

## The Environment of the Petra Region during the Pre-Pottery Neolithic

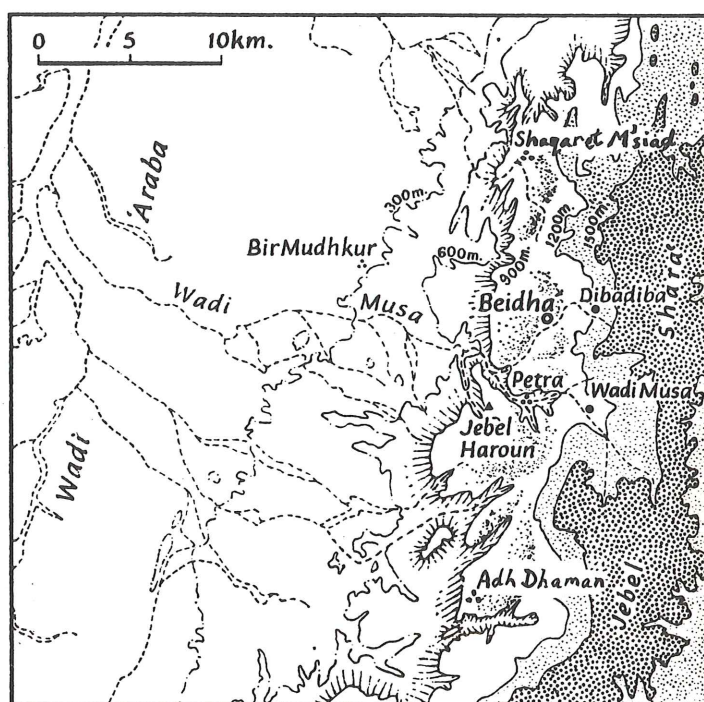
### Introduction

I must begin this paper by stating the obvious. I am a field archaeologist and not a natural scientist and the two are by no means necessarily the same thing. For this reason the paper will be based on the facts as deduced by the various natural scientists who have worked with me in the Petra area in the past and also from my own experience. It will be focussed largely on the environment of the Beidha district where, although probably the same as the whole Petra region, provision must be made for the fact that Beidha lies at a higher altitude than Petra, Petra than Sabra and so on. Also Petra would have had a perennial supply of water through the unharnessed Wadi Musa. Even today minor differences exist on local flora between Beidha and the other sites.

The terrace on which Beidha and the others are situated is about 5 kilometres wide at Beidha and in that place about 1,000 metres above sea level (FIG. 1). To the west this terrace borders the Wadi Araba and terminates in a more or less precipitous drop into the hills that line the desert bed of that wadi. To the east this terrace merges into the foot of the steeply upward sloping range comprising Jebel Shara' which forms the backdrop for the whole of this region, rising some 700 metres above the terrace (FIG. 2). In the general area we are dealing basically with three different geological and ecological zones. Firstly, the limestone country of Jebel Shara' and the high desert beyond; secondly, the terrace with its sandstone rocks and mountains together with its valleys and small plains; and thirdly the alluvial fans from the wadis descending from the uplands, the bordering hills and desert bed of the Araba itself.

About halfway up the west side of Jebel Shara', some 300 metres above the terrace, the limestone of the desert plateau is superimposed on the sandstones of the Petra region. Along this junction a series of rather weak springs, with one exception, emerges. The exception is 'Ain Musa. Above this line a bed of tabular flint runs horizontally. Even if not entirely impermeable, presumably it at least checks the water percolating through the limestone causing the springs to emerge at the next barrier, the rock junction below. At Beidha the nearest spring is at Dibadiba, about an hour's walk away

1. Map of the Petra area showing Beidha, the main wadi systems and the approximate positions of the other Neolithic sites mentioned.



from the site. In contrast to the other springs 'Ain Musa, situated above the village of Elji or Wadi Musa, is a spring of great strength that provides water, not only for that village, but also for others situated in the uplands as well as irrigation for local orchards, vegetable and cereal plots. The Wadi Musa itself has cut down through the sandstone massif and formed the Siq through which Petra is generally entered, though it is by no means the only access route. In former days the uncontrolled floodings of Wadi Musa must have been impressive, but presumably there may well have been permanent water in the wadi terminating in a waterfall as it dropped over the Pre-Cambrian granite in the Siyagh down into the Araba. Should this have been the case, then no doubt there were also marshy areas inside Petra in those days. Now, of course, the



2. Wadi Araba from the Slehsil precipice showing the confluence of Wadi Ghurab with Wadi Musa, left centre, the Araba hills, central desert and the Negeb beyond, together with the alluvial fans now under cultivation.



spring is harnessed and the floods controlled by damming the mouth of the Siq, an engineering feat accomplished first in Nabataean/Roman times and again about 20 years ago.

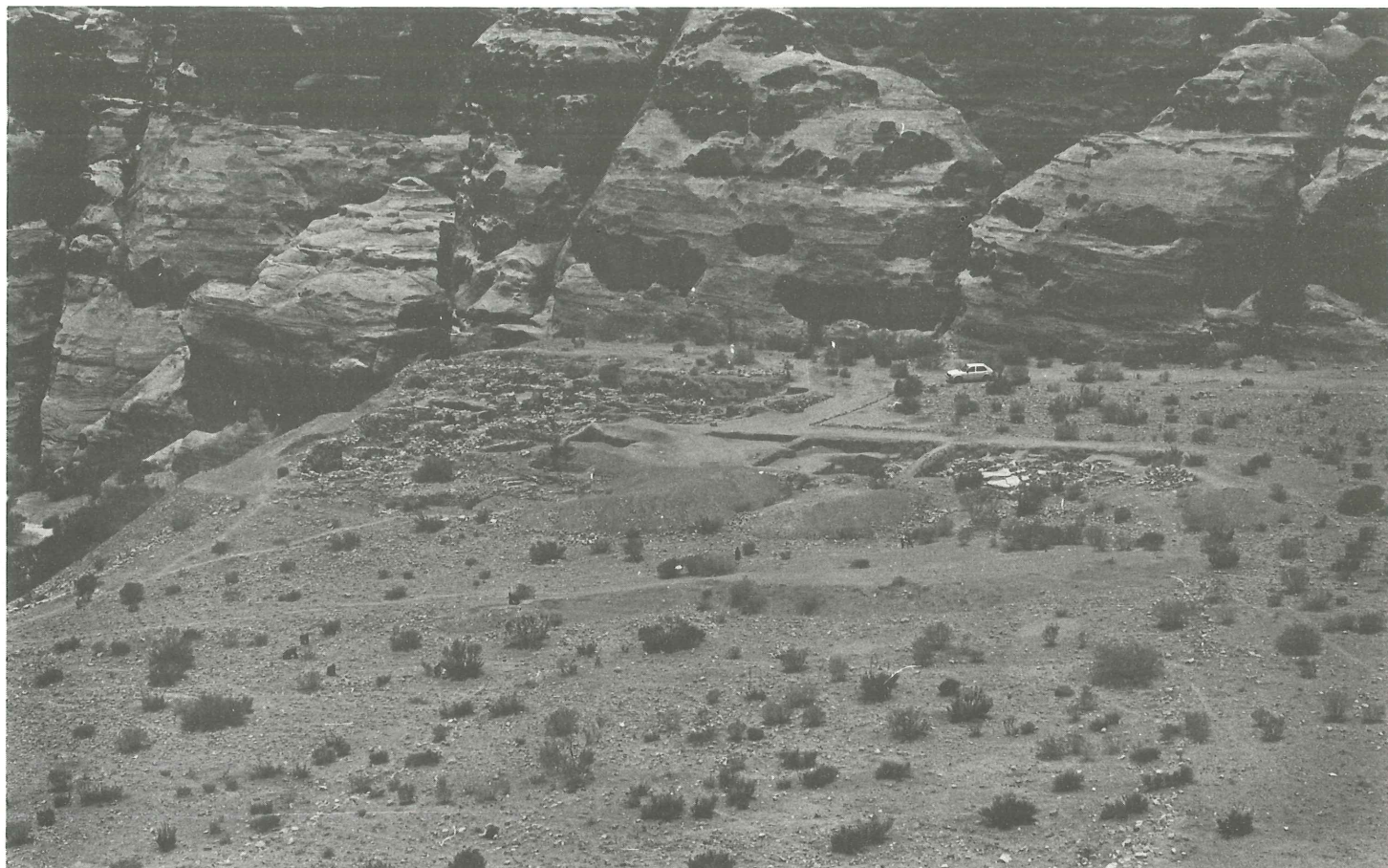
Nowadays, at least until the modern dam was built, storms in the uplands that may not even be visible or audible in Petra may produce these floods. Wadi Musa forms a main run-off for a huge upland catchment area. Before the modern dam was built, and after a storm, the water collected and poured down the wadi, bunching as it entered the Siq. The whole process usually began some 20 minutes after a storm had passed. In Petra one first heard a faint whisper which rapidly became louder developing into a full-throated roar mixed with the rattle of pebbles in the wadi bed that reverberated round the encircling cliffs as the leading wall of water burst out of the Siq, crossed Petra and disappeared into the Araba. I can testify that even when living halfway up a cliff-face in a cave, and therefore perfectly safe, I was always terrified, both by the noise and the terrible force of those floods.

To a lesser degree Beidha today is subject to the same natural phenomenon, and doubtless these flash floods occur all over the region, but I can only speak of those of which I

have had personal experience. Beidha is situated in a relatively wide wadi running roughly E-W and bordered by sandstone cliffs. East of the site, Jebel Shara' again forms the principal catchment which in this vicinity drains into Wadi Ghurab. The Neolithic site is situated beside a powerful seasonal watercourse, a run-off that drains the area west of el-Barid, and which over the millenia has eroded most of the village, Seyl Aqlat (FIG. 3). Wadi Ghurab itself runs N-S across the east end of the Beidha valley, turns west and runs along its south side up against the sandstone cliffs. Below Beidha it is joined by Seyl Aqlat and continues to its confluence with Wadi Slehsil, swings west again and drops to the Araba over a vertical granite precipice. In other words, present day Beidha is cut off from the outside world while Wadi Ghurab and Seyl Aqlat are running. The time element between the end of a storm and the faint sound that heralds the rapidly approaching flood is about the same as in Petra. The personal danger is not so acute, however, because it is possible to get out of the wadi bed quickly almost everywhere except in a mini-siq, only about 100 metres long. Only if one is foolhardy enough to try to cross the wadi while in spate is one in danger



3. The Neolithic village Beidha. On extreme left the bed of the seasonal watercourse Seyl Aqlat which has eroded most of the site.



of being swept away into the Araba. Petra must always have been subjected to these floods, and probably the same may well have been the case for Beidha.

However, in these sandstone areas of the terrace there must always have been strictly local flooding caused by water on the sandstone hills collecting and pouring off down runoffs into the valleys. Later on in Nabataean/Roman times these catchment areas were harnessed and led by rock-cut or built channels to innumerable cisterns both great and small, rock-cut and free-standing. This, however, was not the case in Neolithic times and Beidha, or at any rate its eastern suburb, can be reached by these local floods, as we learnt in the field. Of course depressions in the rocks would also have provided additional water for the settlers and, to judge from today water that lasted a long time. So much then for a brief sketch of the main physical features of the region.

In Neolithic times this terrace seems to have been fairly densely populated because villages of the Pre-Pottery era appear to have been founded at roughly an hour's walk from each other. Beidha was very definitely not an isolated phenomenon. Although we cannot prove absolute contemporaneity, I found another site about 6 kilometres north,

Shaqaret M'Siad, situated in a small plain called Sideh near the head of the main pass down into the Araba north of Petra, Ras el Negeb Nemellah. These are the Beduin names for the places and they do not necessarily coincide with the names given on maps. I think I may, with every confidence, place another site in Petra, somewhere east of the wadi bed and probably based on the perennial spring in Wadi Turkeimanieh, 'Ain Abu Alleqa. It is unlikely that Neolithic remains will ever be found in Petra although faint traces or a scatter of flints could still exist beneath the heavily built up centre of the later city. To the south-west of the city on the small plain above el Thughara, the Snake Tomb, many Neolithic flints lie on the surface although no traces of buildings were seen. There may have been another settlement here. I also found a Pre-Pottery village south of Sabra and to the west astride a minor track into the Araba, called Adh Dhaman. Of course there may be other Pre-Pottery villages, closer together, not yet found. However, the spacing of those that we have found, and including the two postulated for Petra, all lie within one to two hours walk from each other. This may not only have something to do with man's well-known territorial instincts, but also perhaps to the extent of territory considered neces-



sary for general self-sufficiency. It also suggests that the terrace had far more to offer those aspiring early agricultural settlers than immediately leaps to the eye today.

Now we are faced with the almost treeless, denuded slopes of Jebel Shara<sup>c</sup> which do not even bear maquis-type vegetation, while the valley floors of the terrace are composed of mainly calcareous alluvium derived from its slopes, mixed with wind-borne sand from the Araba and the surrounding sandstone rocks. This soil is highly permeable, soft when the desert surface is broken, and does not retain moisture for long. Moreover, the most successful plants that conspicuously cover Petra and most of the region are the squills, poisonous to man and beast, with certain stands of the salt-resistant *Peganum*. Both these plants are indicators of ruined soil. Add to this the fact that the present day rainfall is around 170–200 mm. a year, just below the possible dry farming minimum; and what rain there is descends irregularly, often in the form of violent storms that flood the wadis and break the delicate surfaces of the valley beds, washing any real soil there may be away to join the alluvial fans in the Araba. Quite obviously things were better in Neolithic times or none of the villages I have just mentioned would ever have been founded, or if they had been they would have been abandoned again almost immediately.

Now we must turn to the archaeological record to try to transform the bare hills and ruined steppe of the valleys. Broadly speaking, Beidha was occupied between about 7000 and 6500 BC (Libby's Half-Life), and presumably the other villages I have mentioned were also occupied within this span. The botanical record is largely confined to the earliest level with permanent buildings (Level VI), which contained several burnt houses that produced both carbonised plant remains and plant imprints in the clay of walls and roofs. We know from this evidence that the people of Beidha were cultivating the wild, hulled 2-row barley, *Hordeum spontaneum*, their most important crop. This cultivation of wild cereals is a stage in the process of domestication that was known of theoretically, but had never yet been demonstrated in the field. Domestication presupposes a very long period of cultivation of the wild species allied to automatic harvesting selection before the crop changes physiologically into plants which can no longer disperse their seeds over a wide area at the touch of a breeze, and indeed become helpless without the aid of man. Emmer wheat was also cultivated at Beidha though not quite on the same scale as the barley. No wild Emmer was present, but on the other hand the Beidha *Triticum dicoccum* varied greatly in size between almost as large as the wild Emmer to even smaller than the fully domesticated one. Despite this, all the many specimens examined showed certain features of fully domesticated plants. The report states that this seems to be a highly polymorphic transitional form not clearly demonstrated in archaeological finds before, and adds that such great variability is typical in plants on a stage of genetical transition.

Those, then, were the crops under cultivation, but the

villagers also collected their other plant necessities. Here again through the plant remains we know at least some of the species that were available to them. Their most significant food plant gathered wild, was pistachio nuts. They also gathered and consumed Bulbous barley (*Hordeum Bulbosum*) exactly as the Beduin do today. Three weed grasses characteristic of the earliest cereal fields were recognised, Goat-faced grass (*Aegilops*), Ryegrass (*Lolium*) and Wild Oat (*Avena*). Members of the Pea family, the *Leguminosae*, were also collected, presumably for their comparatively high protein content. Among these were lentil, vetches, Medicago and Cock's Comb (*Onobrychis-crista-galli*). Just as today the Beduin collect and consume the pistachio nuts and acorns available to them, so too did the Beidha farmers utilize acorns as well as pistachios.

Of course one can never get the full botanical record from any site, but it might be useful to mention here that among the sparse remains of the woodlands that once covered Jebel Shara<sup>c</sup>, Juniper, Oak, Hawthorn, Almond and Prunus are still present, as are some massive ancient Pistachios. These may give some indication of the character of the former mixed, probably open, forests where the early farmers gathered their wild plant necessities.

Finally, the botanical report states that since it is highly unlikely that the early Neolithic farmers had mastered control of run-off rain water from the sandstone catchments, their agriculture must have been both stable and rewarding for a village like Beidha to exist and be reconstructed through several centuries. And, since the evidence of the grain imprints testifies both to the abundance and quality of both Emmer and barley, it is necessary to presuppose a greater availability of groundwater than today. Something like the requirement of wild wheat, which may be estimated at an average rainfall of 300–350 mm. a year.

We do not know what kind of vegetation covered the sandstone rocks and valley floors of the terrace in Neolithic times. Today, in catchment areas on top of the mountains are small coppices of oak and some stands of juniper. In addition, hawthorn, sycamore fig, and the strawberry tree occur sparsely. These may indicate former conditions. On the valley floors, now probably to be classified as ruined steppe, if not semi-desert, nothing exists today larger than white broom round Beidha, and oleander in the Petra and Sabra areas, although juniper, pistachio and carob are common in cracks and crevices in the sandstone cliffs out of reach of the goats. It would be pleasant to think that the valleys were open parkland with trees in Neolithic times, and although the fact remains that a thick layer of aeolian sand separates the Neolithic village from the Natufian horizon below, nevertheless the top layer of this sand is stained by organic material. The hydrological report states that this suggests a fairly thick and long-established natural vegetative cover was present at the time the Neolithic people arrived. In other words, the vegetation, left undisturbed for perhaps some centuries would, through its organic remains, have established over the



sand a fairly thick water-retaining fertile mat. I submit that the open parkland with trees, as established today from the forests of Jebel Shara<sup>1</sup> through the agencies of the wind and birds, cannot be ruled out. Whether the presence of vegetation all over the region would be enough in itself to change the character of the rain, making it more even and less unpredictable I am not competent to judge. It may be that we shall have to call in the seemingly inevitable climatic change or geological down-faultings to explain what has happened.

We must now turn from the botanical record to the faunal one. The animal remains from Beidha reveal that the villagers' chief quarry was two species of wild goat, the Bezoar and the Beden, the former the ancestor of the domesticated goat, the latter the ibex. These two species together comprised over 85 per cent of a total of some 15,000 bones excavated over the five seasons to 1965 inclusive. Of these the Beden represents only between 15 per cent and 20 per cent. It is surmised that although the goats were still wild, and showed no features of domestication, nevertheless they were under some kind of cultural control which involved culling the herds. The villagers seem to have preferred to kill young animals of between two and three years old. The Bezoar has long since been transformed into the domestic goat and is no longer to be found in the wild in the entire Levant. A few ibex were still in Petra during the 1960s but I do not know whether they are still there. A small flock lived in the massif reaching from the Deir range through the Mu'asera esh-Sharkiyeh and were occasionally to be seen at dusk.

Apart from the goats, *Bos primigenius* were also hunted, as were gazelle, wild boar, onager, hyrax, hare and jackal. While Bos and boar are creatures of the forests their presence in the faunal list suggest that conditions were somewhat wetter than today. On the other hand, onager, gazelle and hare are open country animals. In Neolithic times probably the artemisia steppe that now extends from the eastern slopes of the Shara<sup>1</sup> range and reaches as far east as the railway line, where it merges into the flint desert, was then a very pleasant steppe-land where these creatures would be available in immense numbers; or they could have been obtained from the Araba. Bezoar, beden and hyrax prefer the rocky, craggy regions and would have been widely available right there on the terrace in the sandstone areas, as hyrax still are, or at least were in the 1960s.

In addition, leopard, cheetah, panther, perhaps the Syrian lion, wolves and suchlike predators, although not yet attested by the animal remains from the site, would certainly have been present in the area.

When I was last in Beidha in 1967, in addition to ibex and hyrax, wolves, jackals, hyenas, foxes and hares many varieties of small rodents, hedgehogs and even the European badger were to be found in the vicinity. Of these, the wolves, a lone grey variety, frequently came down to the terrace and sometimes lived in the rocks. Hyenas and jackals were creatures of Jebel Shara<sup>1</sup> where they scavenged the refuse from the villages, and they could occasionally be heard at night. I saw only one

badger, a young female, dead, but without a mark on her, so I supposed she had been killed by a snake-bite. The fact that she was barely full-grown suggested that at least a family of badgers was living near Beidha. The bird remains from the Neolithic village have not yet been identified, but during the 1960s there were great numbers and a great variety of them, including migrants.

Before finishing I should perhaps touch on other resources close at hand and utilized in Neolithic times.

Excellent flint is obtainable in the form of large pebbles in the wadi beds, while tabular flint is present both in the Shara<sup>1</sup> range and in the Araba. Limestone and sandstone form the immediate environment and the slopes of Jebel Shara<sup>1</sup> and the wadi bed provide a fine source of field boulders. Granite, used for grinders and querns, outcrops at the precipice where the wadi drops to the Araba. Basalt also outcrops there, but the deposit is so hard as to be almost unworkable. The fine-grained basalt used for axes and pestles as well as the porous specimens used for grinders could also have been obtained from the volcanic fields round Aneizah.

Haematite occurs in the wadis of the Petra area as well as in the Araba. Red and yellow ochre are also to be found locally.

Malachite is an extremely common find. The nearest outcrop is again near the precipitous drop to the Araba, while everyone knows that the Araba holds the copper that has been mined continuously since Chalcolithic times, in fact it was already being used during the Neolithic. Mica is also found in the Araba and was present at the site in its raw state. Steatite also seems to be obtainable in the area and was used for various small objects.

That absolute necessity, salt, is to be found in various strata of the sandstone, as well as in the Araba. Bitumen was obtained from the Dead Sea and, among other things, used to line baskets.

Shells for ornamentation and pumice for polishing were obtainable a few days' walk away. The former from both the Mediterranean shore and the Red Sea at Aqaba; both sources were utilised. The latter was from the Mediterranean. These sources were not far away in those days before modern frontiers, but even so, probably the bitumen, shells and pumice, and perhaps the basalt may have been obtained through trade, because even 9,000 years ago to fetch them may have involved crossing other peoples' territory.

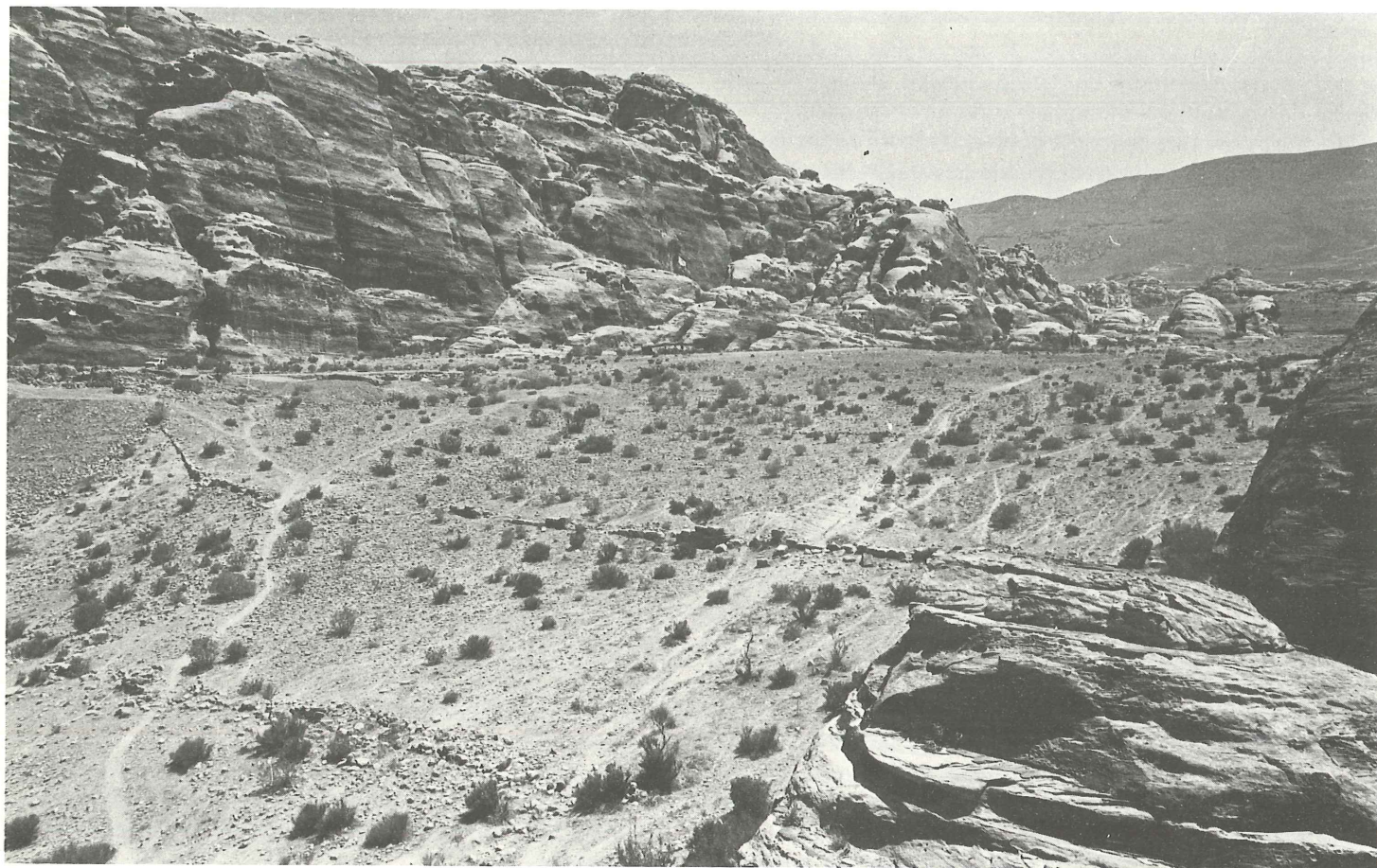
This paper has been based on the findings at Beidha, and we may well wonder about the cause for the scene of beautiful devastation that now greets our eyes. Was it a change in climate, some geological reason or simply, as I rather suspect, the work of man?

#### Post scriptum

Since reading this paper in April 1983, I have returned to Beidha for further excavations lasting just over two months. During that time I was able to make various observations about changes in the area which are perhaps pertinent to the paper because the time-factor during which they have occur-



4. Beidha on extreme left, Jebel Shara<sup>c</sup> right background with a scatter of the remnants of the ancient forests. The spring line is just below the slight cliff. Soil-retaining dams cross the wadi, showing stones removed to make easy trackways which are becoming gullies with small lateral ones forming and leading into them.



red can be placed exactly between my last work there in April–June 1967 and my recent work, between April–July 1983; a period of exactly 16 years.

#### *Erosion*

Some large stones from the top of the soil-retaining dams crossing the wadi have been moved to one side, presumably to facilitate access (FIG. 4). Behind these gaps erosion gullies are forming, and quite steeply. Additionally, gullies are forming near the south side of the excavations. In 1967 the tiny beginnings of a gully, about 25 cm. wide, were visible west of the track leading from the site to the camp. Today, after 16 years, this is at least 3 metres wide and over 20 metres long. It will cut the track and reach the mountain within the very near future (FIG. 5).

#### *Animals and birds*

On enquiry I was told by the Beduin that there are no longer any ibex in the area. This does not necessarily mean they have all been shot and eaten. It could easily be that their habitat has

been destroyed by the advent of cars, trucks and even bulldozers driving up the Siq right into Petra itself, not to mention electricity, generators, portable radios and T.V.'s all going full blast. Ibex, like hyrax are shy, and prefer the quiet places. Hyrax have also disappeared from Beidha, but a few are still to be found in the more remote areas to the north. A new tarmac road has now been made to el-Barid, and indeed it is now possible to drive all the way to Beidha itself, but despite this the valley is rarely visited and retains its feeling of remoteness. Very occasionally a wolf visits the area, but this happened only once in over two months. We neither saw nor heard any jackals or hyenas, in fact the only wild animals we saw were an occasional fox, a hare or two, a few rodents and one hedgehog.

The birds were far more scarce, and there did not seem to be either the variety of species or the spring migrants of former years. Wadi Ghurab means the Valley of the Ravens, and during earlier expeditions great flocks of these birds came cawing home to roost in the evenings and set off on their daily business in the mornings. After the 16 year lapse, we saw only



5. Erosion gully that is exactly 16 years old. Scale: 2 metres.



one flock of some 30 birds coming home to roost. Very few of the once numerous pigeons were seen, a few grackle, many desert chats, a few migrants, swallows, sand-martins, a few small hawks and a bearded vulture. However, the number and variety of birds was not so great as formerly. It is difficult to account for this decrease in bird life; perhaps it is bound up in the increase in the local agriculture. Perhaps the crops are protected by shooting large birds with rifles or catapults. Perhaps, also, some blame may be attached to the large number of Beduin children in the area who search out their nests, and even the homes of hyrax and hedgehogs and then practise their skill in accurate stone throwing at the occupants.

#### *Water*

The spring at Dibadiba has now been cleared and enlarged and furnished with a cement outlet and basin with a resultant increase in the flow of water.

#### *Agriculture*

In the earlier years of my residence at Beidha the Beduin planted small stands of cereals in favoured places, probably where run-offs created moister soil conditions. In 1983 I was

amazed to find the lower slopes of Jebel Shara<sup>f</sup> were covered with cereal crops; large wadi beds in the Beidha terrace were also sown, though not Wadi Ghurab itself. Small plantations of tiny olive trees were also seen, as well as small plots of tomatoes, maize and tobacco. The Beduin sow by hand-scattering and reap by hand-pulling, so the individual plants were somewhat widely cast, irregular and patchy on the ground. I do not know whether this extraordinary transformation has been a gradual development, or whether it was caused by the exceptionally long, wet winter. However, during the last few years the Liatneh of Wadi Musa have been slowly acquiring some of the land originally belonging to the Beduin tribes of Petra and Beidha, the B'dul and 'Amarin respectively. This land has been planted and exploited to the full and perhaps the extraordinary sight of cereals growing up the side of Jebel Shara<sup>f</sup> and in the wadi beds is purely the result of the Beduin learning by seeing what had become of their former lands, copying and competing. The alluvial fans at the point where the wadis of the uplands debouch into the Araba are also being exploited to the full.

One other point deserves a mention. Formerly it was possible to see across the Araba most days of the year, and for that matter across the Jordan Valley as well. It was, of course,