

Michael Fradley
University of Oxford
michael.fradley@arch.ox.ac.uk

Michael Fradley

Northern Jordan from the Air: Landscape Change in the Governorates of Irbid, Ajlun, and Jarash over the Last 100 Years

Introduction

This paper will discuss the work of the Endangered Archaeology in the Middle East and North Africa (EAMENA) project at the University of Oxford in documenting a set of historic aerial photographs covering part of north-western Jordan, and the value of this data for recording heritage sites and understanding landscape change in this region. This photograph set relates to a mapping mission undertaken by the British forces in late 1930, providing near complete coverage of the eastern Jordan valley from the Syrian border in the north to Wādī az-Zarqā' at the southern end of Ajlun governorate. The extensive coverage of this photograph set is important because it enables the assessment of an extensive area as captured in 1930, which can be compared with recent commercial satellite imagery, as well as intervening comparable data sources such as the U.S. Corona satellite imagery from the 1960s. The paper will highlight

the archaeological potential of this 1930 data source, and the value of making this data open-access via systems such as the EAMENA database.

The Jordan Valley Survey, 1930–31

Historic aerial photography is an invaluable dataset for understanding long-term landscape change and its impact on heritage sites. Analysis of these sources and comparison with more recent satellite imagery can allow us to detect sites that were undocumented prior to being buried or destroyed by more recent activity, as well as giving a broader understanding of the rates of landscape change. Even in the context of the first mass use of aerial photography in the Middle East during the First World War, the academic potential of this imagery was being identified by Hugh Hamshaw-Thomas, who had operated as an RAF intelligence officer on the Palestine Front during the war (Thomas 1920a; 1920b).

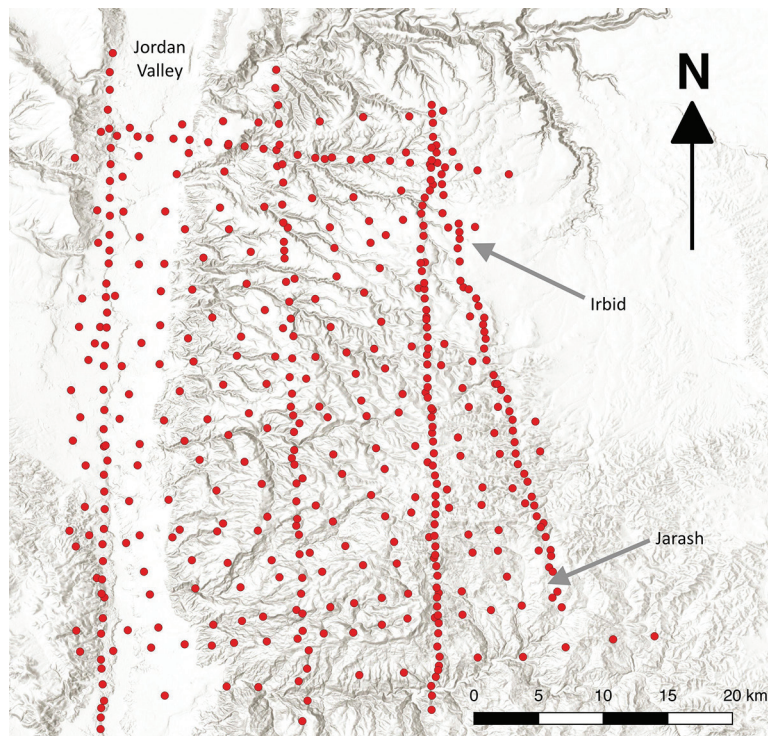
In spite of the case made by Hamshaw-Thomas for the value of aerial photography in the region for supporting archaeological research, as well as other disciplines such as botany, geology, and meteorology, limited scientific use was made of this material, in part because of restricted access beyond official military and mapping uses. It is in this context that the subsequent use of aerial photography in this region by individuals such as O.G.S. Crawford and Auriel Stein are relatively exceptional (Banks 2017).

The survey of the eastern Jordan Valley was undertaken to help plan the construction of a railway line connecting Haifa and Baghdad (Anon. 1932: 240; War Office 1936: 137–42). While the British Mandate of Palestine was relatively well mapped, there was a deficit of topographical mapping east of the River Jordan. From the end of the First World War, the British administrators of this region had considered developing a rail connection from the Mediterranean to Baghdad, although development was held back by issues of investment and a lack of formal agreement on the defined borders of the Mandate of Transjordan. However, renewed interest by 1930 led members of the Air Survey Committee to push for the use of the new photogrammetric methods of air survey that they had developed, a radial lines technique known as the “Arundel Method” (Collier 2006: 104–5), which would support their decision of which route to take across this region. This survey would lead to the construction of a pair of 1:50,000 topographical maps (General Staff, Geographical Section 1933a), published, and an earlier set of six 1:24,000 maps (General Staff, Geographical Section 1931). In terms of practical application, this mapping mission was too slow to influence the route decision made by ground surveyors and engineers, although the cartographers responsible for the air survey work felt the project would still be useful for administrators in the future. In turn the railway project itself

would be cancelled, and instead a formal motor route was established (Briggs 1939), which was apt as the main purpose of the link was to facilitate the transfer of oil from Iraq to the Mediterranean, as evidenced by the rapid establishment of a pipeline along a comparable route.

The set of photographs discussed in this paper relate to an aerial mapping mission across the eastern section of the northern Jordan Valley (FIG. 1). Overlapping strips of photographs could be used to photogrammetrically construct topographical maps, utilizing the same basic principles as our contemporary 3D digital photogrammetry, and differs from the more standard use of aerial photography during this period for observation, military interpretation purposes, or constructing less accurate map mosaics. While there had been rapid developments in photogrammetric mapping during the First World War on the Palestine Front, when it had enabled surveyors to map regions in inaccessible conflict zones or behind enemy lines, there had been limited investment by Britain after the war as surveyors returned to ground survey techniques that they considered more accurate and cost-effective (Gavish and Biger 1985; Collier 1994; 2014). After the war there were calls to continue this work, including by Hamshaw-Thomas and Stewart Newcombe, the latter undertaking a limited survey of the Nile Valley in 1920, there is little evidence of continued aerial mapping in the region during the 1920s (Newcombe 1920; 1921a; 1921b).

A renewed push by the British Air Survey Committee following a change of leadership in the 1920s saw a small group of Royal Engineers in the British Army able to take advantage of new mapping opportunities in the Middle East region to trial new methods that they had been developing (Collier 2014). The British Royal Air Force (RAF) took the photographs as part of a mapping mission, largely during November and December of



1. A plot of center-points of vertical aerial photographs taken by the RAF in November–December 1930 in north-western Jordan. Background mapping: ESRI World Hillshade.

1930. Although the mission was officially undertaken by 14 Squadron RAF who were stationed in the mandates of Palestine and Transjordan, the work was actually undertaken by a detachment of 45 Squadron RAF, B Wing, who were stationed in Egypt. It has not been possible to uncover exactly why a detachment from 45 Squadron RAF was needed to undertake this survey, as well as a subsequent survey of the al-'Azraq lava fields (General Staff, Geographical Section 1933b), rather than the crew of 14 Squadron. This survey is particularly interesting from an archaeological perspective, as the cartographers included details on the location of desert kites and stone enclosure features on the six maps from this series that were published. It is possible that members of 45 Squadron had already received training in air mapping techniques, and had received cameras and camera mountings for their

aircraft, having been involved in a survey of the Suez Canal Zone earlier in the year in conjunction with Lieutenant John Salt, the Research Officer of Britain's Air Survey Committee (General Staff, Geographical Section 1932).

The mission was flown in a series of linear, parallel runs, with a smaller number of cross-strip runs to ensure the integrity of the layout of the main runs. Pre-radar, these runs would have to be set out on the ground, incorporating ground control points that could be used in the triangulation process, while the flight runs would have to rely on the skill of individual pilots to fly in straight lines at a fixed altitude over long distances. In the related survey of the al-'Azraq lava fields through into 1931 the team would also experiment with a gyroscopic rudder-control to maintain route and altitude with some success, but in this earlier mission it is

still possible to identify areas of pilot error in the “swerving” of the photograph run alignments (War Office 1936: 140–1).

In the UK staff of the Geographical Section, General Staff (GSGS) constructed the resulting maps. Multiple prints would be made from the negatives, with each set being used to inform different components of the map. An information strip would be photographed and appear on the right-hand side of each print, giving information such as the time, altitude, and mission data, although in many cases this information is masked by a poor exposure. Different portions of these photograph sets have been preserved, and make up the archive scanned by the EAMENA project. Some images contain details drawn over the prints in colored pencil or ink by the cartographic team, including the course of roads, names of settlements, and topographic contours. In some cases, pencil notes were also scribbled on the reverse of the images, which often depict the photogrammetric process, possibly as one member of staff was explaining it to a less experienced staff member.

The digitized collection is from a partial set of original prints used during the map-construction process in the 1930s, and have therefore been subject to a certain amount of deterioration and wear over time. Several prints would originally have been made of each negative set to develop a different part of the map content (*e.g.*, contours, control points, toponyms). Not all of these groups would require every overlapping photogrammetric image, and as such the surviving digitized collection only includes every other image in the majority of east-west traverses. Other damage, such as the use of pins, staples, and adhesives tapes on the face of the photographic prints has also left damage, which in some cases can be mistaken for features on the ground. However, in spite of these deficiencies, the collection still holds a great deal of potential

for further scientific study, and the paper will now briefly cover some examples.

The Changing Landscapes of North-Western Jordan

While there has been significant change across this area of Jordan, the most complete alteration has been in areas of agricultural and urban intensification, such as the Jordan Valley and in the area around Irbid. It is in these areas that the 1930 aerial photograph collection has the greatest potential to inform of landscape change in the region, and potentially identify archaeological sites lost or significantly altered over the last 90 years.

In the Jordan Valley, near the Wādī az-Zarqā’ at the southern end of the survey area, it is possible to see the two of these aspects at play (FIG. 2). A comparison between a digitized print from this area and any recent satellite image of this area shows a landscape changed, with the expansion of settlements, laying out of modern roads and a complete change of agricultural regime in the intervening period. Additionally, it is possible to analyse a number of potential mound (*tall*) features extant across this area. While a number of these features have been documented previously by archaeologists, this imagery enables the sites to be reassessed. This includes an ability to study the wider landscape of these sites, including their relationship with former drainage channels that are prominent on these historic aerial photographs.

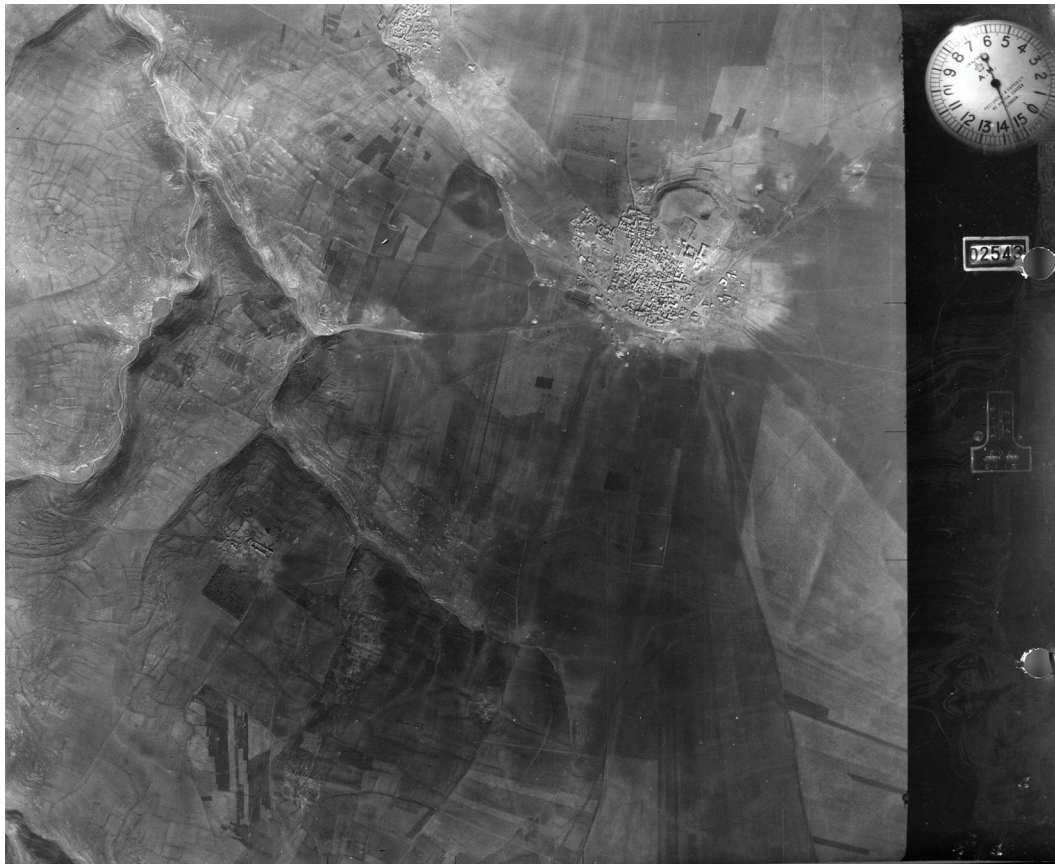
The area around Irbid has also changed dramatically since 1930, most conspicuously through the rapid expansion of the city from a small, mound-side settlement to an expansive urban center over the past 90 years (FIG. 3). As in the Jordan Valley, there is the opportunity to analyse documented archaeological sites, prior to the impact of more recent encroachment and development. The fabric of settlements such as Irbid can also been assessed in



2. An aerial photograph of the Jordan Valley north of the confluence of Wādī az-Zarqā' and the Jordan River, taken on 5 December 1930. Potential mound features are highlighted by red arrows. EAMENA image reference: JORDAN_45B-SQN_JordanValley_Run-C_9977.

terms of understanding the modern urban heritage of the city. There is also the evidence of archaeological sites that have not been documented. An example of this can be seen south of Irbid, where a large, trapezoid-shaped enclosure can be seen beneath the agricultural system in place in 1930 (Fig. 4). Only the southern section of

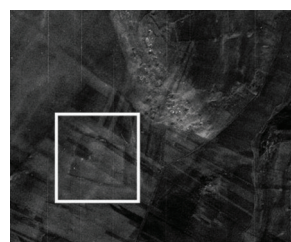
this feature is now visible on contemporary satellite imagery, possibly as a result the intensification of the agricultural regime in this area, and is unlikely to have been identified without the clarity of its visual signature as it appears in the historic aerial photograph.



3. An aerial photograph of Irbid from November or December 1930, when it was relatively small settlement, visible in the upper-right side of the image. Most of the information strip has been lost in the exposure. EAMENA image reference: JORDAN_45B-SQN_JordanValley_Run-G_2543.

Conclusion

The 1930 aerial survey of the east Jordan Valley have a clear potential for significantly developing our understanding of the historic landscapes of north-west Jordan, as well as informing what processes have led to the loss of heritage features in the region. Further detailed and systematic analysis of this photograph set is required, and to support that process these digitized image files will be uploaded on to the EAMENA database platform, where they will be available as an open-access resource for registered users.



4. A detail from an aerial photograph taken south of Irbid from November or December 1930. A trapezoidal enclosure can be seen as a cropmark, highlighted by the grey box. Note the possible features or pits visible on the rock outcrop, to the north-west of the of the enclosure. EAMENA image reference: JORDAN_45B-SQN_JordanValley_Run-G_2559.

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