

## Aerial Archaeology in Jordan: Air Photography and the Jordanian Southern Ḥawrān

### Introduction

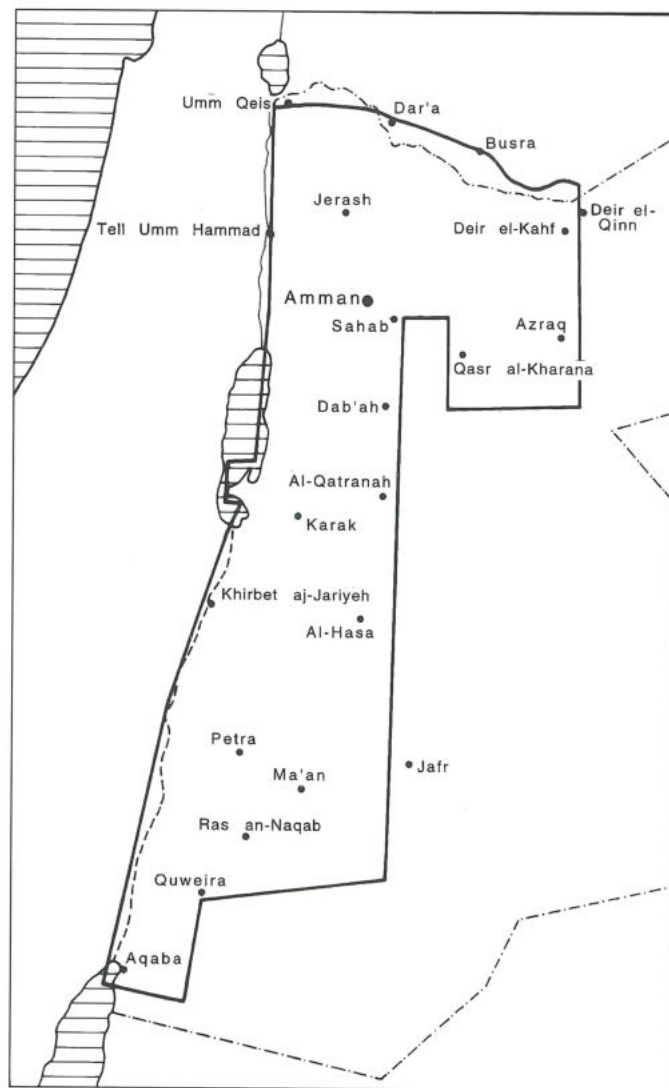
At Oxford in 1980, at the First Conference on the History and Archaeology of Jordan, the author presented a paper which was, in essence, a reminder of the potential of air photography in archaeology in general and a plea for its further use in Jordan in particular (Kennedy 1983; cf. 1982: 327-344). The motivation was simple: In the 1920s and 1930s, there were two significant areas of pioneering activity in what is often called "Aerial Archaeology". That, in Britain, continues still and the technique is well-established as the single most powerful tool for prospection and discovery available to archaeology, as well as offering wide scope for interpretation (see in general Riley 1987; Wilson 1982). The second area was in a part of the Middle East - in Syria, then it extended later into Iraq and Transjordan (Poidebard 1934; Mouterde and Poidebard 1945; Gregory and Kennedy 1985)<sup>1</sup> - but it largely came to an end in 1939 (see Kennedy and Riley 1990: Ch. 3). That has been a tragedy for the archaeology of the region.

### The Aerial Photographic Archive for Archaeology in the Middle East

In 1980, the author had already established the Aerial Photographic Archive for Archaeology in the Middle East. Its objectives - essentially to identify and obtain access to existing caches of air photographs and to promote actively the value of the technique - were set out in a number of publications (Kennedy 1980; 1982: 341-342; 1987). With the patronage and support of HRH Crown Prince Hassan, and through the generous response of the Royal Jordanian Geographic Centre (RJGC) under its former Director-General Rifat Majali, the Archive developed rapidly in the later 1980s.<sup>2</sup>

Photographs and maps of the Middle East - but overwhelmingly of Jordan - were obtained from various sources, not least the holdings in Britain of the Royal Air Force. The principal acquisition, however, was from the RJGC itself of some 4000 frames of a vertical aerial survey of much of Jordan taken by Hunting Aerial Surveys in 1953 (FIG. 1).

Initial work on the material in the Archive was slow



1. Map of Jordan to illustrate the extent of coverage of the air photographs of the Hunting Aerial Survey of 1953.

for want of funds but there was a trickle of publications in which air photographs were a significant primary source (Gilbertson and Kennedy 1984; Gregory and Kennedy 1985; Kennedy 1982; Kennedy and Cowie 1984; Kennedy and Riley 1990; cf. Riley 1982). In 1991, how-

<sup>1</sup> We should not, of course, overlook the important work of Baradez published in 1949.

<sup>2</sup> It has continued to benefit still with, most recently, the friendly support of Dr Saliem M. Khalifa, the current Director-General.

ever, the Australian Research Council awarded a grant for the three years of 1992-1994 for a project, "Remote Sensing for Archaeology in the Middle East", the core of which was to be the systematic analysis of this air photographic evidence. That work continues still with a renewed grant for 1996 and has given rise to a number of publications (Kennedy 1992/93; 1994; 1995a; 1995b) with others pending (Kennedy 1995d; 1996a; 1996b; Kennedy forthcoming a; b; c). The entire research should be completed in 1997 and published in 1998 (Kennedy forthcoming d)

### **Remote Sensing for Archaeology in the Middle East Project: The Jordanian Air Photographs**

For present purposes it is necessary only to describe briefly the procedures adopted for this air photography of Jordan; a fuller description is in press (Kennedy 1996a) and an overall interim survey of the project is in preparation (Kennedy forthcoming c).

The air photographs consist of diapositives (positive rather than negative images on film) each some 18-20 cm square (two different films were employed). The scale is 1:25,000 giving a coverage for each frame of about 20-25 sq km.

As is well-known, there are three steps in the analysis of air photographs in archaeology: air photographic interpretation, transcription/ recording (written description, plotting, drawing), and archaeological interpretation.

For the first of these, air photographic interpretation, various experiments have been carried out to identify an appropriate and cost-effective methodology. After several false starts, it was concluded that there was no alternative to the fundamental need for an *experienced* eye to be employed in scrutinizing each photograph in detail. With diapositives, that meant examining each frame under magnification on a light-table to identify actual or possible man-made intrusions which might pre-date 1919. The subsequent transcription/ recording involved plotting the colour-coded detail onto transparent overlays at the same scale. These overlays were derived by photographic enlargement of the 1:50,000 map series of Jordan onto acetate sheets. The third step in the procedure, archaeological interpretation, requires a familiarity with the landscape in question, with the existing archaeology, and, ideally, will involve a phase of ground verification. In practice, for so large an area and so many sites, existing funds will not permit full ground verification, only sampling of the whole and more detailed work for a selection of case study areas.

As far as air photographic interpretation is concerned, the intensity of scrutiny had to be set at a level to allow the project to proceed at a speed which would see its completion within three years. In doing so, it was recognized

that a procedure which is already highly subjective, would be further compromised by placing limits on how much time could be devoted to any specific photograph or group of photographs. Nevertheless, it was judged that this level of scrutiny would reveal a detailed picture of the archaeological remains preserved on the photographs and a satisfactory overall impression of the patterns for sites in general and site types in particular. In short, it would reveal on a major scale the potential of the photographs as a source of evidence.

This general analysis of all the c. 4000 air photographs – hereafter called the First Interpretation – has progressed from a starting point in the north-east at Dayr al-Qinn, west to the Jordan Valley and then proceeded south (cf. FIG. 1). At the time of writing (November 1995), we were concerned with the photographs for the region south-east of the Dead Sea around Ma'ān. It was anticipated that all the remaining region down to the Red Sea will have been completed before the end of 1995. The number of sites recorded as visible on the air photographs from this First Interpretation stands at c. 12,500 and it is estimated that the final tally may be about 15,000. For reasons that will become apparent, it seems that this figure should be revised upwards quite considerably.

The photographs cover much of Jordan and, as such, record a wide variety of site types, forms, construction techniques and building materials. And, of course, the archaeological evidence is set within an ever-changing landscape and environment. For example, it was very likely that the site types and the character and degree of their survival in the arid conditions of the basalt desert would be very different from that in the extensively farmed and better watered Jordan Valley. In short, within the framework of general lessons which would be widely applicable across all of Jordan, it was likely that in detail we would have to identify and deal with several regions within which there were broadly similar conditions. Five regions have been provisionally identified. For the purposes of this paper, we are concerned with part of one of those regions, the basalt desert of north-east Jordan.

### **The Southern Ḥawrān**

As is well-known, the basalt desert extends, in broad terms, eastwards from al-Mafraq; indeed, it extends far beyond the limits of the available air photographs. For practical purposes, therefore, the author is dealing in this instance with the region usually called the Ḥawrān, or, since much of it lies in Syria, the Jordanian Southern Ḥawrān.<sup>3</sup> There is of course great diversity even within this region from the mud-flats east of Qaṣr al-Ḥallabāt, through the unpopulated lava-strewn areas south of the Baghdad Highway, to the agricultural pockets quite common close to the frontier with Syria as at Dayr al-Kahf.

<sup>3</sup> The Princeton Expeditions to Syria at the beginning of this century differentiated between the sites they recorded in the Ḥawrān Plain and Jabal Ḥawrān on the one hand, and the Southern Ḥawrān on the other (PES). The sites vis-

ited in the latter included mainly ones now lying inside Syria (cf. Kennedy 1995c).

The basalt mantle and the generally low rainfall, however, provide a degree of unity which allows one to treat it as a single region for the purposes of the present exercise.

The question then was to devise a means of evaluating the extent to which the First Interpretation of all the air photographs of this region could be used as a guide to what might have been detected with a more detailed analysis and to what was *actually* there on the ground in 1953 as opposed to what we could see on the air photographs. The solution was to carry out now an intensive scrutiny of the air photographs of parts of this region - the Second Interpretation - and to pursue that by ground verification. It was hoped that the general lessons learned in this way would be applicable to the other regions or at least act as a guide in evaluating the results from the First Interpretation.

The selection of this region was not fortuitous. As noted above, analysis of the air photographs had begun with this area so that now, eighteen months after we completed work on the photographs for it, there has been time to absorb the lessons learnt there and subsequently developed as we moved southwards through changing landscapes and environments. More importantly, however, the region is one with which the author has greatest personal familiarity having been engaged on a field survey for some years.

The Southern Ḥawrān Survey, covering an area of some 600 sq km between Ṣabḥāh in the west and Dayr al-Qinn in the east, and from the Syrian frontier south to the Baghdad Highway, has been in progress for a decade (Kennedy, MacAdam and Riley 1986; Kennedy 1993; 1995d; Kennedy and Freeman 1995; 1996). The area under investigation in this survey represents a manageable portion of the Jordanian Southern Ḥawrān. More of the Southern Ḥawrān lies to the west and is being treated by the Umm al-Jimāl Project and more lies further south beyond the Baghdad Highway. From the outset the survey methodology included the use of air photographs and the fieldwork explicitly aimed to evaluate those available. In practice that meant both endeavouring to locate and investigate on the ground those traces identified on specific frames, and seeking to explain how sites previously identified on the ground appeared on the photographs in the way they did - or why they did not appear at all (Kennedy, MacAdam and Riley 1986: 151-153; Kennedy and Freeman 1995: 39-61, *passim*).

### Air Photographs of the Southern Ḥawrān

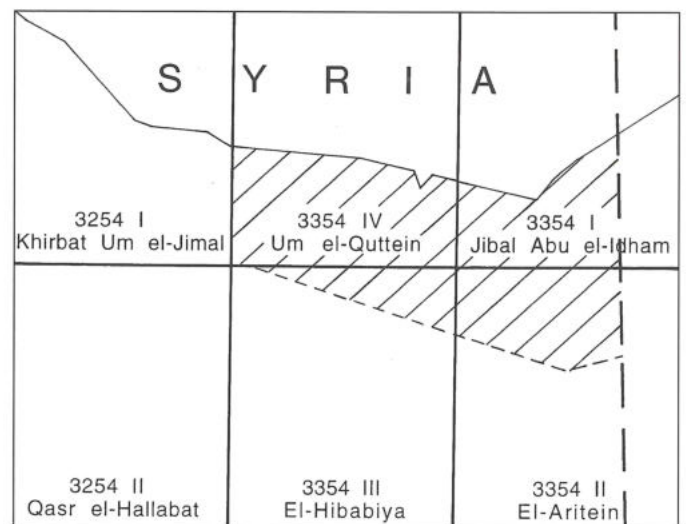
For present purposes, the author has chosen to define the Southern Ḥawrān as the region encompassed by six sheets of the K737 series, 1:50,000 scale maps of Jordan provided by the Royal Jordanian Geographic Centre. The sheets in question are illustrated in (FIG. 2).<sup>4</sup> The area encompassed is, of course, also far more extensive than either the remit of the Southern Ḥawrān Survey or of the

Southern Ḥawrān itself.

The air photographic coverage available in the Hunting Survey does not extend all the way across the "Jibāl Abū al-Idham" and "al-Aritein" sheets, but stops just before the longitude of Dayr al-Qinn. Moreover, for the three more northerly maps, many of the photographs of the Hunting Survey relate to Syria and are not included in this exercise which is limited to Jordan.

The area defined above is some 2,560 sq km. The three northern sheets covering c. 430, 260 and 140 sq km respectively; the southerly covering 650, 650, and 430 (cf. FIG. 3). The total number of photographs covering this area is 645 (about 16% of the c4000 in the Hunting Survey). All were taken flying north-south and south-north alternately and as part of much longer runs which extend from southern Syria deep into Jordan (FIG. 1). As the analysis of the photographs followed individual runs beyond the northern and southern limits of these maps, work on these particular sheets for the First Interpretation was spread over much of a year.

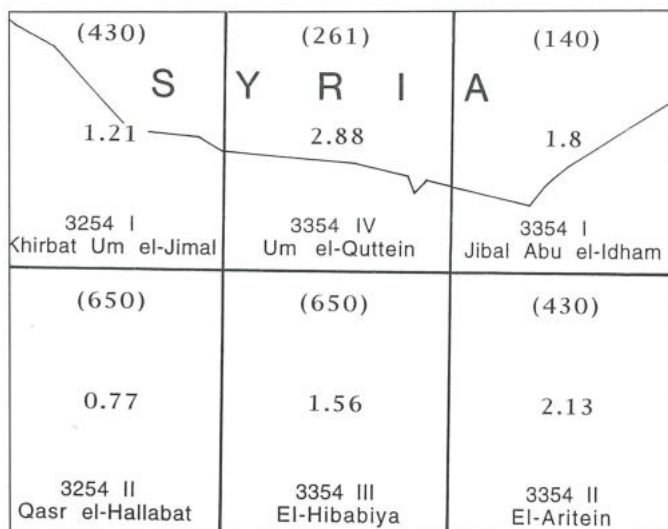
The number of sites identified on the First Interpretation was 3946 giving an average site density of just over 1.5 per sq km. The number of sites is very large; far in excess of what one might have gleaned from the maps themselves (cf. Kennedy 1996a) or what is known from previous ground recording by investigators over the last century. But to what extent are these findings a reliable guide to the number and range of sites which might be discovered on the photographs if a more intense analysis was carried out? Are they indeed archaeological sites and to what extent can they be traced on the ground today and dated? Finally, can such findings as these be employed as part of a full ground survey? Part of the answer to these questions can now be provided. Since the completion of the First Interpretation, the photographs covering two of



2. Diagram to illustrate the region encompassed by the present exercise, the limit of coverage towards the east, and its relationship to the area covered by the Southern Ḥawrān Survey.

equation is usually self-evident.

<sup>4</sup> These map names are as they appear on the 1:50,000 map series. In the text itself, however, I have used a different spelling in more common use. The



3. Diagram to illustrate site density as seen after the First Interpretation. Area in sq km in brackets at top.

these sheets – al-Jimāl and al-Idham – have been the subject of a Second Interpretation. For this, no time limit was set. We may now compare the results.

**The First Interpretation**

The First Interpretation produced interesting comparative figures for the three most northerly sheets under discussion (TABLE 1). In many cases the numbers are too small to permit any meaningful comparison; for a few, however, they are more instructive (TABLE 2).

Generally there is a close co-relation between the percentages of site types in each of the three map areas. The exceptions are with agricultural features where the numbers rise proportionately by about half as much again as one goes further east. However, for cross-wadi walls the position is strikingly different for the Umm al-Jimāl area where they are 16-20 times more common than further east. This is best viewed not as a persistent oversight by the interpreter but a reflection of the reality: there are fewer instances of cross-wadi walls as one moves eastward in this broad area.<sup>6</sup> A desideratum will be to plot out the pattern of this site type and relate it to the landform and environment.

The implications of the figures in these tables are encouraging. The interpretation process is one which may be subject to variations from a number of factors; for example, fluctuating concentration, failing to recognize site-types initially, gradual and imperceptible changes in the criteria employed, changes in speed of scrutiny, the quality and timing of the air photographs, interruptions. Moreover, as noted above, these sheets were not examined in succession. Nevertheless, it would seem that broadly the same level of concentration and the same broad criteria for identification were maintained across

**Table 1.** Comparative figures of site types<sup>5</sup> recorded during the First Interpretation of three sheets of the Jordanian Southern Hawran. 1. "Khirbat Umm al-Jimāl"; 2. "Umm al-Quttayn"; 3. "Jibal Abū al-Idham". The bold figures in brackets are the approximate areas in each instance in sq km.

	<b>1</b> <b>(425)</b>	<b>2</b> <b>(260)</b>	<b>3</b> <b>(140)</b>
Animal Enclosure /Corral	296	504	165
Rectilinear Enclosure	3	2	2
'Circular' Enclosure	10	22	5
Kite	39	59	19
Water Associated Site (Reservoir, cistern, waterhole, channel)	37	84	30
Agricultural Feature, Field system	19	39	15
Road, Road Towers/Stations Bridge	2		1
Linear Feature	9	6	4
Village			5
Dam			1
cross Wadi Walls	42	4	1
Military Site (Fortress, fort, tower, defended site)	1	1	1
Cemetery/ Tumulus /Cairn	3	1	1
Cartwheel / hut (landscape and single)	3 ?	2 ?	
Farmstead	3		1 ?
Ring Settlements	1	6	1
Major structures	4	3	
Ancient settlement	12	13	
Modern feature?	6	4	
Foggara	3		
Areas of Discolouration	9		
Areas of Disturbance	2		
Pitting / Linear Landscape	5		
Rectilinear Structures	5		
<b>Total</b>	<b>514</b>	<b>750</b>	<b>252</b>

**Table 2.** Percentages of the total of site-types recorded in the First Interpretation of the air photographs for three sheets of the Jordanian Southern Hawran. 1. "Khirbat Umm al-Jimāl"; 2. "Umm al-Quttayn"; 3. "Jibal Abū al-Idham". The bold figures in brackets are the approximate areas in each instance in sq km.

	<b>1</b> <b>(425)</b>	<b>2</b> <b>(260)</b>	<b>3</b> <b>(140)</b>
Animal Enclosure /Corral	58	67	66
'Circular' Enclosure	02	02.9	02
Kite	07.6	07.8	07.5
Water Associated Site	13.9	11.2	11.9
Agricultural Feature, Field system	03.7	05.2	06
Cross Wadi Walls	08.2	00.5	00.4

<sup>5</sup> The site types were refined and reordered for the purposes of the Second Interpretation. For present purposes of general comparisons, the precise types are unimportant.

<sup>6</sup> The incidence of cross-wadi walls on the al-Jimāl sheet had already revealed a thinning in the pattern as one moved eastwards (Kennedy 1996a).

the sheets and over the course of the year which elapsed between work on the first and third sheets of this trio. Nevertheless, now, in the fourth year of the project the methodology is still constantly being evaluated and refined, new site types are still occasionally identified and the differing landscapes and environments give rise to new problems and opportunities.

### The Second Interpretation

Great care was taken to look at the same areas on each photograph not just on any one single frame but on one or more others in the same overlapping sequence and one or more others in the parallel overlapping sequences. In some instances, up to nine frames could be examined with regard to a single location (Kennedy 1996a: FIG. 1a). The motivation was simply that it was apparent that sites clearly identifiable on three consecutive frames could show in very different ways and degrees; it was reasonable to assume, therefore, that other sites which were less distinct might show faintly on one frame but be invisible on another. The procedure is cumbersome even on a large light table and very time-consuming. For this Second Interpretation, therefore, no time limit was placed on the work. Second, in the light of ground verification and a generally greater familiarity with the region and its archaeology, the author was able to refine the view of how to isolate individual sites. The outcome was rather different as the tables below reveal. For both sheets, a number of sites from the First Interpretation were subdivided, others (principally isolated cairns) which had been deliberately excluded before were now included (as cairns/ burials), and a number of sites missed were now recorded (see, for example, the increase in the number of kites on the al-Jimāl sheet from 39 to 58). The outcome for the Umm al-Jimāl sheet was a doubling of the number of sites from 514 to 1070 (TABLE 3).

The "Jibāl Abū al-Idham" sheet covers an area of c. 140 sq km. Because it lies at some distance from the Umm al-Jimāl area a Second Interpretation of it permitted any glaring difference between the two to be more noticeable and offer lessons in advance for what one may detect on the intervening Umm al - Quṭṭayn map and to some extent the sheets to the south.

The Second Interpretation recorded 185 sites more than the First, an increase of 74%. The increase is less than the doubling for the Umm al- Jimāl area but gives a final site density of just over 3 per sq km compared with 2.5 on the Umm al- Jimāl sheet. There are notable differences and similarities.

### Comparison of the Results of the Second Interpretations of the Sheets "Jibāl Abū al-Idham" and "Umm al-Jimāl".

First, the number of instances of cross wadi walls only changed from one to two. Even allowing for the differences in size of area, it is plain there are very few features

of this kind in this easterly region in comparison with Umm al-Jimāl where, finally, 22 were isolated and many more examples were associated with settlements and the identified as components of farms.

Second, it is certainly possible to identify "farms"; including uncertain examples and others which might be small villages, the total is 51 which compares quite favourably with the much larger area of al-Jimāl with 223. The farms in the east, however, are rather different from those around Umm al- Jimāl where they were often associated with cross wadi walls. Here they are often defined in terms of the extent and number of corrals and the presence of modern farming in the vicinity. Striking, however, is their near absence in the north of the area. There, modern farming and widespread and continuous traces of ancient field boundaries, implies earlier farming but vir-

**Table 3.** Comparison of the numbers and range of sites recorded on the First and Second Interpretations of the air photographs of the "Umm al-Jimāl" sheet (partly based on Kennedy 1996a: TABLE 2).

Major Settlements	12	13
Major Structure	4	1
Larger Enclosure	13	21
Farm (probable)	3	116
Cross-Wadi Walls (in isolation)	42	22
Fields (ancient)	19	5
Corrals (possible farm)		107
Corrals (multiple cells or scatter of single cells)	296	180
Corral (single isolated cell)		127
Discolouration (possible corral)		12
Reservoir/ Waterhole/ Cistern	37	37
Foggara/ Water Channel	3	9
Dams		2
Kites	39	58
Fortlet	1	2
Road (Roman)		5
Tower	2	11
Crain/Tiny Corral(possible Tower)		18
Cairns	3	178
Cairns (possible tiny corrals)		40
Discolouration (possible cairn)		27
Pitting (possible cemetery)	5	4
Earthwork		4
Wall		1
Areas of Disturbance	2	35
Areas of Discolouration	9	32
Miscellaneous	5 (rect.struct.)	3
	6 ( mod .feat)	
	1( ring settl.?)	
	3(cartwheels?)	
	9( linear feat.)	
<b>Total</b>	<b>514</b>	<b>1070</b>

**Table 4.** Comparison of numbers of sites found on photographs covering the "Jibāl Abū al-Idham" sheet between the First Interpretation and the Second. For present purposes the site types employed have been redefined to suit those employed on the Second Interpretation.

	1st	2nd
Corral/ circular enclosure		100
Corrals	165	180
Irregular enclosures		7
Rectangular enclosure	2	4
Circular enclosure	5	1
Ring settlement	1	
Reservoir/ Reservoir?		13
Waterhole?	30	7
Cistern?		9
Water channel?		2
Dam	1	
Cross wadi walls	1	2
Kites	19	12
Village(?)/ farm(?)	5 ?	4
Farm?	1 ?	28
Corrals/ Farm?		19
Field(s)	15	14
Cairn?/ tower?/ burial?	1	20
Fort	1	1
Road	1	2
Miscellaneous		12
<b>Total</b>	<b>252</b>	<b>437</b>

tually no farms can be found. Unless they have been lost through recent land development, one must suppose people resided in the larger villages which existed further north in what is now Syria.

The number of kites is proportionately about that one would expect from the Umm al-Jimāl survey, but less than one might have predicted on the basis of the basalt landscape and the known chains of them only a little further east again (Helms 1981: 39-47).

The major increase in numbers has been with corrals, whether individual enclosures or multiple. While many are probably post-Ottoman and many of the total are individually unexciting, the category should not be neglected. Collectively their pattern points to the areas of human activity; individually, some of the more complex examples are worth closer examination. Sometimes around the clear corral circuits, traces of others appear as "phantoms". Around al-Jimāl, several examples of such corral sites were identified during the ground verification as ancient farms.

Several sites are individually worthy of closer investigation. Dayr al-Kahf has been examined by a number of scholars over several decades. More recently it has been the subject of air photographic interpretation (Kennedy

1995a). The very interesting collection of corrals, reservoirs and cisterns, and house foundations to the east of al-Kahf has been examined on the ground since the air photographic interpretation work (Kennedy 1995a). Notable too is Jubaiya. The site today is largely lost beneath modern structures but on the air photographs (FIG. 4) it appears in a fashion reminiscent of five such sites in the Umm al-Jimāl area (Kennedy 1996a: FIG. 17).

**The Lessons of the Second Interpretation.**

There seem to be two main lessons. First, we must be alert to notable differences; adjoining areas will not necessarily be at all similar in detail. Second, in broad terms, the results of the First Interpretation of the air photographs may be taken as a reliable guide to what would be achieved by a Second Interpretation when the overall numbers of sites will increase but will do so in reasonably predictable ways.

For the intervening map, the "Umm al-Quṭṭayn" sheet, one might now predict that the 750 sites of the First Interpretation would rise somewhere between the 100% increase for al-Jimāl and the 74% increase for Idham. The outcome might fall somewhere around 1400 sites. In detail, one might expect, for example, about 55-60 kites, several areas of cross wadi walls, and about 120 "farms".

Across the entire area of these three northern maps, a Second Interpretation may be expected to identify almost 3000 sites increasing the site density to 3.6 per sq km. If the three southern sheets were similarly treated, the total could rise steeply there too, giving perhaps an overall total of about 7500, and a site density of 2.85 per sq km (TABLE 5 and FIG. 4).

What is immediately apparent is that the lowest density is for the sheet on which one may see the most extensive modern settlement, namely "Qaṣr al-Ḥallābāt". Density rises as one moves north into the (at that time) less settled area around Umm al - Jimāl, and likewise east into the al- Hibabiya area. It rises steeply beyond each of those to the area around Umm al-Quṭṭayn which, in 1953, was very thinly occupied even in the village itself. Densities remain high to the east again but are starting to

**Table 5.** Comparing the actual and predicted numbers of sites for each of the six sheets of the Southern Ḥawrān on the basis of a First Interpretation and sample Second Interpretations.

	First	Second(Prediction*)
"Khirbat Umm al-Jimāl"	514	1070
"Qaṣr al-Ḥallābāt"	498	750*
"Umm al-Quṭṭayn"	750	1400*
"El-Hibabiya"	1015	2000*
"Jibāl Abū al-Idham"	252	437
"El-Aritein"	917	1700*
<b>Total</b>	<b>3946</b>	<b>7357*</b>

fall away in the Dayr al-Kahf area where there was even then farming along the border but also the beginnings of the full basalt desert and declining scope for permanent settlement. In short, the photographs record most sites in the areas least developed.<sup>7</sup> That is the reverse of what one would have expected the *actual* pattern to have been and alerts us to the significant under-representation likely as one moves westwards into more densely settled.

Overwhelmingly these sites are “corrals”. Already from the First Interpretation, there were 2627 single or multiple corrals and they are the category which increased most in the Second Interpretation. That term implies animal pens; that is doubtless what most were and dating evidence from them may be slight. But the category deserves closer attention for that very reason and because some are plainly more than mere pens for the animals of migrating nomads.

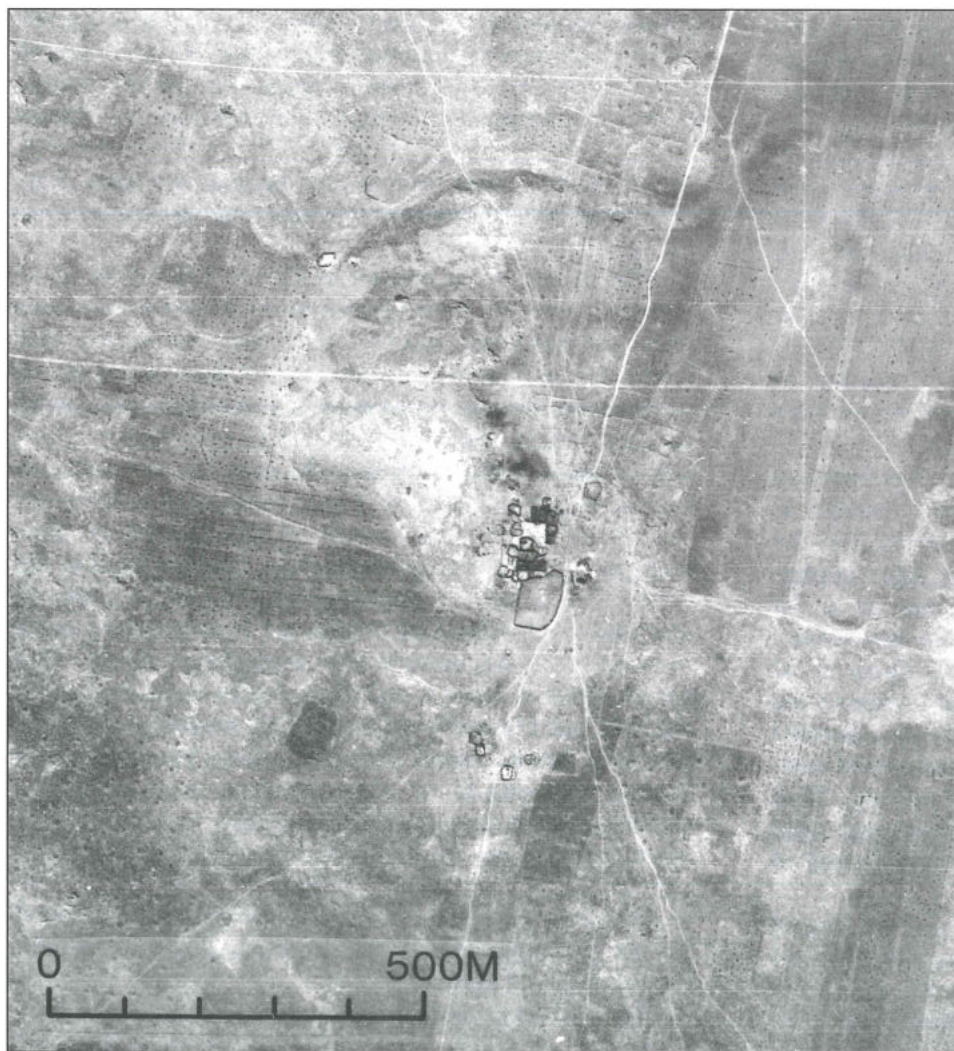
As a result of field-work and closer scrutiny of some of these “corral” sites and their context on the air photographs, it is better to think of at least some as the traces of a building for human habitation surrounded by pens for stock and, perhaps, small gardens. The principle may be

seen widely from prehistoric Britain to contemporary examples in Jordan. In the western part of the Southern Ḥawrān such “farms” often included some arable farming, marked by their location close to a wadi course and traces there of cross walls.

Two other site types are especially numerous: over the six sheets in question the First Interpretation recorded 490 kites. The densities are as follows (FIG. 5). It is striking that in the al-Ḥallābāt area, despite the intense agriculture, clear traces of so many kites can still be found. Kites, because of their size and usefulness as boundaries, are much more resilient to development, leaving tell-tale traces in the landscape even where least expected (cf. Kennedy 1996a: 23).

#### Sites and Ground Survey

Although the photographs are now over 40 years old and the landscape much changed, fieldwork in 1994 had relatively little trouble in tracing many of the sites; a more concentrated search in 1995 in the course of the final season of the Southern Ḥawrān Survey was even more suc-



4. Air photograph of Jubaiya (SHS Site 333) as preserved on an air photograph of 1953 (HAS 61.137).

<sup>7</sup> The same pattern was detectable further west where visible sites declined in number very considerably.

(430)	(261)	(140)
S	Y	R
39	59	19
0.092	0.227	0.136
3254 I Khirbat Um el-Jimal	3354 IV Um el-Quttein	3354 I Jibal Abu el-Idham
(650)	(650)	(430)
54	166	153
0.083	0.255	0.235
3254 II Qasr el-Hallabat	3354 III El-Hibabiya	3354 II El-Aritein

5. Diagram to illustrate numbers and densities per sq km of kites on the Southern Ḥawrān sheets after First Interpretation. Area in sq km in brackets at top.

successful, finding over 90% of sites sought. In most cases it was apparent that the traces on the photograph were indeed those of an ancient structure. However, it is yet to be determined what sort of proportions survive. In specific areas it was immediately apparent that some sites had disappeared entirely under pressure of modern agriculture. Indeed, in the Umm al- Quṭṭayn area and around al-Ḥallābāt it was especially shocking to find some very large sites destroyed very recently by bulldozing for land clearance. Some large structures such as kites survived still embedded in the landscape; conversely, in one striking instance investigated in 1995, two large kites just south of ad-Dafyāna had been removed entirely (FIG. 6). In such instances, however, it is doubtful whether at ground level they would have been recognized as kites without the photograph to guide and explain.

In the light of the foregoing analysis, a few points may be made with regard to the potential of these interpretations for use in conjunction with ground survey. For the final season of the Southern Ḥawrān Survey just completed, the results of this work began by alerting us to the huge numbers and great variety of sites in the landscape - even a relatively inhospitable one as here. There is far more there than one might have guessed and without the air photographs many sites in low relief or incorporated into the modern landscape or lacking artifacts could easily be missed by even intensive ground survey. Then again, many may have been damaged or destroyed since 1953, the air photograph preserving the only record of what they were once like.

The fieldwork strategy for this last season was geared more specifically to locating and exploring specific sites found on the air photographs. Some because they were problematic; for others it was a case of seeking dating evidence from a representative of a type. In most cases a sketch plan at least is most easily prepared from the air

photographs. A second strand to the strategy was to compare in a very direct way the results to be gained from ground survey with what was already known from the intensive Second Interpretation of the air photographs. It was fully expected that the air photographs would not show certain types of site. Our preliminary finding in August-September 1995 allowed us, at least provisionally, to quantify that belief - the air photographs recorded only about half the sites we were able to identify on the ground.

### Air Photographic Research

Twenty years ago, aerial archaeology in north-western Europe created an "information explosion". Many thousands of new sites were recorded and an unexpectedly densely settled landscape emerged in many areas. The evidence offered opportunities of many kinds. Individual sites could be "explored" without resorting to expensive excavation, some sites could be understood better without excavation at all or excavation guided by air photographic evidence. The density of sites obliged archaeologists to reassess their views on land use and population - figures for which have been revised upwards significantly. The great quantities of new information arrived, too, at a point in the development of archaeology where the amassing of data was viewed as a means of permitting greater sophistication in interpretation. Finally, the technique was linked closely to the growing awareness of the need for planning: aerial surveys could help predict damage and alert planners to the consequences of intended actions before it was too late.

The results of our present project - even before completion - offer the same opportunities. It will be apparent from the foregoing discussion of just one region that Jordan too is littered with the traces of human activity. It is clear, too, that the exploration of individual sites can be pursued cheaply and easily through examination of existing air photographs even though taken for non-archaeological purposes. Likewise, future excavation or field survey should begin with a study of the relevant air photographs and they should be kept in hand throughout the work. With a view to assessing what might be achieved elsewhere in Jordan, case studies are in progress for areas in which there has already been a published survey. That for the Wādī al-Ḥasa is nearing completion while that for the al-Karak Plateau is planned. In the meantime, our project as a whole, based largely on these Hunting Aerial Survey photographs of 1953, covering much of Jordan and most of the areas within which there are active fieldwork projects, has produced a mass of data available for use. In the light of the above discussion, one would estimate that the number of sites which might be identified if *all* the photographs were to be re-examined intensively, would exceed 25,000.

The potential for such research in Jordan at this juncture where Cultural Resource Management (CRM) has become a critical issue, is self-evident. The JADIS project





6. Air photograph illustrating two large kites just south of Dafyāna visible in 1953 but destroyed by 1995 (HAS 55.056).

too may be transformed by systematic analysis of *all* the air photographs held by the Royal Jordanian Geographic Centre. A fuller picture of the archaeological heritage of Jordan may be obtained, an evaluation made of the pace and nature of the threat to sites, and plans made to preserve sites and record others before they are destroyed. The importance of doing so should not disguise the difficulties. The work is slow and painstaking, the skills required in separating the work of humankind from that of nature cannot be acquired swiftly, and adequate recording is not yet, in the author's opinion, a fully resolved problem.

Allied with that, one should seek to establish a programme of flying. Initially, that need be little more than some experimental flying to test the methodology in an environment and circumstances far different from those of north-western Europe or North America. In the longer term, however, it would be to the advantage of archaeol-

ogy as a whole if a regular annual programme was to be established with a detailed research design and clearly defined goals. As has been noted above, the Middle East was one of the two areas in which pioneering work in aerial archaeology took place – that in Syria by Père Poidebard in the 1920s and 30s is well-known, as is that by Sir Aurel Stein in Iraq and Transjordan in 1938-1939. Less well-known are the air photographs of archaeological sites in what is now Jordan being taken already in 1918 by the German air force attached to the Ottoman forces.<sup>8</sup> It would be fitting if Jordan were able to benefit from and to be at the forefront of such work once more. And, of course, it is a very cost-effective method of prospection.

<sup>8</sup> I owe this information to Professor Benjamin Isaac of the Dept of Classics, University of Tel Aviv. Cf. Lewis 1987: photographs *passim*; Kennedy and

Riley 1990: 48-49.

**Bibliography**

- Baradez, J. 1949. *Fossatum Africae. Vue aérienne de l'organisation romaine dans le Sud-Algérien*. Paris: Editions Arts et Métiers Graphiques.
- Gilbertson, D. D. and Kennedy, D. L. 1984. An archaeological reconnaissance of water-harvesting structures and wadi walls in the Jordanian Desert north of Azraq Oasis. *ADAJ* 28: 151-62.
- Gregory, S. and Kennedy, D. L. 1985. *Sir Aurel Stein's Limes Report. (The full text of M.A. Stein's unpublished Limes Report, his aerial and ground reconnaissances in Iraq and Transjordan in 1938-39)*. Oxford: BAR Int. Ser. 272.
- Helms, S. 1981. *Jawa. Lost City of the Black Desert*. London: Methuen.
- Kennedy, D. L. 1980. The Aerial Photographic Archive for Archaeology in the Middle East. *Aerial Archaeology* 6: 54-9.
- 1982. *Archaeological Explorations on the Roman Frontier in North East Jordan*. Oxford; BAR, Int. Ser. 132.
- 1983. The contribution of aerial photography to archaeology in the Middle East: with special reference to the Roman period. Pp. 29-36 in *SHAJI*. Amman: Department of Antiquities of Jordan.
- 1987. Aerial Photographic Archive for Archaeology in the Middle East. *LA* 37: 412-4.
- 1992/93. Remote Sensing for Archaeology in the Middle East. In C. E. V. Nixon (ed.), *Chronicle of Excavations, Mediterranean Archaeology* 5/6: 167; Pl. 51.3.
- 1993. Umm al-Quttayn, Southern Ḥawrān. *AJA* 97: 495-7
- 1994. Remote Sensing in Jordan. *AJA* 98:523 .
- 1995a. Water supply and use in the Southern Hauran, Jordan. *JFA* 22.3: 75-90.
- 1995b. Remote sensing in Jordan. *AJA* 99:507-509 .
- 1995c. The Publications of the Princeton University Archaeological Expeditions to Syria in 1904-05 and 1909. *PEQ* January-June: 21-32.
- 1995d. Southern Hauran Survey: 1995 Season, *West Australian Archaeology*: in press.
- 1996a. The archaeology of the Umm el-Jemal area: maps, air photographs and surface survey, in B de Vries (ed.), *Um el-Jemal I*, Ann Arbor (*JRA*, Supplementary Volume): in press.
- 1996b. Remote sensing in Jordan. *Archaeology in Jordan AJA* 100.
- Forthcoming a. *Roman roads and routes in north-east Jordan*.
- Forthcoming b. *Aerial archaeology in Turkey*: in preparation.
- Forthcoming c. *Remote sensing for archaeology in the Middle East*: in preparation.
- Forthcoming d. *Remote sensing for archaeology in the Middle East*: in preparation.
- Kennedy, D. L. and Cowie, R. 1984. Archaeological Explorations on the Roman Frontier in North-East Jordan: some further notes. *ADAJ* 28: 321-332.
- Kennedy, D. L. and Freeman, P. W. M. 1995. Southern Hauran Survey 1993. *Levant* 27: 39-73.
- 1996. Southern Hauran Survey 1995, *AJA* 100.
- Kennedy, D. L., MacAdam, H. I. and Riley, D. N. 1986. Southern Hauran Survey, 1985. Preliminary Report. *ADAJ* 30: 145-53; 452-5.
- Kennedy, D. L. and Riley, D. N. 1990. *Rome's Desert Frontier from the Air*. London: Batsford/ Austin, TX: University of Texas Press.
- Lewis, N. N. 1987. *Nomads and Settlers in Syria and Jordan, 1800-1980*, Cambridge CUP.
- Mouterde, R. and Poidebard, A. 1945 *Le Limes de Chalcis*. Paris: Geuthner.
- PES = Butler, H. C. et al. (1907-1949) *Publications of the Princeton University Archaeological Expeditions to Syria in 1905-1905 and 1909*, 4 vols in many parts, Leyden.
- Podebard, A. 1934. *La Trace de Rome dans le Désert de Syrie*. Paris: Geuthner.
- Riley, D. N. 1982. Antiquities recorded by old photographs taken by the Royal Air Force of the desert near Azraq Duruz. Pp. 345-355 in D. L. Kennedy (ed.), *Archaeological Explorations on the Roman Frontier in North East Jordan*. Oxford: BAR Int. Ser. 132: Riley, D. N. 1998. *Air Photography and Archaeology*. London: Duckworth.
- Wilson, D. 1982. *Air Photo Interpretation for Archaeologists*. London: Batsford.