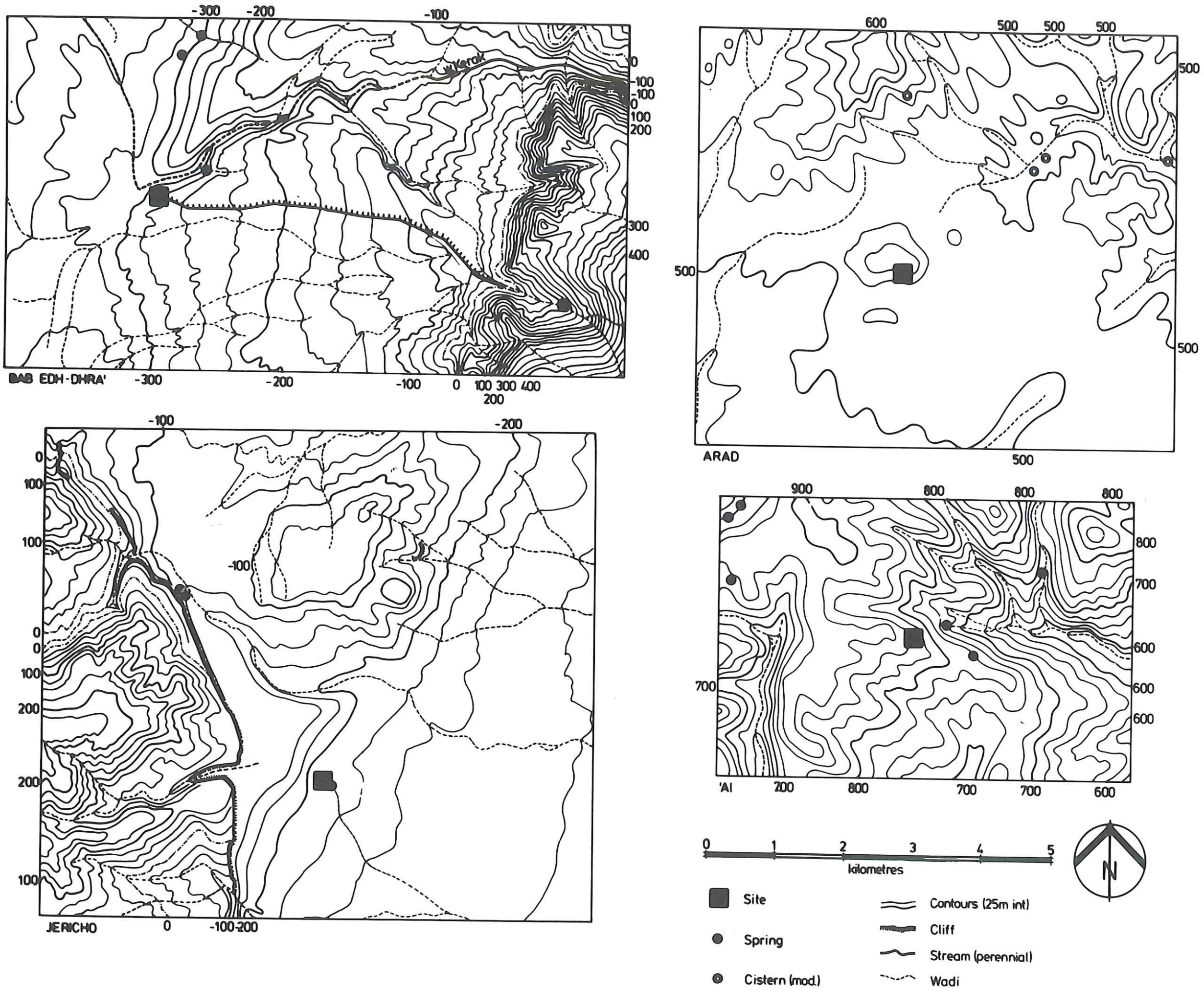
Two basic aspects of the new Early Bronze Age towns are relevant here: fortifications, particularly the rampart, and municipal water supply. For the former compare the profile of dam D1 at Jawa (FIG. 11) and EB II ramparts at Tell el-Far'ah (N) (de Vaux, 1961, 1962) and Tell Ta'annek (Lapp, 1964, 1967, 1969). In all cases we are dealing with similar soil mechanics and structural matrices: revetments, corewalls (re-use of previous constructions) and selected soil fill (see also Paar, 1968; Helms, 1977b, 1975b, 1976b).

However, the most poignant comparison lies in the Early Bronze Age water systems (FIG. 9) which we can now interpret more fully with the precedent of Jawa whether, as noted, that place and its people had anything directly to do with it or not.

Bab edh-Dhra' (B) (FIG. 16)
The site lies beside the deep wadi Kerak, on Dead Sea marl, in a region of low annual precipitation. The wadi was always an inconvenient water source, especially during siege, because of its steep slopes. Today a spring exists just north of the site and may once have lain higher up, though still well without the fortifications. In other words the water source, as at Jawa, was extramural. Topographically Bab edh-Dhra' allows for some speculation about the internal arrangements of the settlement. This was first suggested to me by Paul Lapp's excavations at the north end of the site (Lapp, 1968) where he noted that the interior of the town was lower than the land to the east and that the fortifications stood on a permeable gravel bed. The notion then was that the site once had man-made reservoirs (Helms, 1976b). This was before the excavations at Jawa. Topography and precedent now combine to make this line of reasoning at least a possibility.

Indications of internal water storage are supported by looking just a little beyond the site. About 6 kilometres east lies the strong spring of Dhra' which drains into wadi Kerak. There is little doubt that this was so during the Early Bronze Age because a small Neolithic site was found just above the stream bed. Today water is diverted from near this point along a concrete gravity canal to fields. An older though still modern version of this canal still flows within less than 1,000 metres of Bab edh-Dhra'. Evoking Jawa: the proposed Early

16. Maps: Bab edh-Dhra', Arad, 'Ai (et-Tell), Jericho.



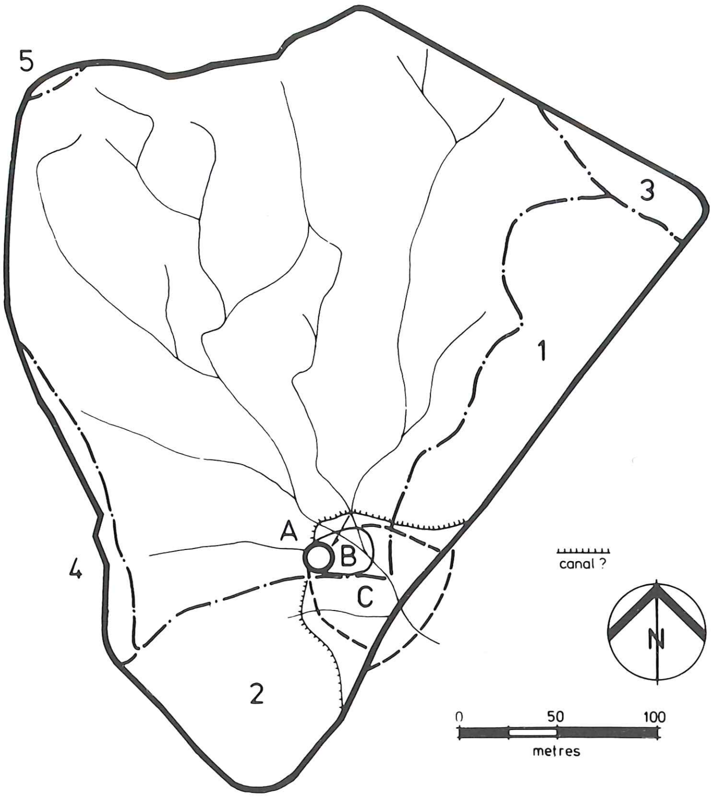
Bronze Age water system (as early perhaps as the first settlement) would consist of an earth and stone lined gravity canal from the narrow gorge of Dhra' to the town, under the north wall—perhaps as suggested by Lapp—and into one or more reservoirs. The storage areas would lie along the cliff of wadi Kerak, they would be revetted as at Jawa and probably be supplied with a spillway. The principles are the same as Jawa's and essentially simple: deflection—this time of a much more reliable source—into canals and storage behind heavily revetted earth dams. Similar systems may have been used at the other Early Bronze Age sites recently surveyed and excavated to the south (Rast and Schaub, 1974, 1976).

Arad (Ar) (FIGS 16 & 17)
The site, 27 kilometres south of Hebron, lies in a semi-arid zone at the northern edge of the Negeb Desert (c. 200 mm./yr.), on shallow soil overlying chalk whose form not only made it a suitable site for defence but also for water supply. The most recent account of the water system is incomplete and confusing (Amiran, 1979). However, enough information survives to describe the principle involved. Here one must recall another aspect of the Jawa precedent, the use of surface runoff after rain and its storage against the dry season.

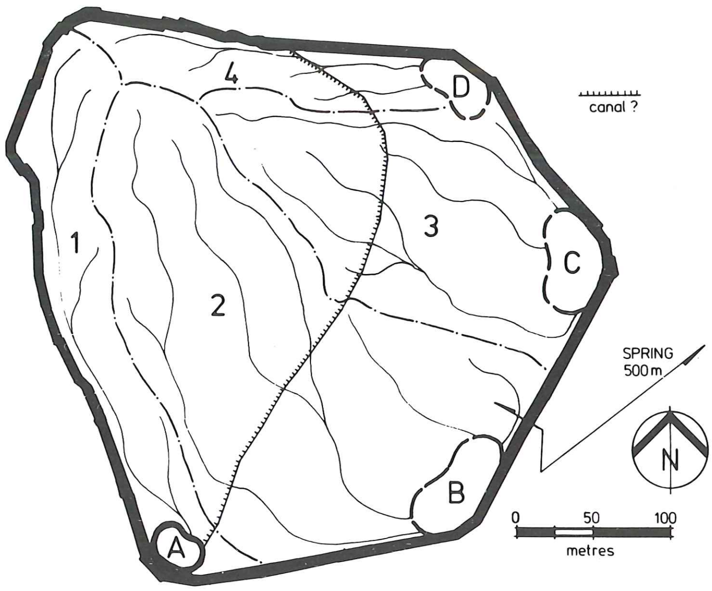
Topographically Arad forms a three sided bowl, a natural catchment or basin with a depression at its lowest point. There the excavators first proposed, now—presumably—found evidence for a reservoir. Measurements published so far are unreliable, as are the attendant calculations. Rosenan (Amiran, 1979) cites an annual runoff yield from the entire basin (area c. 90,000 m.^{2}) of 2,250 cubic metres in a drought year (100 mm./yr.) and considers this to be enough for 2,000 persons (for one year). Several errors include the following:

a) not the entire basin drains into the depression (micro-catchments 1–5) unless canals were built—especially to tap mc1 and mc2;
b) losses due to evaporation are given as 300 m.^{3} from a total input of 2,250 m.^{3}: far too little for this region if water is stored in an open reservoir;
c) even if c. 2,000 m.^{3} of water were available (in a wet year) a simple calculation (i.e. mc – (E + C)) shows that the

17. Plan: Arad.



18. Plan: 'Ai (et-Tell).



end-of-month storage curve reaches zero well before the next rains;

d) no allowances are made for other 'losses': none for animal consumption.

Nevertheless the water system of Arad did apparently rely on surface runoff, but it is not clear whether structural provisions were made to control the direction of flow (canals), whether such provisions were extended to augment runoff rates (open, specially treated catchment areas), whether any sanitary considerations ever entered the planning, or whether we are dealing with interflow as well as surface runoff collecting in a natural depression. In general principle Arad resembles Jawa: but many questions arise regarding the kind of settled life that was possible at the site if runoff was the only water source. Once more reliable data are available it may, for example, be possible to show that either larger reservoirs were built (FIG. 11: B, C) or that the scarcity of water required control and budgeting (as at Jawa)—hence social organization of truly urban proportions—and that a part of the population and their flocks were meant to quit the town in the dry season. Arad might turn out to be an example of urban-based transhumance during EB II.

'Ai (et-Tell) (Ai) (FIGS 15 & 18)
Two aspects of Jawa combined at this Early Bronze Age town north of Jerusalem: runoff exploitation and deliberate storage. Callaway (1975) found part of a stone and earth lined and revetted cistern or reservoir at 'Ai (EB III) which he reported could hold c. 1,800 cubic metres of water and was 'designed to capture rainwater channelled from the upper city'—and, again, this amount is said to be enough for a minimum population of 2,000.

The reservoir (FIG. 18: A) is situated at a curve in the fortifications which, reinforced with stone and clay, served as the dam. We are reminded of the revetted pools and reservoirs at Jawa and conversely have a good parallel for the proposed reservoir(s) at Bab edh-Dhra' discussed above. We note, moreover, that water system and fortifications, both naturally part of military town planning, are structurally combined here at 'Ai.

This valuable new evidence may be taken further simply by analyzing the catchment at 'Ai. Two features emerge. First, the catchment may be divided into four microcatchments (FIG. 18: 1–4) and only mc1 serves the known reservoir at the southwest corner of the town, unless a canal was built, as shown here, to incorporate parts of mc2, mc3 and mc4. Second, the form of the urban fortified container at the known reservoir and point of microcatchment discharge is repeated three times: at the southeast, east and northeast corners. We may thus propose the existence of three similar reservoirs (FIG. 18: B, C, D) of which the first two were probably larger because of the size of the corresponding microcatchments. Therefore a storage potential of well over 8,000 cubic metres is achieved. The Early Bronze Age town of 'Ai was thus a well-watered place for it also had a spring some 500 metres beyond the east trave of fortifications.

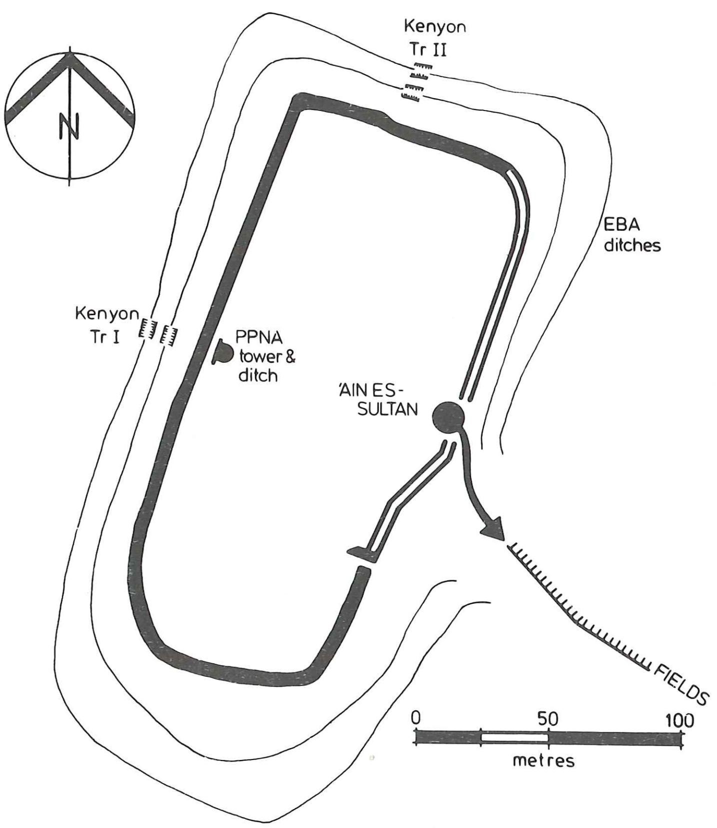
What is significant in the sense of military and town planning is that internal water storage was deemed essential—even in a relatively verdant area. At Jawa this was a dire necessity imposed by desert hydrology; at 'Ai it was perhaps more clearly dictated by man's potential agression.

Jericho (J) (FIG. 19)
Until recently the spring of 'Ain es-Sultan was strong and steady, flowing at a maximum rate of 0.37 cumecs after heavy rain in the hills to the west, 0.26 cumecs in the dry season (Dorrell, 1978). This makes Jericho almost a hydrological anomaly in Palestine. The 'uniqueness of Jericho' in a semi-arid zone is due to this and therefore the water system of any settlement at the site remained unchanged in principle ever since the Pre-Pottery Neolithic (A) period (c. 8000 BC).

In terms of Jawa's technological precedent but one aspect is strictly relevant and that is structural: the potential ability, certainly by the third millennium, to build effective dams. It can be shown that the spring lay enticingly close to the built-up areas, ever since the first town or city or mega-village of the PPNA period. The spring lay so close that it seems ludicrous to deny that it remained extramural. For the moment we must leave out discussion of any Neolithic water system—although there may be the implication of a local tradition of hydro-dynamics. We may, however, suggest that the spring was enclosed within the fortifications of the Early Bronze Age town (EB I and certainly thereafter) and cite as 'proof': the precedent of Jawa, the fact of 'Ai and the emerging evidence of an awareness of water conservation and budgeting as a part of town planning—in short, the emergence of specialists, no less than the ancestors of modern civil and military engineers.

If the spring was enclosed, how was this done? Referring more directly to the case reconstructed for Bab edh-Dhra' and the evidence from 'Ai, it is well within Early Bronze Age technology to propose a dam incorporating the eastern trace of Jericho's fortifications that would follow, more or less, the line of the modern cement and stone reservoir. A spillway or conduit would lead overflow under the curtain and into the irrigation canals farther to the south and east.

19. Plan: Jericho.



According to the excavator of Jericho (Kenyon, 1979) that town—and as an extension of the hypothesis to the 'national' level, all of Palestine during the Early Bronze Age—ended in conflagration, rape and pillage, in yet another invasion or incursion, this time of semi-nomadic folk. This was linked even more broadly to disturbances on the 'international' scale: Amorites in the north (Kenyon, 1966) and the First Intermediate Period of Egypt. Other ideas followed as more and more names were given to this next revolution of the demographic cycle: Caliciform, EB—MB (Kenyon, 1966, 1979; Prag, 1974), Intermediate Bronze Age (Lapp, 1966), MB I (Amiran, 1969; and others), EB IV (Dever and Richard, 1977) and so forth, and just what was really happening is still not clear, although as with the end of the previous millennium, we can recognize the grand cyclical pattern that is still with us today—if only through the proliferation of demographic hypotheses.

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