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Irrigation Systems at Dayr 'Allā

Introduction

The excavations at Dayr 'Allā in the central East Jordan Valley, were started by Leiden University in 1960 and resumed in 1976 – in cooperation with the Department of Antiquities of Jordan, with Yarmouk University as a third partner since 1980. The [in total] fifteen large and small scale field seasons dealt with the MB, LB, Iron Age and Islamic Period use of the site and its surroundings. They provided a wealth of information about the Iron Age – the period of concern of this contribution.

Iron Age I strata were excavated in the 1960s and Franken produced his first major and seminal archaeological publication about the results in 1969, dealing with the stratigraphic and ceramic aspects of these strata (Franken 1969). The Iron Age II and III strata (ninth till forth century BC) were excavated mainly during five seasons in the 1970s and 1980s, but also earlier and later seasons (up to and including the latest one in 2004) provided important information. Their data are now under study for final publication, but preliminary reports are presented in Van der Kooij and Ibrahim (1989) with additions in Ibrahim and Van der Kooij (1997), and Van der Kooij and Kafafi (in preparation).

One of the striking features of the use of the site during this period is the alternating variety of intensity, from being densely inhabited until hardly used, or not at all used, as well as the different ways the peaks of use started and ended (see Van der Kooij 2001). The periods of intensive use (particularly the phases IX, ca. 800BC, and VII, ca. 700BC) provided large amounts and a great variety of plant remains, showing that not only animal husbandry, but also varied agriculture made up a great deal of the economy of the populations of these periods.

The current physical geographic condition of the landscape surrounding Dayr 'Allā provides a good view of the agricultural possibilities, which is taken also as valid for the past of the Iron Age II period, since no climatic changes are recorded since that time (cf. e.g. Van Zeist 1985).

The surrounding land of the site is part of the alluvial floor of the Jordan Valley, with saline and alkaline lacustrine sediments (cf. recently Hourani 2002: 49-57). At the eastern edge of the East side of the Valley the soil has a lower salinity than near az-Zūr, to the west, but is still not optimal for agriculture (JVP 1969 Annex C: 43f). The climatic situation gives the region of the site a steppe character, with a rainfall average of 263mm, varying between 118 and 432 at Dayr 'Allā itself in the 1950s and 60s (JVP 1969 Annex B: 8) and a very high mean annual Potential Evapo-transpiration of ca.1900 (JVP 1969 Annex G: 26).

With these circumstances some rain-fed agriculture is possible now, as it was in the Iron Age. However some archaeological plant remains from that period, as well as from the LB Age, indicate the use of irrigated fields (Van Zeist and Heeres 1973: 27, dealing with flax).

This prompts questions regarding the organization of agricultural activities and furthermore, the fluctuations of intensity of use of the site (and surrounding land) also prompt questions regarding how and why the technology of irrigation was introduced and again abandoned.

In an attempt to answer these questions we have to know address three specific subjects, namely:

1) how irrigation agriculture generally looked — technically, economically and socially — and how it may have changed;
2) how this general image might be applied to the the Dayr 'Allā landscape; and
3) how this 'localised' image could be applied to

the specific Iron Age II periods.

This means that four steps have to be taken to answer the questions. The first and second step are ethnographical/ ethno-historical descriptions and analysis, namely about general systems of irrigation agriculture (and their changes), and about local landscape specific systems. The third is the construction of a hypothesis for the archaeological situation, and the fourth is a discussion of the application of this hypothesis to the specific archaeological situation.

In this contribution the focus will be on the first two steps, in particular in relation to the technical and economic aspects.

Systems of Irrigation Agriculture: A General View (Step1)

Irrigation agriculture is studied by several disciplines, such as physical and social geography, agriculture sciences, economy and anthropology. It appears that the interaction between these disciplines is not always optimal, especially when dealing with technical and social aspects, but in modern development studies bridging interdisciplinary approaches are often used.

In archaeological studies a fully interdisciplinary approach is necessary, in order to take account of all possible factors that may have played a role in establishing, using and abandoning such a system, during the process of interpretation of the — by definition — scanty archaeological data.

In the following paragraphs the two, chronologically distinguished, main parts of this general view will be considered:

A. How does an irrigation system work — providing a synchronic view;
B. How does such a system develop, how is it maintained or changed and how is it abandoned — providing a diachronic view.

A. How Does an Irrigation System Work; its Technical and Social Aspects

Scanning of some relevant accessible dictionaries provides elements of a definition of irrigation (Goodall 1987, s.v.): "The artificial distribution and application of water to arable land to initiate and maintain plant growth". The author adds that this "is essential to farming if annual rainfall is less than 30cm, desirable where rainfall is less than 50cm", and is meant to spread water (time-wise) more adequately than rain does. His additions in fact correct his definition, because irrigation does not necessarily initiate plant growth except in completely dry regions or in a dry season. In most of the Middle East this dry season is the summer period, with the production of summer crops. In fact in most regions of the Levant irrigation-agriculture goes together with, or functions in addition to, rainfed agriculture in the same field-system, for example in the 200-400 isohyète zones, and even in the dryer *ghouta*s in Syria: see Wirth 1971: 200f.

A German definition (Meyers' 1986: 51), using the term *Bewässerung*, takes irrigation as the total of measures taken to humidify the soil in order to take care of plants by providing water beyond the natural precipitation. It is interesting to note that this dictionary defines irrigation-economy (*Bewässerungswirtschaft*) "as the total of measures and arrangements (*Einrichtungen*) in order to rationally provide for the water-needs of cultivated plants". It basically includes availability of water and distribution of water, together making up an irrigation system.

These definitions adequately describe the use of irrigation. In this first step we have to find out how a system with such aims works, but for this study the search is limited to pre-modern examples, especially while dealing with technological aspects. In an archaeological study, an irrigation system has to be taken as an "artefact", that is produced and used as part of a small scale or a large scale social system, living and working in a given environment. It may be preliminarily assumed for the archaeological application at Dayr ʻAllā that we are partly dealing with a *peasant* economy, with as its "key dynamic" the household structure, and with the "production and consumption … oriented to the household", but with also "some economic and political obligations to outside power-holders" (Spencer 1996). We may also be dealing with a kind of market economy, where a large surplus is to be produced, with a different economic, social and political organization behind both the production and the means of production.

Technically (artefactually) different systems of irrigation can be distinguished. Irrelevant for this study is the so-called flood irrigation as brought about by a swelling river that inundates the fields during a limited period of time a year. We know this method from Egypt and Mesopotamia.

With the other methods of irrigation five elements form the physical make-up the system, each with its own techniques, organizations and activities of man power, as well as animal power:

1. The water source (a river, a lake, a well, a source; all with a device to separate and extract the water needed).
2. The way of bringing this water towards the fields (canal, *qanat* / *falaj*-tunnel).
3. The way to move water from the canal onto the fields (lifting, or gravity/flowing method); with some very small systems the canal may be the same as the water source.
4. The way to spread water over the fields (ditches — of different lay-out, or flooding).
5. The way to drain off or flow off the water from the land.

Each of these elements demands quite an investment to be prepared, as well as maintainance of a significant labour force, and an additional care to prevent salinity.

With these elements one could classify irrigation systems in a variety of ways, but an oft-used classification is the one based upon element 3 (the way water is brought onto the fields) and is divided into lift irrigation and flow irrigation:

- Lift irrigation means that water is available at a lower level, generally in a canal (this is also the case in Egypt and Mesopotamia) and has to be lifted up, with a special device (and power), on to the fields.
- Flow irrigation, or gravity system, has the water supply at a higher level already, and can be brought on the fields via an opening in a dike, whether a gate or otherwise.

The first system generally deals with horizontal flat landscapes, the second with a more or less sloping field-floor. This is, for our purpose, an adequate distinction because according to a study in Egypt (Mehanna, Huntington and Antonius 1984: 5,134) "the two technologies determine the style of social institutions responsible for the allocation of water, labour time and maintenance", as far as they could deduce this from Egyptian practice. These "styles" are described thus:

- A lifting system (in the Delta) produces a *saqia* ring (group), and cooperation is among a relatively small and stable group of people.
- A gravity flow system (in the Faiyum) produces a large group, organized according to principles of power, patron-client relations, based on a single source of water.
- A mixed system with gravity (multiple source) and lifting (in Minia; at the Ibrahimyeh canal - higher up along the Nile) produces combinations (teams) of farmers of relatively equal status, shifting, forming and reforming according to precise needs and opportunities.

Furthermore it appears that here the water source is also an important variable.

This point brings us to the **economic and social aspects** of irrigation systems, because the kind and amount of work needed for these systems have a strong economic impact.

The main infra-structural elements mentioned above, namely the devices to take water from a source and to bring water up to the fields, demand a lot of work to be set up, but they may exist for a long time — needing only occasional repair or adaptation. The other three elements, especially the delivery of water to a field (by lifting or by opening dykes) and the spreading of it across a field, requires much work with each new crop:

- Often ploughing at least twice;
- Watering frequently (summer crop for example each 10-14 days, cf. Wirth 1971: 232); and
- Frequent weeding in the dry season since unwanted plants grow well too.

This requires a labour investment 10 times larger than with mechanized winter crop (Wirth 1971). Indeed, figures have been produced for the relationship between extra production and extra labour with irrigated farming (see below).

All this work is organized since it has to be repeated regularly to ensure a reliable production. Particularly important issues within this **(economic) organization** are the time at which the water is made available and the amount of water. These may differ around the year, especially if the source varies in amount available, by water shortage, which may cause more fallow land and another choice of crop. In many cases the distance to the source also requires a difference of amount of water (or another frequency of watering) available for a field.

In any case it has been concluded (with figures) that the extra production needs a lot of extra work (Boserup 1965: 39f, based upon data from China and India). The total labour input per irrigated crop/hectare may be twice as high as with dry-cultivation, even when watering is by gravitation and requires little labour. Much more labour is required for lift-irrigation.

Altogether, on average, there is a lower production per labour hour compared to dry farming. This is even more marked when animal workforce is required and taken into account, because fodder is produced in the fields.

In irrigation systems the main **social issue** is water rights (the assignment of water), but also assignment of land (depending on the organization of land ownership), and the obligation of maintenance. These are very sensitive issues and have to be organized adequately (Diemer and Slabbers 1991). Some examples may clarify this issue.

Wirth (1971) mentions that very old customary laws control the division of water for day and year. They are often disputed, not well fixed and often conflicting. On the other hand studies often refer to the smoothness and effectiveness of the organization. Fernea (1970), for example, mentions for a village in S-Iraq, that a tribal system (shaykh as leader) provides a perfect realization of the irrigation, based upon firm rules of solidarity. The right of water may be established by labour investment in the system/ infra-structure (Coward 1985 — as quoted in Diemen and Slabbers 1991: 112). Often the producers, the peasants/households, form commonly the organization. This could mean one village, but also several villages – if they are connected by one system, or one set of systems (cf. Wirth 1970: 384).

It should be added here that studies hardly deal with the issue of co-existence of cattle, sheep and goats with this agricultural system. These animals have to be kept separate from the vulnerable physical parts of the system, at least during some seasons, which means the implementation of additional special arrangements.

We come now to the second question:

3. How and why does an Irrigation System Come up, is it Changed and Abandoned?

Basic to answering this question is still the study of the Danish economist Ester Boserup about the conditions for agricultural growth (Boserup1965). She opposed the functionalistic view, which was common at that time, that improved techniques are necessarily introduced from outside into static primitive communities. She makes it clear that rather the opposite is true, namely that profound changes are occurring within primitive agricultural communities by internal forces.

The process of introducing these innovations has also been studied by other scholars and technicians working in the Third World, where they are always dealing with the problem of introducing new technologies effectively. For example Dutch scholars from the Agricultural University at Wageningen are attempting to understand 'failure' when new technologies are introduced, in order to improve the introduction. Thus Diemer and Slabbers (1991: 111f; cf. also Diemer 1990) conclude that it does not work when a new technology is simply imposed (which is often done), but that it should be integrated in the existing system — including its social aspects. They understand technique as a social process, following Pfaffenberger (1988). To this may be added the experience of Boserup (1965). The introduction of a new technology will work only if the receiving society is ready for it, or up to it (or to its results), which indeed is a normal observation in acculturative situations. In her opinion the society should be in need of more agricultural food production — a need provoked by population pressure.

Boserup's **model of intensity** of land use is based upon the number of crops and consequently also upon the length of lying fallow. This model is suitable for our purpose. Her five stages, or levels, of intensity are (Boserup 1965: 15f; cf. discussions in Downing and Gibson 1974):

- Forest-fallow cultivation: plots of land are cleared, used some years, then left for many years to become forested again;
- Bush-fallow: the same, but left during a shorter period, giving only bush vegetation the opportunity to grow;
- Short-fallow cultivation (or "grass-fallow") with one or a few years fallow, giving only "grass" the opportunity to grow;
- Annual cropping: land is left uncultivated for several months only, but with fallow rotation;
- Multi-cropping, with two or more successive crops every year.

"Annual cropping" is done with rain-fed farming in semi-arid regions, and in the same regions multi-cropping is only possible by irrigating the fields during the rainless but warm seasons. Such an intensity of use and high production can only be maintained for some time if fertilization or long-fallow, is used as well.

This innovation requires new techniques and organizations, as well as new working habits, with many more hours of work, during all seasons. In Boserup's opinion the internal reason to make this change (if the technology is within reach) is an increase of the local population. Her work is based on a basic subsistence economy. However, for ethnographic as well as historic reasons we also have to take into account a kind of specialization of producing agricultural surplus when dealing with the Jordan Valley, connected with, for example, tax and special products — such as sugar cane during the Ayyubid and Mamluk periods.

It should be added, that innovations may also concern new crops.

Ethnographically/-historically, in the Levant the general winter crops are/were wheat and barley, and some vegetables. Summer crops are/were often vegetables, with sorghum and sesame, and fodder such as clover and lucerne (cf. among others Wirth 1971: in Syria also cotton), as well as tree fruits, often grown without irrigation.

Regional Specification: Dayr 'Allā Region (Step 2)

The regional example is specified in this paper for the physical aspects only. The specification of social aspects of the irrigation system has to be necessarily dealt with at another occasion, in order to develop a reference of interpretation when dealing with the material remains from the Iron Age.

The immediate surroundings of Dayr 'Allā provide a large piece of land suitable for agriculture, extending about 3kms to north, west and south and 2kms to the east (totaling up to 2 000ha), except for a salt plain of more than 200ha to the south-west. Since the end of the 1950s the region has a new irrigation system, because of the central governmental intention to strongly increase the agricultural production of the Jordan Valley and to take part in a national and international market for agricultural products. The development of the new system in the East Jordan Valley has been studied by Sharif Elmusa (1994), with a focus on economic and social aspects, and (more journalistically) by Rami Khouri (1981).

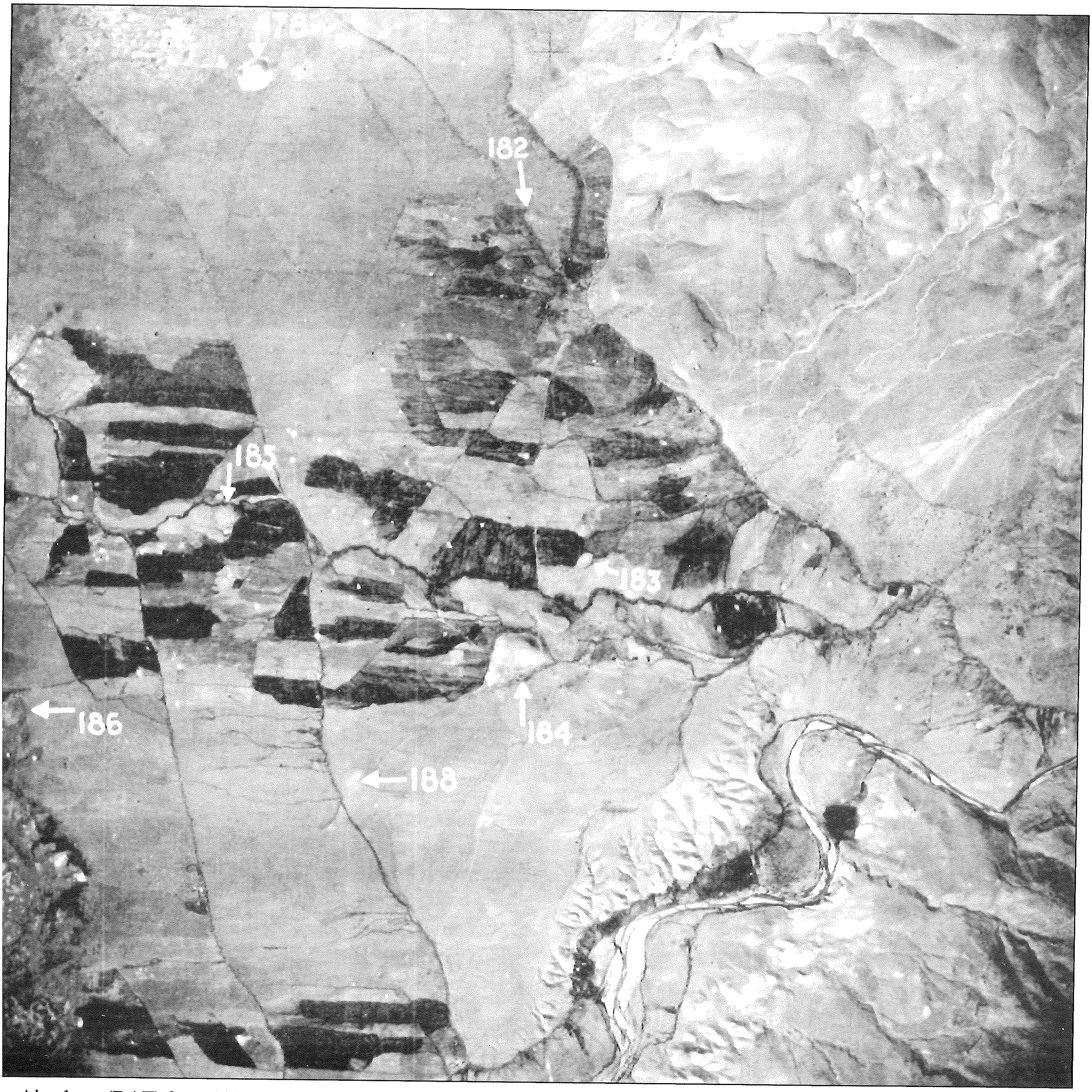
The Sub-recent Irrigation System

Before this new system was introduced another, but local system existed, organized by local authorities, namely some tribes, and used by the ploughmen (*harrath*), for basically a subsistence economy. The old system has been described to some extent by Mohammed Tarawneh (1989) in his study of the social aspects of the transition from the old to the new system. References to that system are also given in Van der Kooij and Ibrahim (1989: 12f), based on interviews by Mr. Mohammed Jamra. Presumably the population was very small, but tax demanded parts of the surplus as did nomadic raids. The British Mandate counted that one family needed 130 dunums of rain-fed fields or 40 dunums of irrigated fields, to feed itself (Tarawneh 1989: 36). This would mean for the Dayr 'Allā region, with its 20 000 dunum of land, that 150 families could be fed by dry-farming, and 500 by irrigated farming.

The structure of the system has not been studied or accessibly published, although the British topographic map of the region from the 1940s – partly reproduced in Van der Kooij and Ibrahim (1989: 11, fig. 4), as well as some other maps, give the three main canals running SE to NW. Also the names of two canals are given: the eastern one (*qanat el-mazariiya*) and the middle one (*qanat el-yahudiya*). The system is also visible on the Royal Air-Force photographs from the same time and published by Nelson Glueck, when archaeologically exploring Eastern Palestine (Glueck 1951: figs 96, 100, 101, and 102). The photo was not taken in the rainy season, because no "wild" green is shown. (FIG. 2) is a provisional map drawn from these photographs and indicating the main canals (running SE to NW) as well as the secondary canals (generally running E to W). The RAF air-photos (FIG. 1) show the watered plots of land with dark plant growth. They also shows that only a part of the system was used at that time and that parts were neglected. It should be added that some of the east-parts of that system (east of the current East-Ghawr canal, specially east of Dabbab) were still in use till a few years ago.

The system's basic elements are clear (FIG. 2):

1. The water source is az-Zarqā' River, with its year-through water, though most in winter.
2. The three canals mentioned above tap water at three locations to bring it towards the field-areas, running almost horizontally, following contour lines. Al-Mazariyya takes it from a place 1km east of al-Ḥimma (behind the hill-ridge of "Tall Mughanni", beyond the map), with a diverting dyke system. The second canal (al-Yahudiyya) takes water from az-Zarqā' River 1km west of al-Ḥimma, following the edge of az-Zarqā' flood-plain to get to the Valley floor near az-Zarqā' bridge. There the third canal may split from the second, apart from taking water directly from az-Zarqā', further to the NE.
3. Each canal has a number of outlets into secondary canals, generally running east-west, that



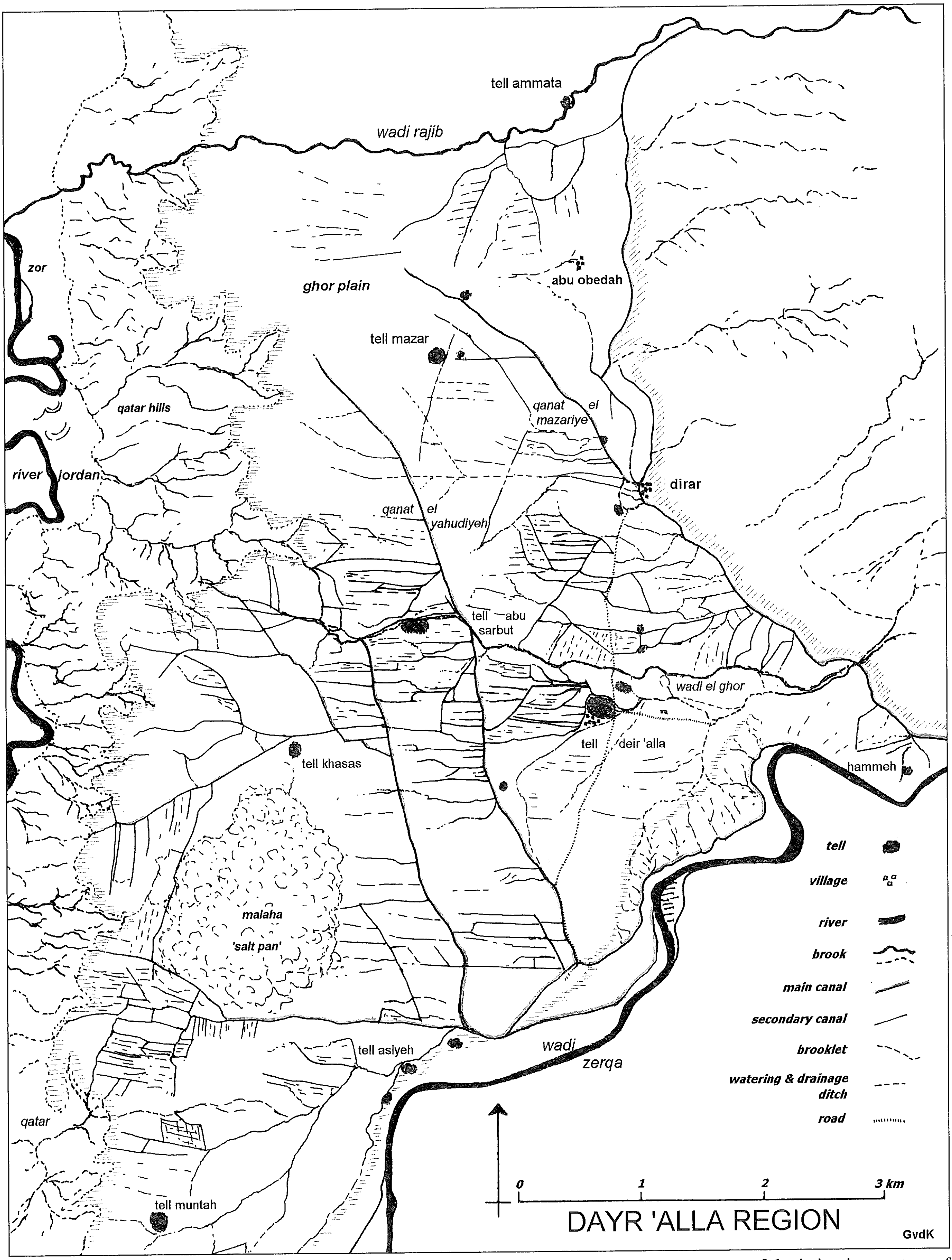
.. Air-photo (RAF) from 1940s of the Jordan Valley landscape around Tall Dayr ʻAllā, showing irrigated fields. Number indicate sides described by Glueck, such as 178 al-Mazār, 184 Dayr ʻAllā, 185 Abū Sarbūṭ and 186 Ikhaṣāṣ (from Glueck 1951).

may have branches running parallel to the main canals (thus in almost horizontal position).

4. From these secondary canals the water is tapped to flow over the fields. However in places this appears to have been done also from the main canals. The system is based on gravity, the fields having a gradually decreasing slope from east to west, from 4m to 2m height over 100m distance. The method of flow is not clear, but traditionally the system used parallel (ploughed) grooves-and-ridges for the water to run through.

5. Drainage seems to have been taken care of, in places, by small canals carrying away the flown-in water from the fields.

The organisation of the large system and the social aspects need further study. For now it is important to find out about the period of use and perhaps the origin of this sub-recent system.

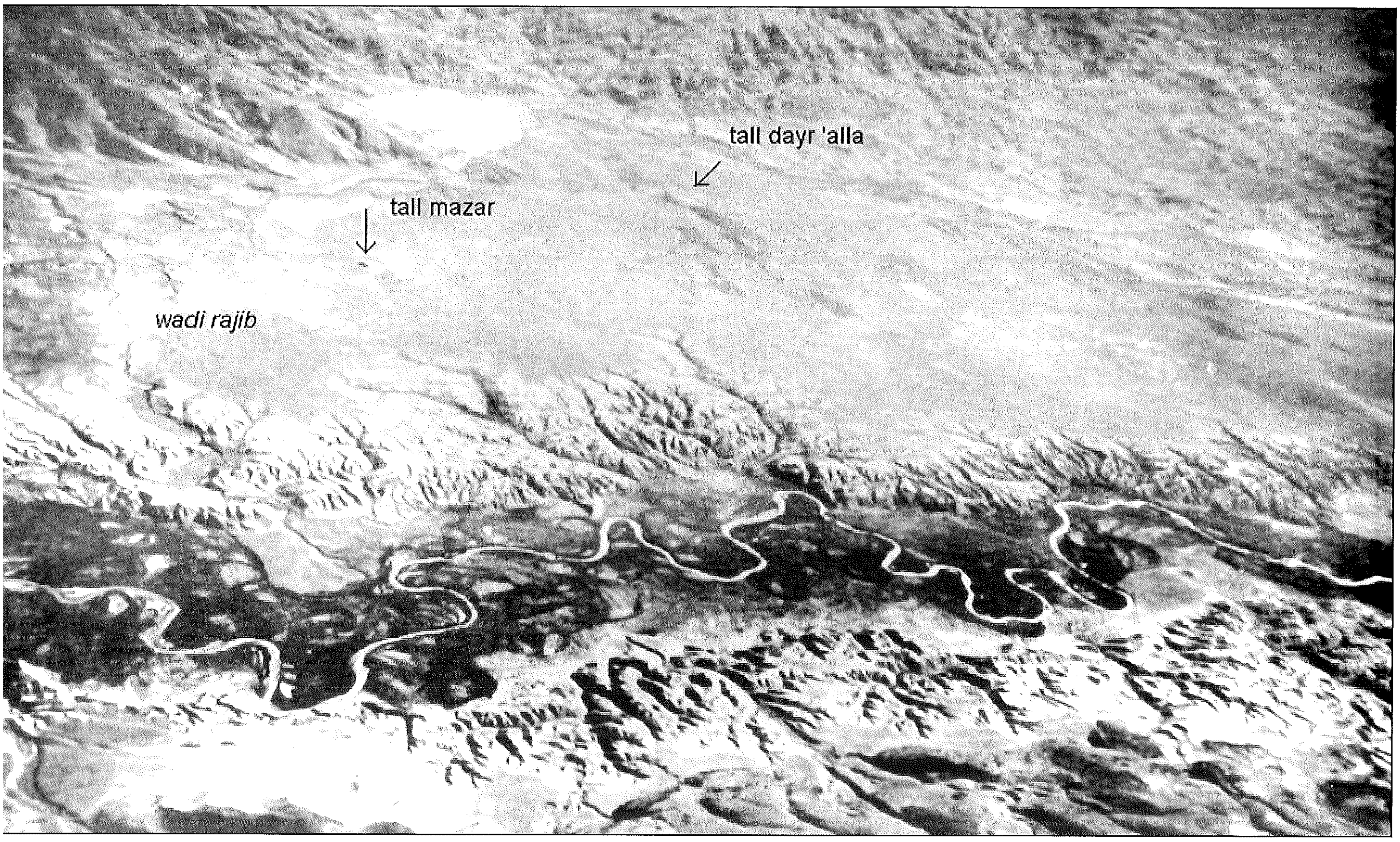


2. Drawing of the Jordan Valley landscape surrounding Dayr 'Allā, with indications of features of the irrigation system of the 1940s (mainly after air-photos in Glueck 1951).

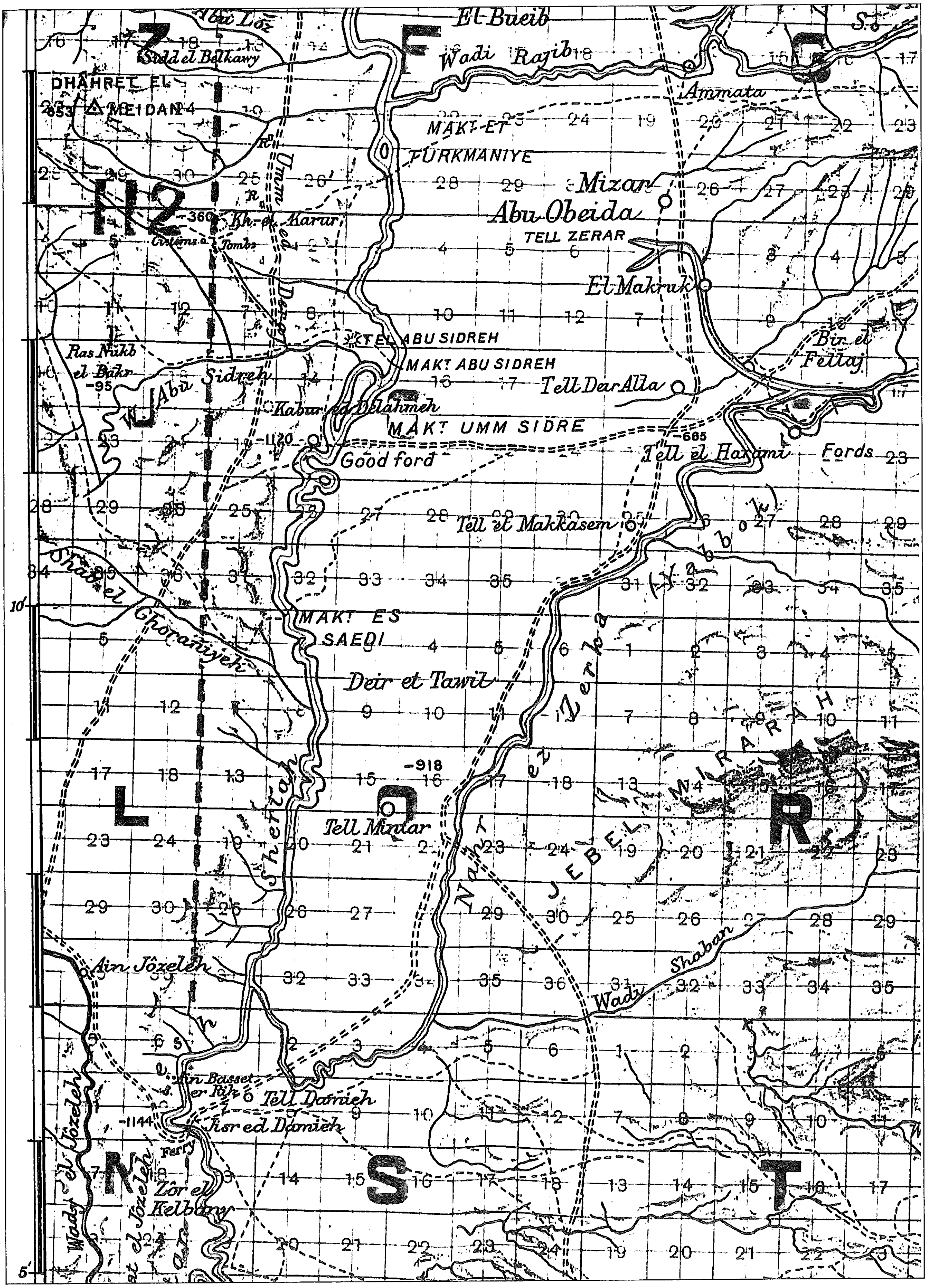
The Antiquity of this System

Going back to the 1940s, some information may be gleaned from old photographs, maps and traveller's accounts. In fact the system appears already very clearly in use on a German air-photo from ca. 1917, published by Gustav Dalman in 1925 (FIG. 3), which is surprisingly early, considering the largely pastoral and nomadic way of life of the local population. There are also indications, on some opographic maps of that same time, of the Mazariyya canal (FIG. 4). However it [probably] does not appear on the earlier Schumacher based maps and he Ordnance survey map of 1867, nor on the best preceding map by Charles van de Velde of 1858 (see FIG. 5). On the other hand, from travelers accounts, especially Selah Merrill's from 1881, it appears that canals existed at that time and were apparently not made by his local informants. We must conclude that we are dealing with the same system. On the 1917 air-photo the same large system [as hown on the RAF photo] is visible, including the hree main canals and their length. It is also clear hat only a small part of the system was used, and even less intensively than in the 1940s. The development of such a large system cannot be expected during the nomadic-pastoral use of this part of the valley in the 17th-19th centuries. However the 16th century witnessed strong agricultural activity in the region. This is shown by the historical-geographic study of Hütteroth and Abdulfattah (1977). They base their view on historical data from the last intensive Ottoman census registers (dafters) from 1596/97 that were made to calculate tax revenues (a quarter or third of the agricultural produce) from all of the population, geographical data from topographic maps and some archaeological records. Although their location of villages needs revision, this study is of great value to reconstruct the local economy of around 1600AD.

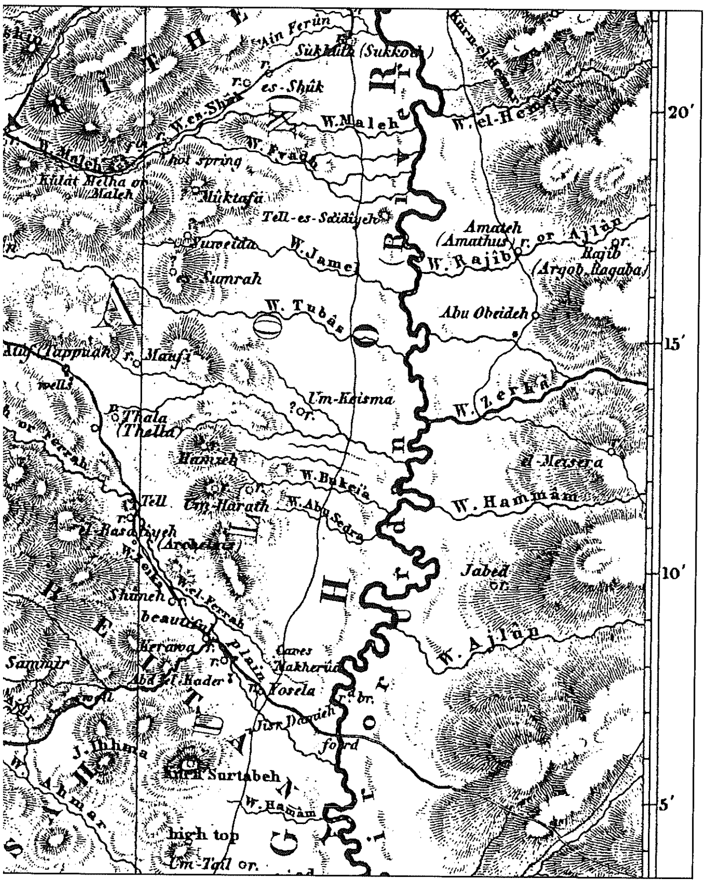
For the Dayr 'Allā region (from Kurayma, north of Wādī Rājib, to Dāmiya) 174 family heads are listed in six villages (taken as representing nearly 900 people), with a good production of wheat, barley and the summer crop sesame. Also many water buffalos were in use, for traction, as well as a water mill at Dayr 'Allā (Hütteroth and Abdulfattah 1977: 167f). The amount of products at this particular time point may be a stage in a decreasing production, following the trend elsewhere in Palestine. In any case it is known from historical sources, as well as



Air-photo (German Luftwaffe) from ca. 1917 of the Jordan Valley towards east-south-east, showing the region between Wādī Rājib and az-Zarqā' (from Dalman 1925).



4. Part of German made topographic map (1917, 1: 50 0000) of about the same part of the Jordan Valley.



i. Part of the 1858 map by Charles van de Velde, showing several streams coming from the east in az-Zarqā' region.

'rom archaeological data from sites in this part of he Valley, such as Tall Abū Sarbūṭ, that especially luring the Ayyubid (and Crusader) and Mamluk eriods the region was intensively cultivated, in- :luding sugar cane production, as a tax and export :rop, to outside the district. This indicates that the rrigation system used for summer crops (at least) round 1600AD was already in use some 4 cen- uries before. This indicates that an irrigation sys- em close to the above technical description, based pon the data from the 1940s, was also in use in 1e 13th century — when it may have originated as vell. During its long history, intensive and limited se (or no use at all) are indicated.

ıpplication to the Past: Basic Hypothesis (Step)

'he ethnographic data indicate the basic elements f systems of irrigation agriculture. For the appli- ation of this reference model to **the Iron Age II ituation** at Dayr 'Allā we have to make choices egarding what would be acceptable, for both the ystem (technically and socio-economically), and 1e changing processes, in particular the innova- ons.

The system may be easily *technically* described, because there is little choice, as the main water source would be az-Zarqā' River. In order to water the fields that are closest to Dayr 'Allā (including the good soil to the east, in az-Zarqā'-triangle) the tapping place has to be about the same as that of the sub-recent main canal along the foot of the hills, so this canal has to be included in the hypothetical system as well. If Tall al-Mazār was inhabited, the population would have used an extension of the same canal, because the Wādī Rājib (just a little to the north) is very modest in water flow. Because of the source and the slight slope of the valley floor it has to be a gravitation system, with all the elements of side canals and temporary out-lets for drainage.

It is difficult to project the amount of irrigated area: other sites may have been contemporary, and therefore add to the number of people. This population density would be an important determining factor for the amount of irrigated land, if a subsistence economy is considered. However the presence of nomads would make it necessary to produce a surplus for exchange with them, to avoid raids. It is also expected that a larger economic organisation would demand a surplus for tax or markets.

A local *socio-economic* part of the hypothesis can be described, but within the framework of a wider socio-economic and political situation. It would include the possibility that only a part of the fields were used for summer cropping (and therefore irrigated), unless the population density was too high to allow that, or a surplus production was necessary. Thus we envisage a small-scale subsistence economy, with a less complicated functional organization and maintenance of the system than that of a lifting system. With a demand for surplus production the system would be larger and the organisation more complicated. Matters of ownership are beyond the reach of this exercise now, and with them the element of decision making. A certain amount of stability in the region would be necessary in order to maintain the year-round working of vulnerable elements of the system. The larger the system (for a larger population or a larger surplus) the greater the stability demanded.

In order to obtain a hypothetical view of the start of the system (the innovations) and changes, the interesting features of the Dayr 'Allā societies have to be accounted for, namely the quite sudden start, at full size, of the settlements of Phases IX and VII. It has been suggested (van der Kooij

2001) that population pressure elsewhere brought the Phase IX people (ninth century BC) from the east (the mediterranean zone of the plateau) to this marginal region, although some local nomads may have joined them. The phase VII people (probably mid of late eighth century) appear to have arrived from a greater distance, considering the elements of their material culture traditions, which were largely unknown locally. It is quite possible that they were transplanted people from within the Assyrian Empire, and required irrigation agriculture right away because of the number of people involved. However, in both cases it is also possible that the settlements and use of surrounding lands played a role beyond subsistence, and had to supply an agricultural surplus for people outside the immediate region, or even a special product, such as iron (Tall al-Ḥimma) and trade services.

The end of use of the systems may have come with the sudden destructions of both phases of habitation. On the other hand, the knowledge about Tall al-Mazār is not detailed enough to exclude a continuation of use by the community of that settlement.

Application to the Past: Discussion (Step 4)

In such a discussion there are many aspects to consider in relation to the construction of the irrigation systems of the phases IX and VII, but on this occasion it is sufficient to refer to a number, just to give a few examples:

Which plants were cultivated under irrigation (cf. Arlene Rosen's phytolith studies on wheat); do the types of weed indicate a certain season of use (Charles *et al.* 2003), and so are there indications of summer crop with which the weeds were harvested? Which cultivated plants were not from irrigated fields (olive? - see Neef 1989). Is an increase of draught animals (cattle or equids) recorded in these phases? Are specific tools found, including calculation devices (not treated now from ethnography). Furthermore, field research in the surrounding landscape may provide data of activities during these phases in the fields but especially at locations where the irrigation system is expected, as deduced from the sub-recent system. Further social interpretations about the community living at Dayr 'Allā have to be worked out from independent sources (such as village organization) in order to connect them with the social implications of an irrigation system.

It should be added that currently an intensive surface exploration of the Dayr 'Allā region, from Wādī Rājib till Dāmiya, is taking place, as well as a study of Iron Age II sites in that region. This study is part of the four year project "Settling the Steppe; the archaeology of changing societies in Syro-Palestinian drylands during the Bronze and Iron Ages". Mrs. Eva Kaptijn is following up the study of use of landscape, and deals in great detail with the issue of irrigation systems (cf. Kaptijn *et al.* 2005).

Conclusion

The current conclusion is that, as is a common feature in archaeology, with this comparative ethnographic and historic knowledge, the investigations are better equipped. Indications are given about where and what to look for in both field work and data analyses, in order to detect the data relevant for the interpretation of the irrigation system, with all its physical, economic and social aspects. As to the case of Iron Age II Dayr 'Allā, quite a clear theoretical image is appearing, with a substantial amount of data from the site to support it (or negate it) and in addition a growing amount of data is being retrieved from the surrounding landscape.

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